
APPENDIX F: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORTS



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client **Nokia Salo TCC**

Certificate No: **D835V2-480_Dec12**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 480**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **December 03, 2012**

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

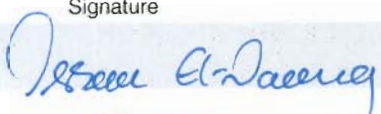
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Israe El-Naouq** Name: **Israe El-Naouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature



Issued: December 3, 2012

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

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:

- 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 300 MHz to 3 GHz)", 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:

- DASY4/5 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	41.4 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °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 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.40 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.16 W/kg $\pm$ 16.5 % (k=2)

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 $\pm$ 0.2) °C	54.5 $\pm$ 6 %	0.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.51 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.27 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 3.3 j Ω
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 4.9 j Ω
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 ns
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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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	January 28, 2003

DASY5 Validation Report for Head TSL

Date: 03.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 480

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.92$ mho/m; $\epsilon_r = 41.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

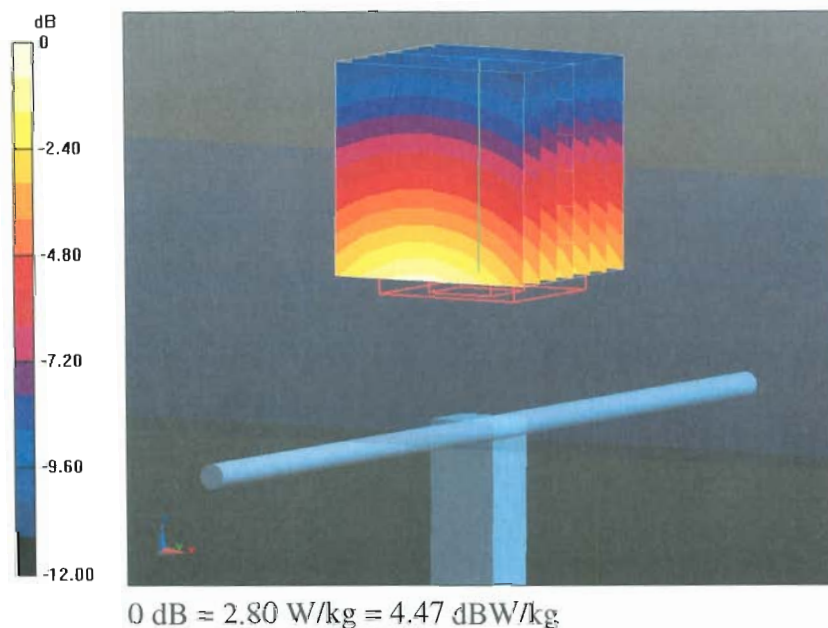
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 56.814 V/m; Power Drift = 0.00 dB

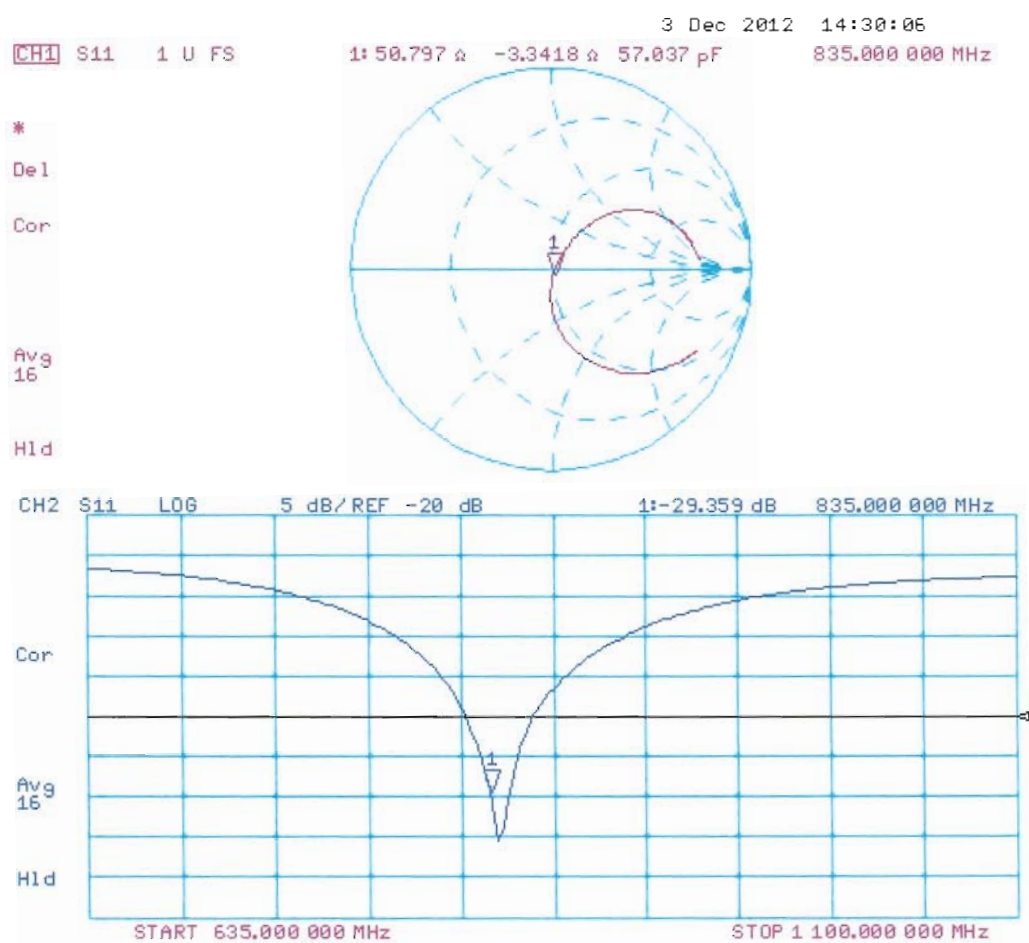
Peak SAR (extrapolated) = 3.60 W/kg

SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 03.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 480

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.99$ mho/m; $\epsilon_r = 54.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

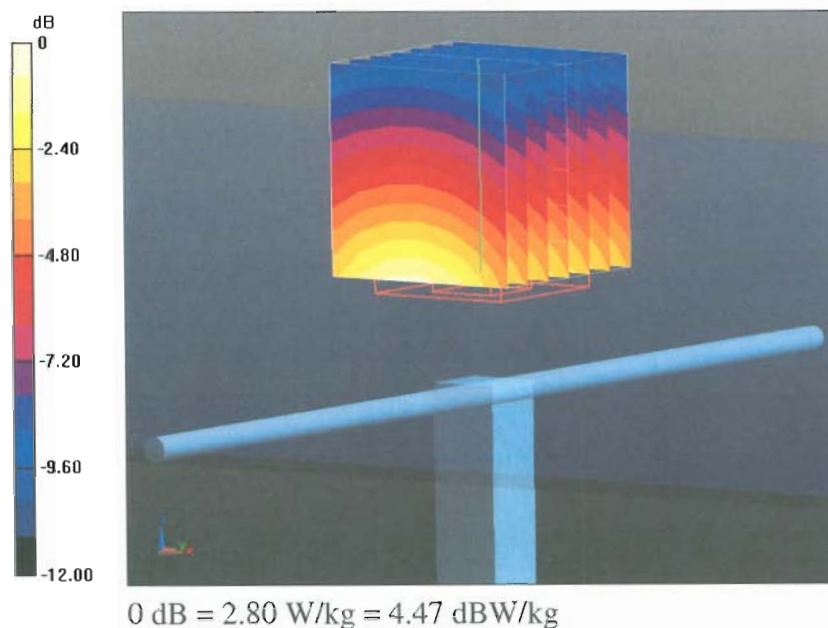
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.301 V/m; Power Drift = 0.00 dB

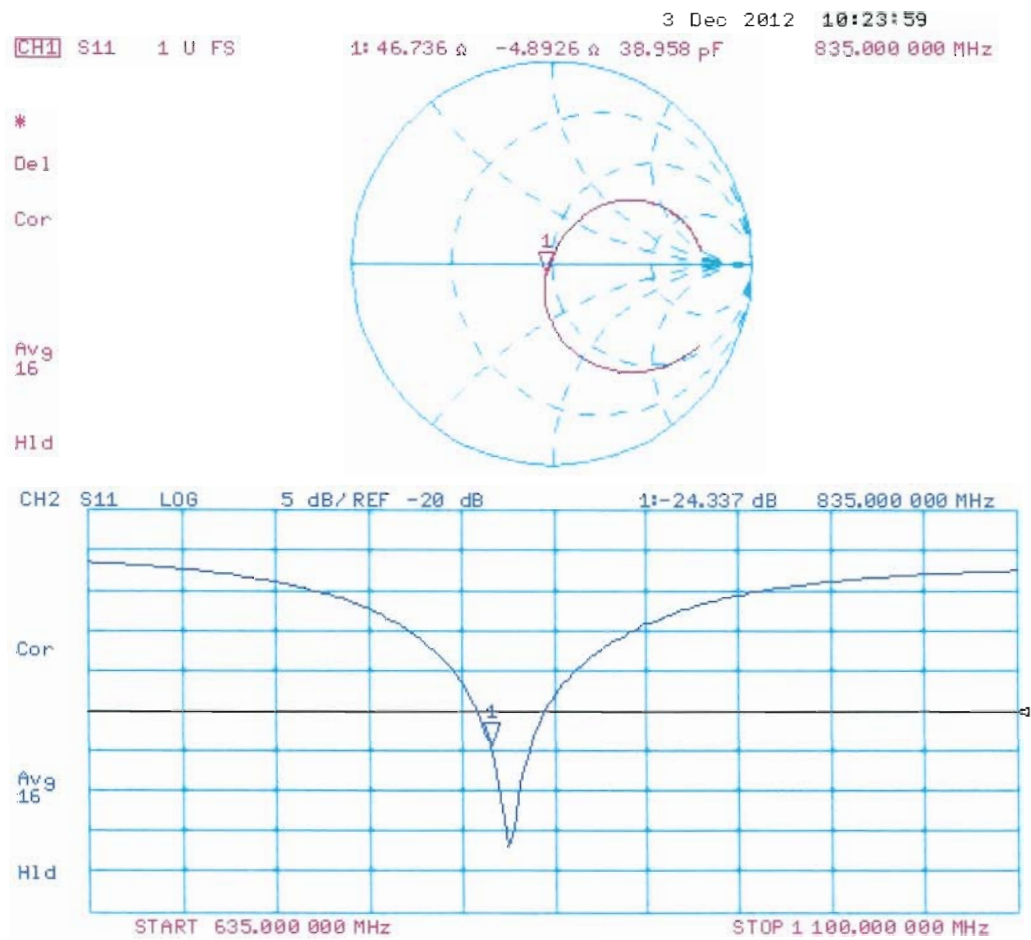
Peak SAR (extrapolated) = 3.53 W/kg

SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



Impedance Measurement Plot for Body TSL



Dipole D835V2 – SN: 480 Antenna Parameters measured: 2014-01-31.

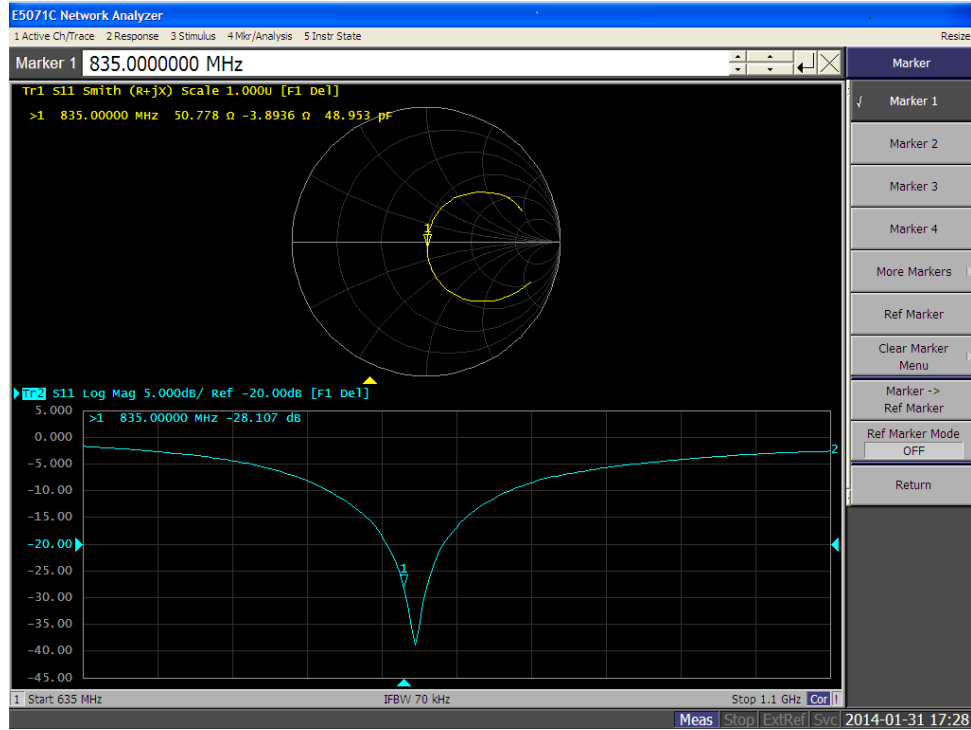
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	50.8 Ω - 3.3 j Ω	50.8 Ω -3.9 j Ω
Return loss	-29.4 dB	-28.1 dB

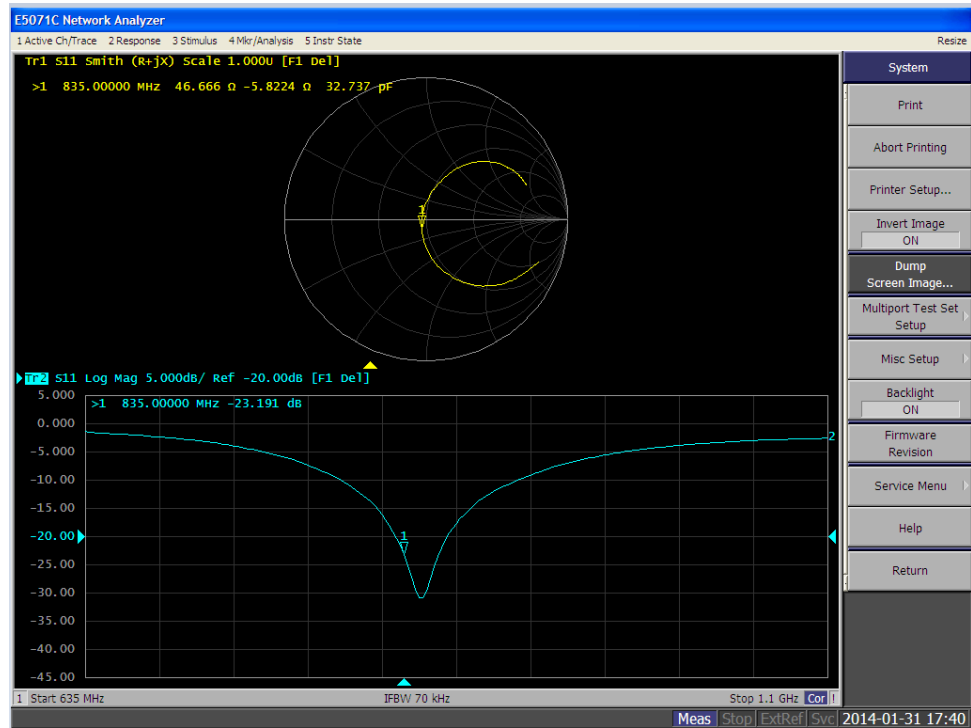
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	47.4 Ω - 3.8 j Ω	46.7 Ω -5.8 j Ω
Return loss	-26.5 dB	-23.2 dB

Impedance Measurement Plot for Head TSL 83



Impedance Measurement Plot for Body TSL 835





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Client **Nokia Salo TCC**

Certificate No: **D1900V2-5d013_Dec12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d013**

Calibration procedure(s) **QA CAL-05.v8**
 Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **December 06, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 6, 2012

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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:

- 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 300 MHz to 3 GHz)", 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:

- DASY4/5 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	39.5 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.2 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	41.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.3 \Omega + 6.2 j\Omega$
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.4 \Omega + 5.9 j\Omega$
Return Loss	- 24.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 ns
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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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	April 30, 2002

DASY5 Validation Report for Head TSL

Date: 06.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d013

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ mho/m; $\epsilon_r = 39.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

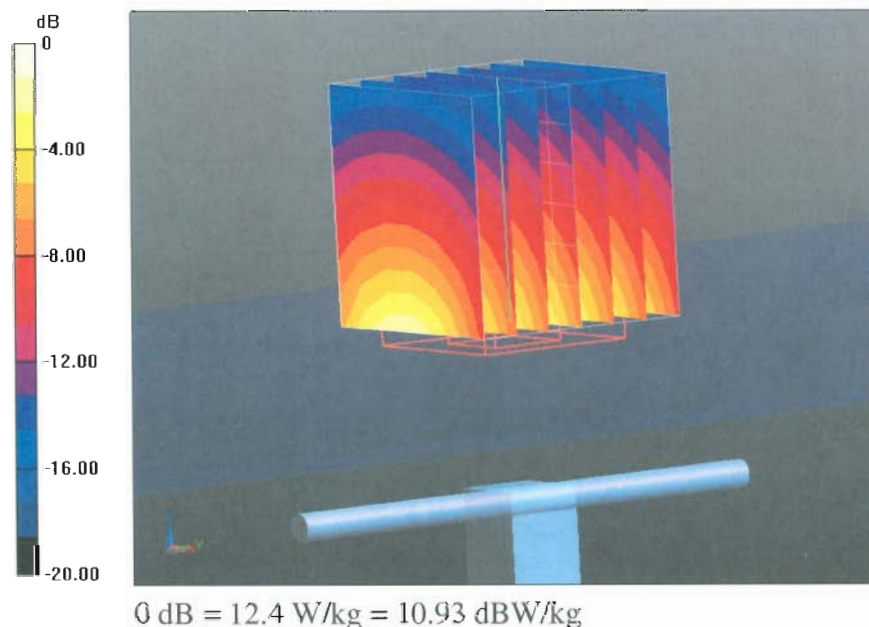
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.748 V/m; Power Drift = 0.04 dB

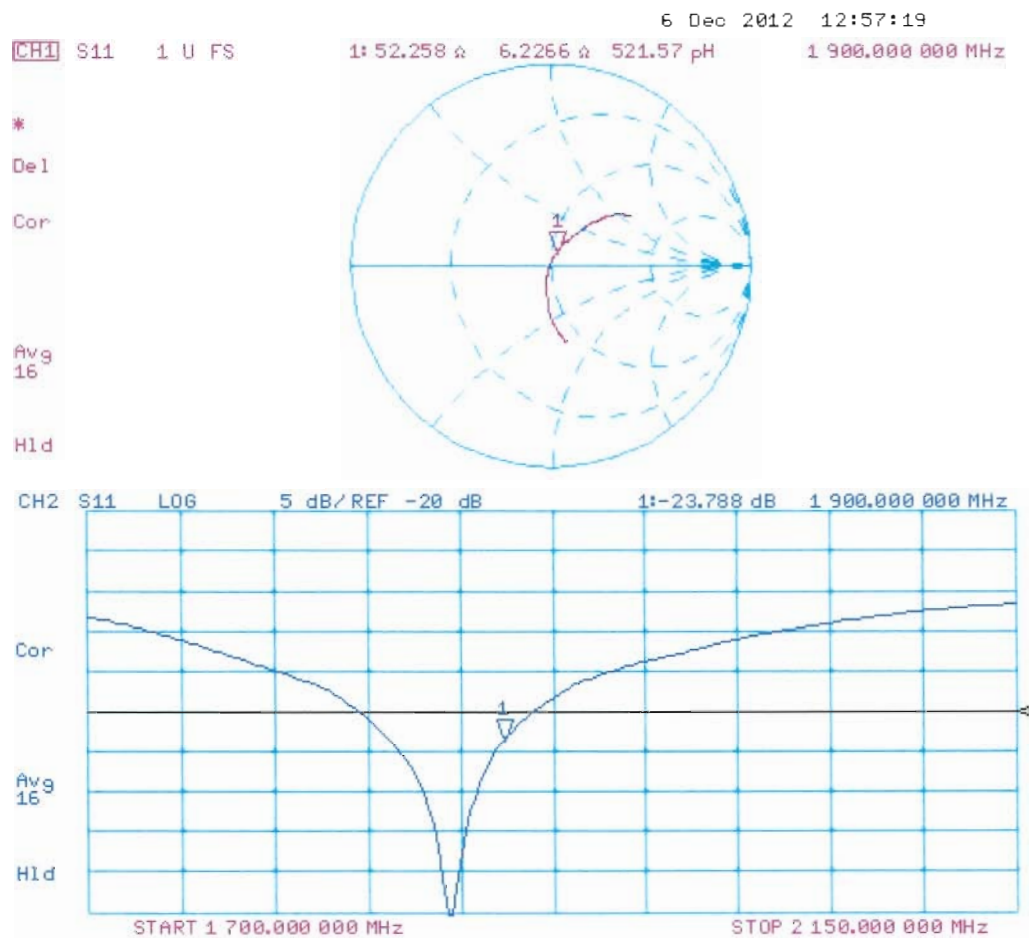
Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg

Maximum value of SAR (measured) = 12.4 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d013

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

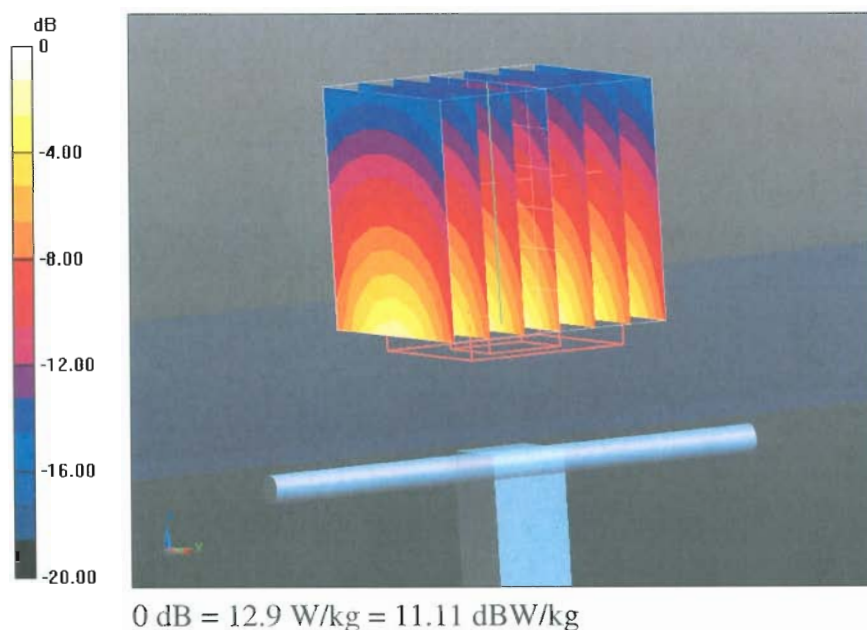
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.039 V/m; Power Drift = 0.04 dB

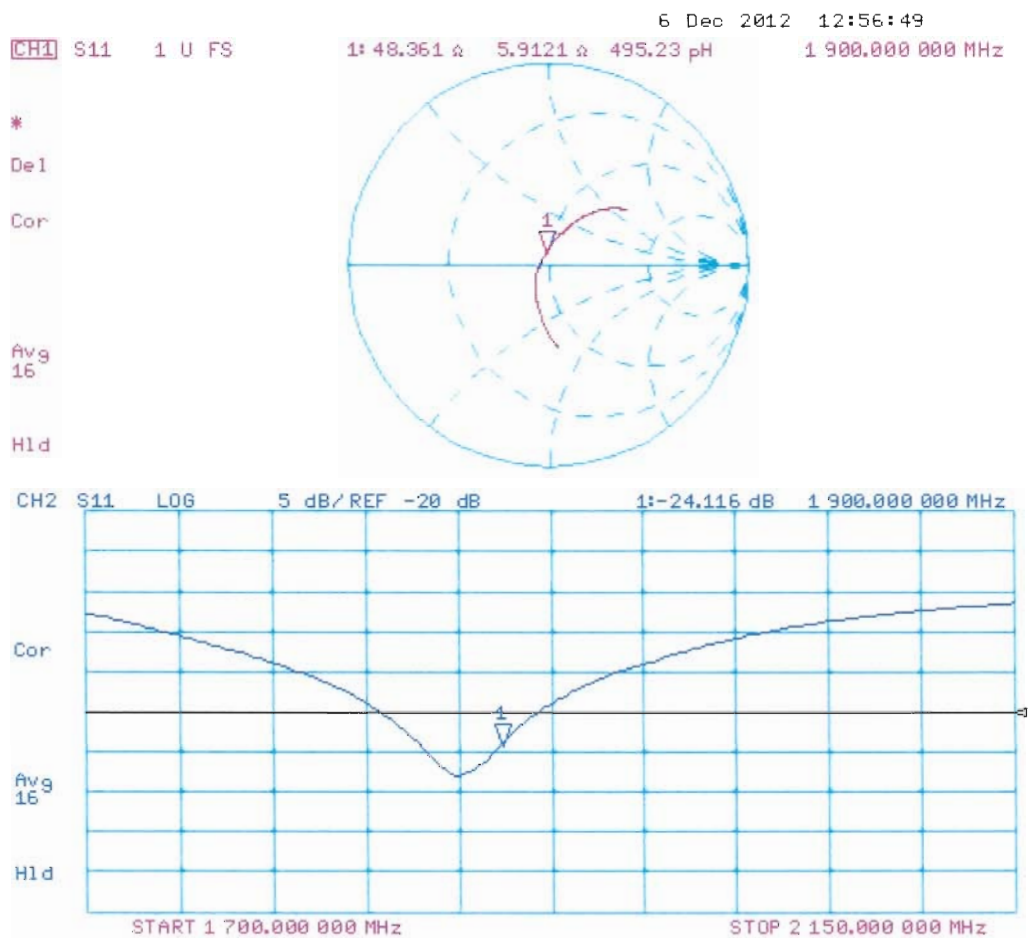
Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



Impedance Measurement Plot for Body TSL



Dipole D1900V2 - SN5d013 Antenna Parameters measured: 2014-01-31.

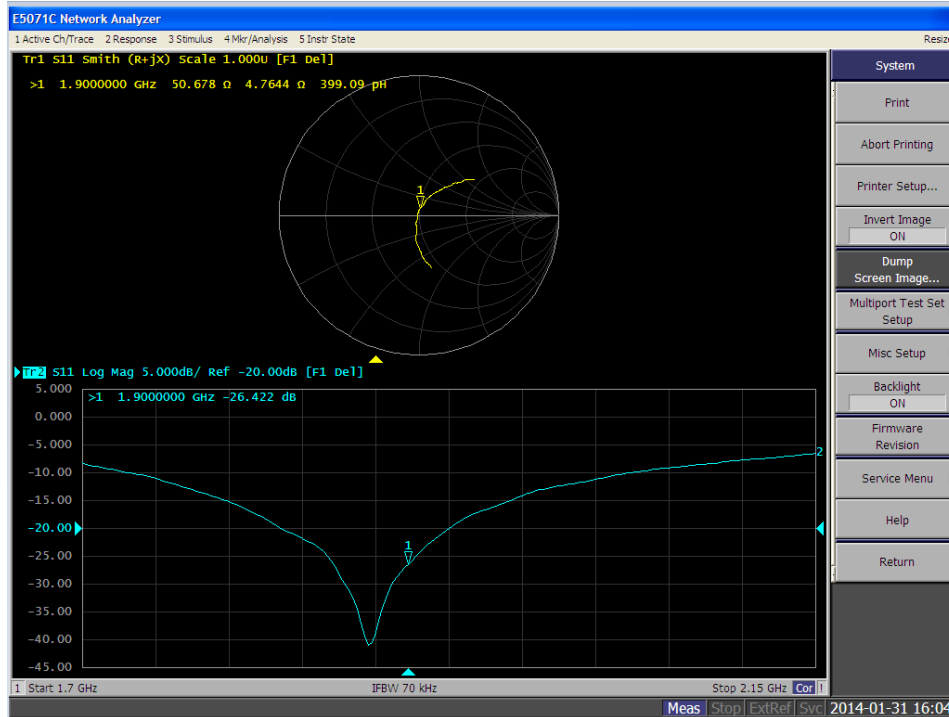
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	52.3 Ω 6.2 j Ω	50.7 Ω 4.8 j Ω
Return loss	-23.8 dB	-26.4 dB

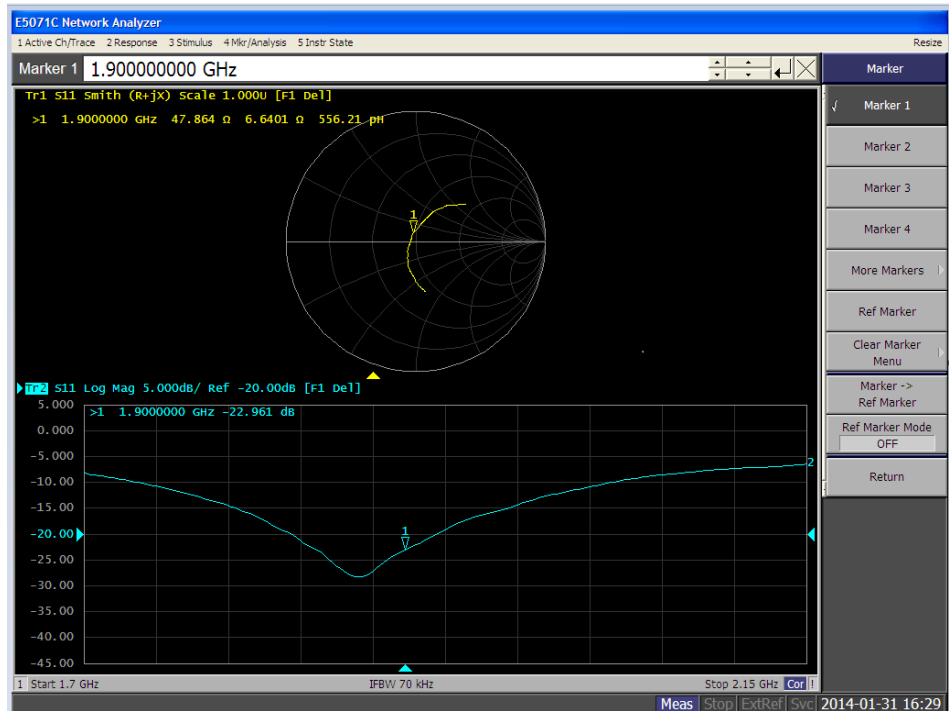
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	48.4 Ω 5.9 j Ω	47.9 Ω 6.6 j Ω
Return loss	-24.1 dB	-23.0 dB

Impedance Measurement Plot for Head TSL 1900



Impedance Measurement Plot for Body TSL 1900





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Accreditation No.: **SCS 108**

Client **Nokia Salo TCC**

Certificate No: **D2450V2-749_Dec12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 749**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **December 07, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Name** **Function** **Signature**
Leif Klysner **Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Issued: December 7, 2012

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



Accredited by the Swiss Accreditation Service (SAS)

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Multilateral Agreement for the recognition of calibration certificates

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:

- 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 300 MHz to 3 GHz)", 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:

- DASY4/5 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.2 $\pm$ 6 %	1.84 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.7 $\pm$ 6 %	2.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.6 \Omega + 3.4 j\Omega$
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.5 \Omega + 4.3 j\Omega$
Return Loss	- 27.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.163 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	December 01, 2003

DASY5 Validation Report for Head TSL

Date: 07.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 749

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ mho/m; $\epsilon_r = 38.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

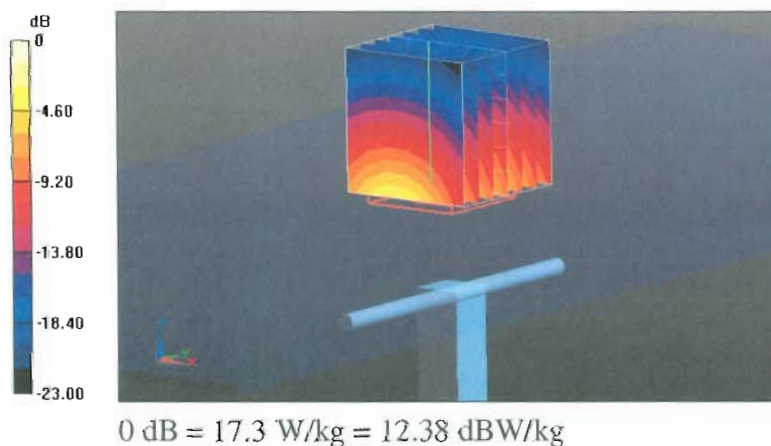
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.608 V/m; Power Drift = 0.00 dB

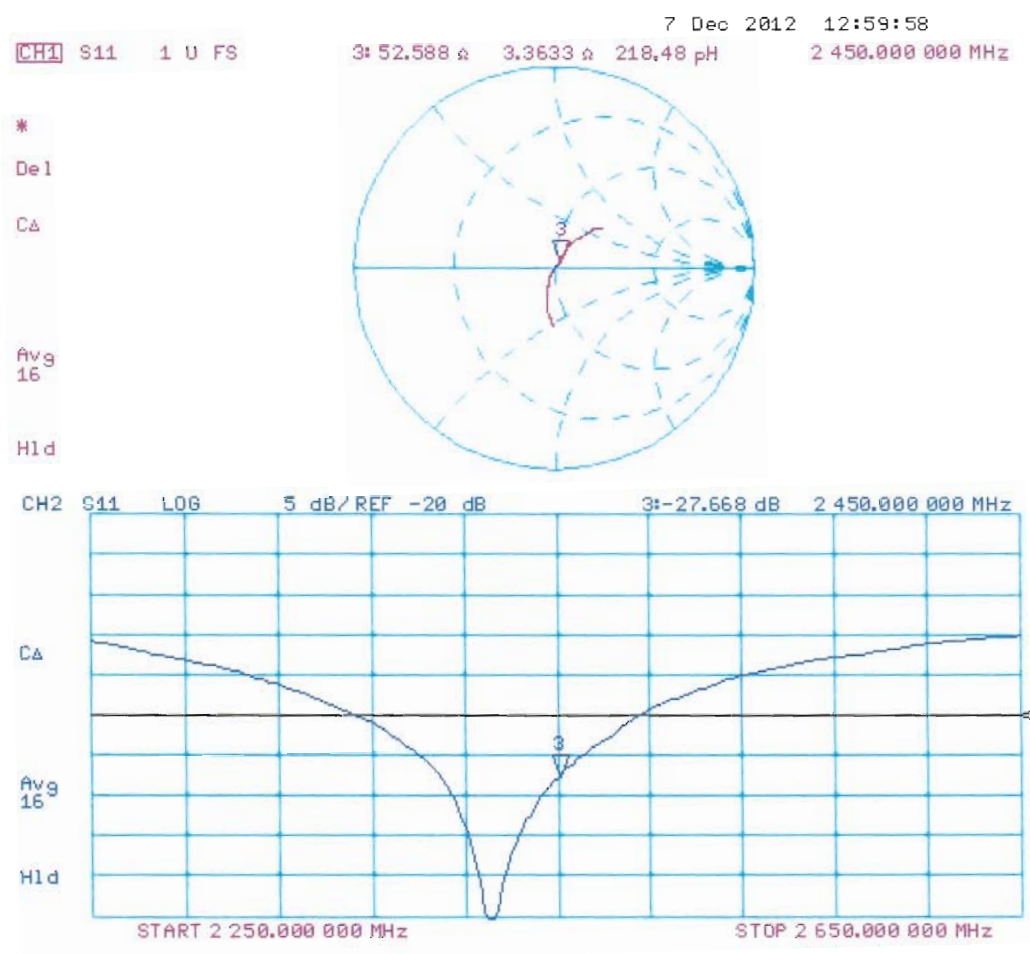
Peak SAR (extrapolated) = 28.2 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.35 W/kg

Maximum value of SAR (measured) = 17.3 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 749

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ mho/m; $\epsilon_r = 50.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm 2/Zoom Scan (7x7x7)/Cube 0:

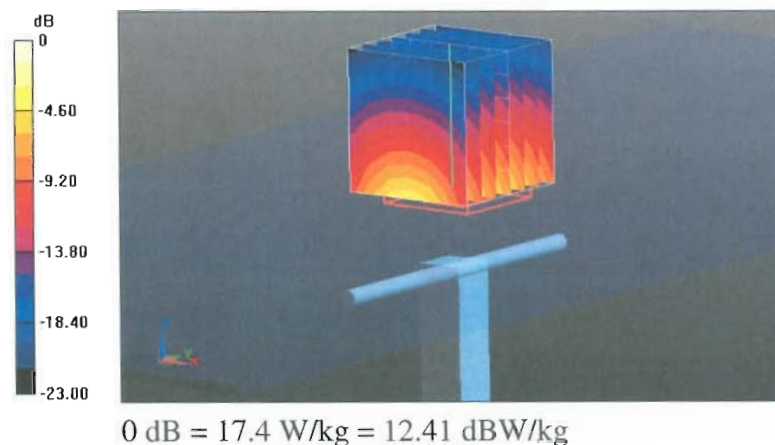
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.139 V/m; Power Drift = -0.00 dB

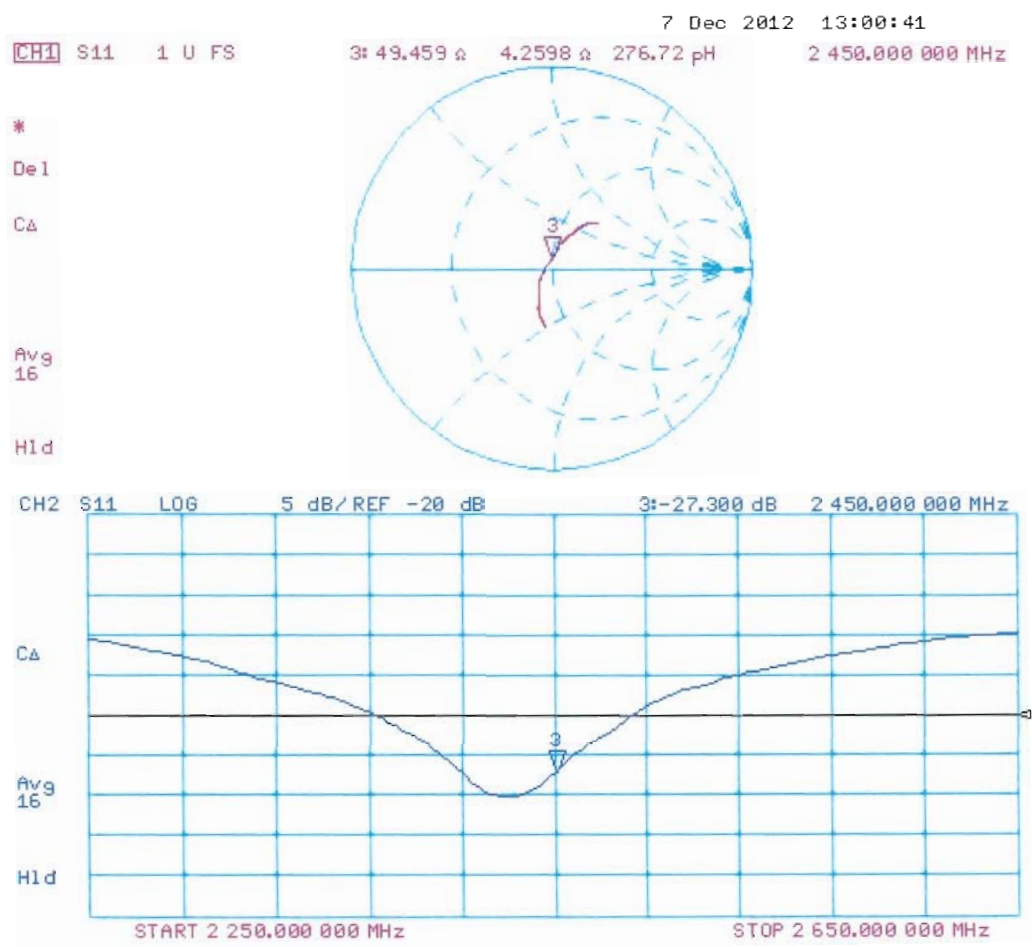
Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (measured) = 17.4 W/kg



Impedance Measurement Plot for Body TSL



Dipole D2450V2 – SN:729 Antenna Parameters measured: 2013-04-16.

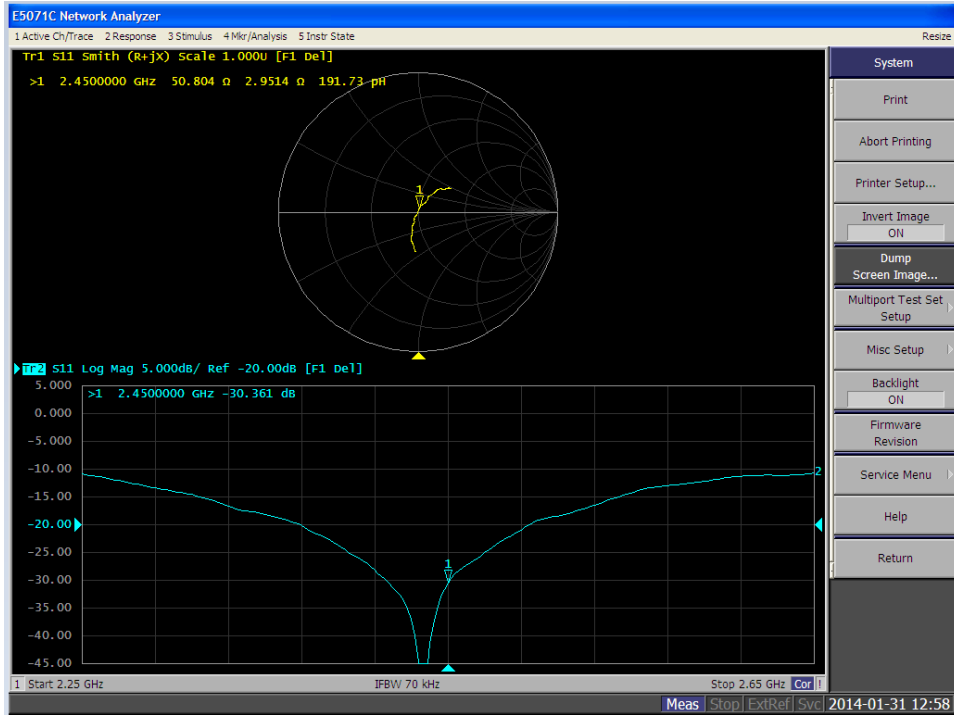
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	52.6 Ω - 3.4 j Ω	50.8 Ω - 3.0 j Ω
Return loss	-27.7 dB	-30.4 dB

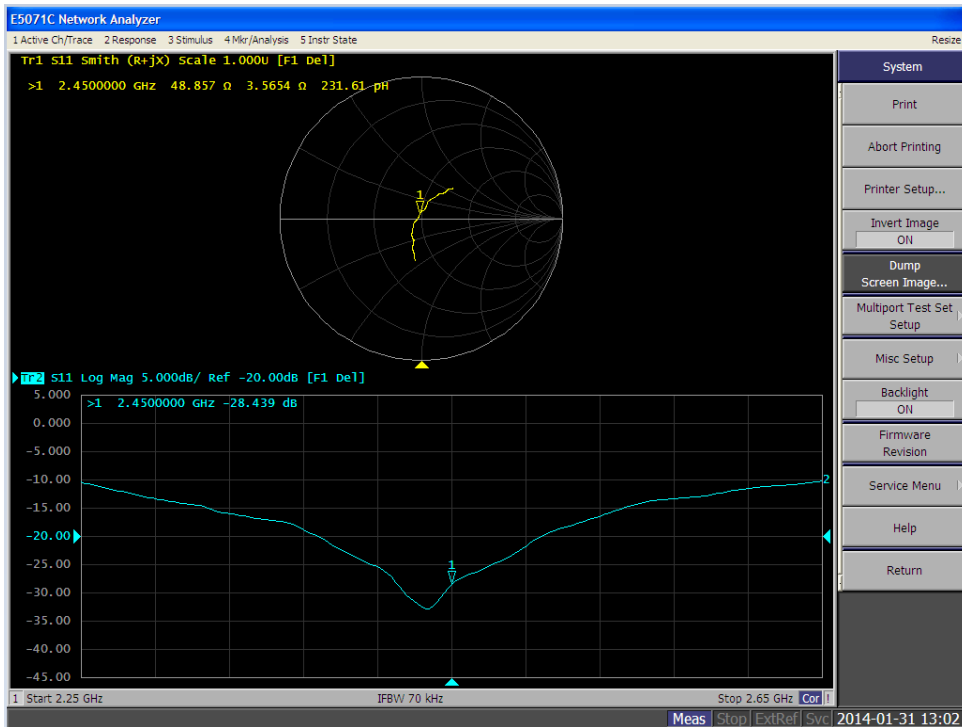
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	49.5 Ω - 4.3 j Ω	48.9 Ω - 3.6 j Ω
Return loss	-27.3 dB	-28.4 dB

Impedance Measurement Plot for Head TSL 2450



Impedance Measurement Plot for Body TSL 2450





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Client **Nokia Salo TCC**

Certificate No: **D2600V2-1056_Nov12**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN: 1056**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **November 07, 2012**

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
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 7, 2012

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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:

- 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 300 MHz to 3 GHz)", 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:

- DASY4/5 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.1 $\pm$ 6 %	2.01 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	57.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.9 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.8 $\pm$ 6 %	2.19 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.8 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.3 Ω - 5.1 j Ω
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0 Ω - 4.4 j Ω
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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 14, 2012

DASY5 Validation Report for Head TSL

Date: 07.11.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1056

Communication System: CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.01$ mho/m; $\epsilon_r = 38.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.39, 4.39, 4.39); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

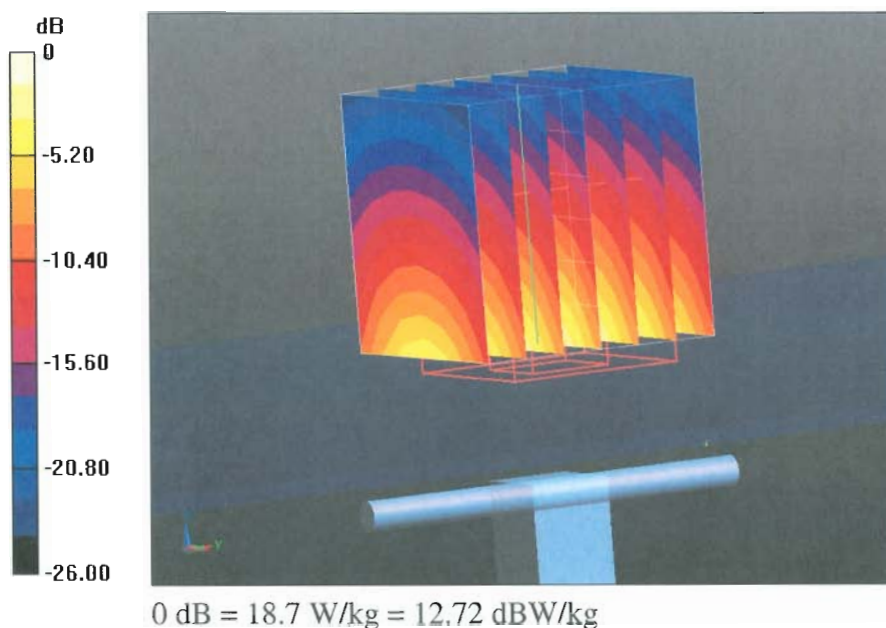
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.2 V/m; Power Drift = 0.00 dB

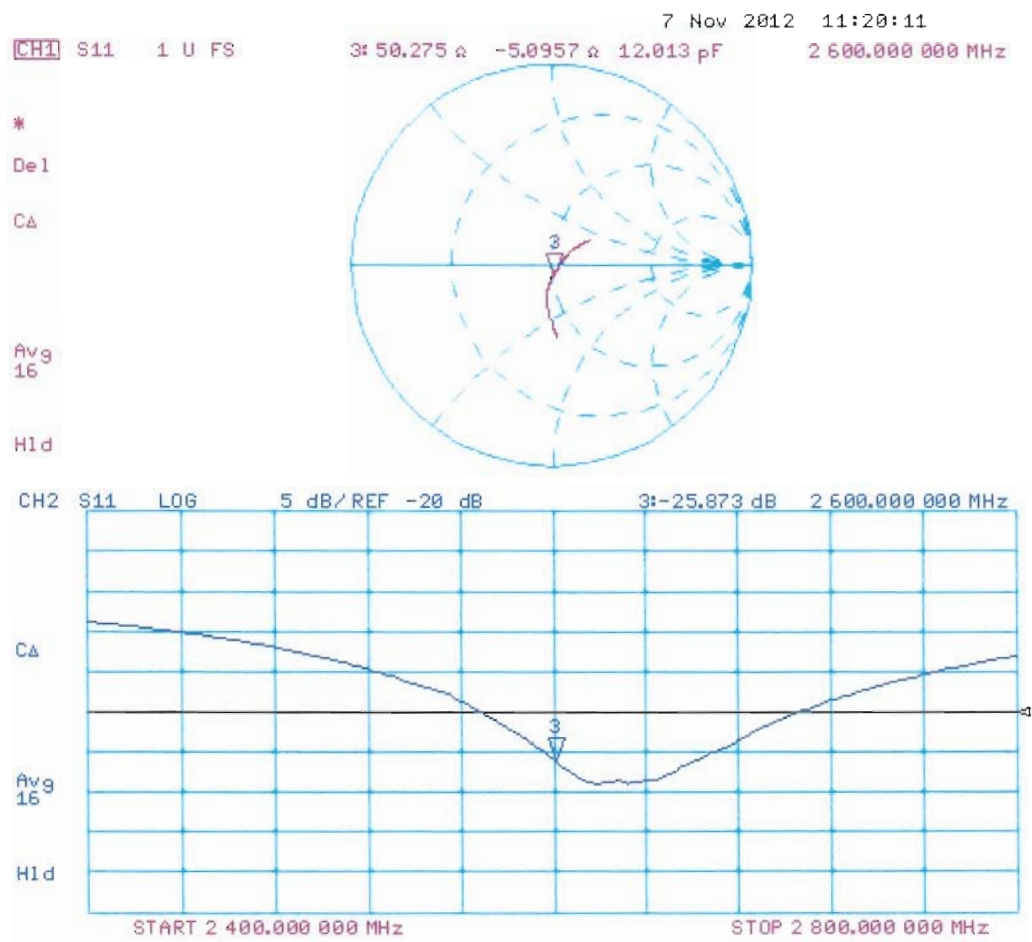
Peak SAR (extrapolated) = 31.3 W/kg

SAR(1 g) = 14.7 W/kg; SAR(10 g) = 6.54 W/kg

Maximum value of SAR (measured) = 18.7 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.11.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1056

Communication System: CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.19$ mho/m; $\epsilon_r = 50.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.16, 4.16, 4.16); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

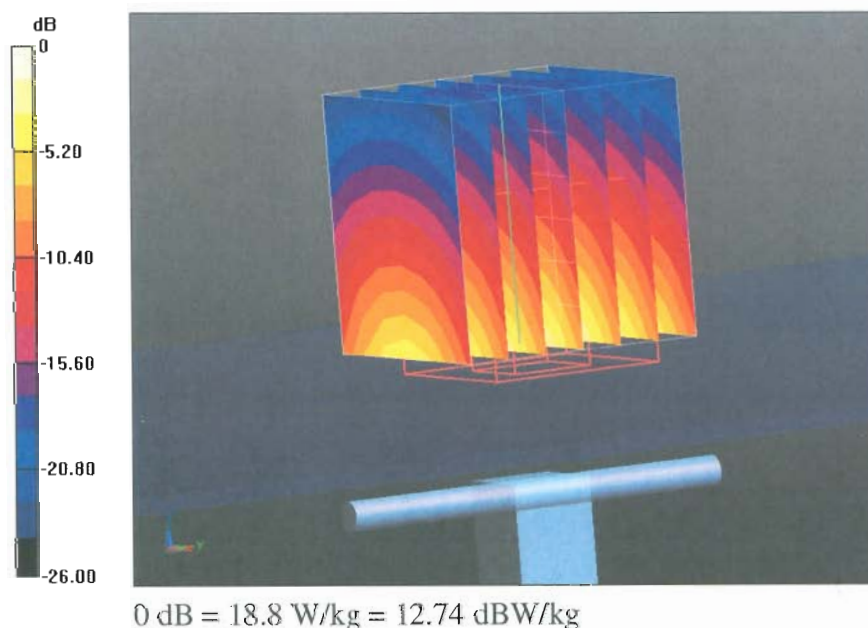
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.2 V/m; Power Drift = 0.00 dB

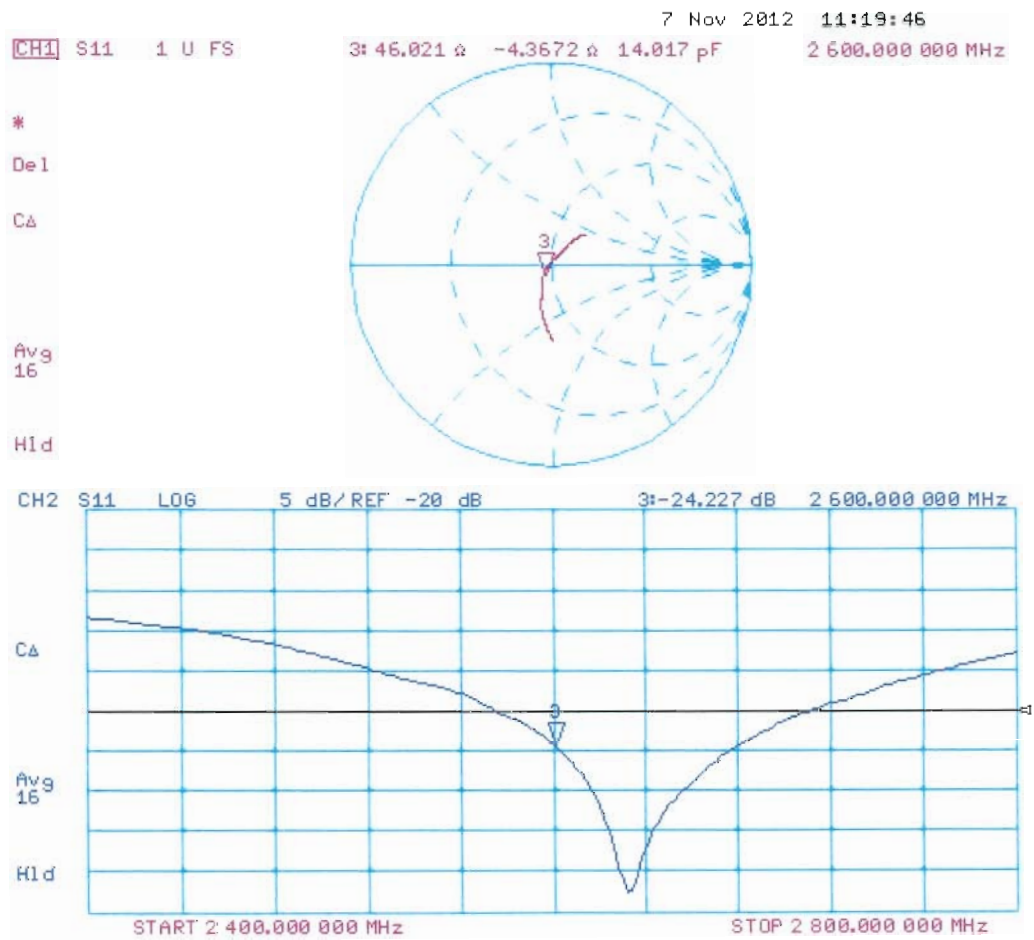
Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.26 W/kg

Maximum value of SAR (measured) = 18.8 W/kg



Impedance Measurement Plot for Body TSL



Dipole D2600V2 – SN:1056 Antenna Parameters measured: 2014-01-31.

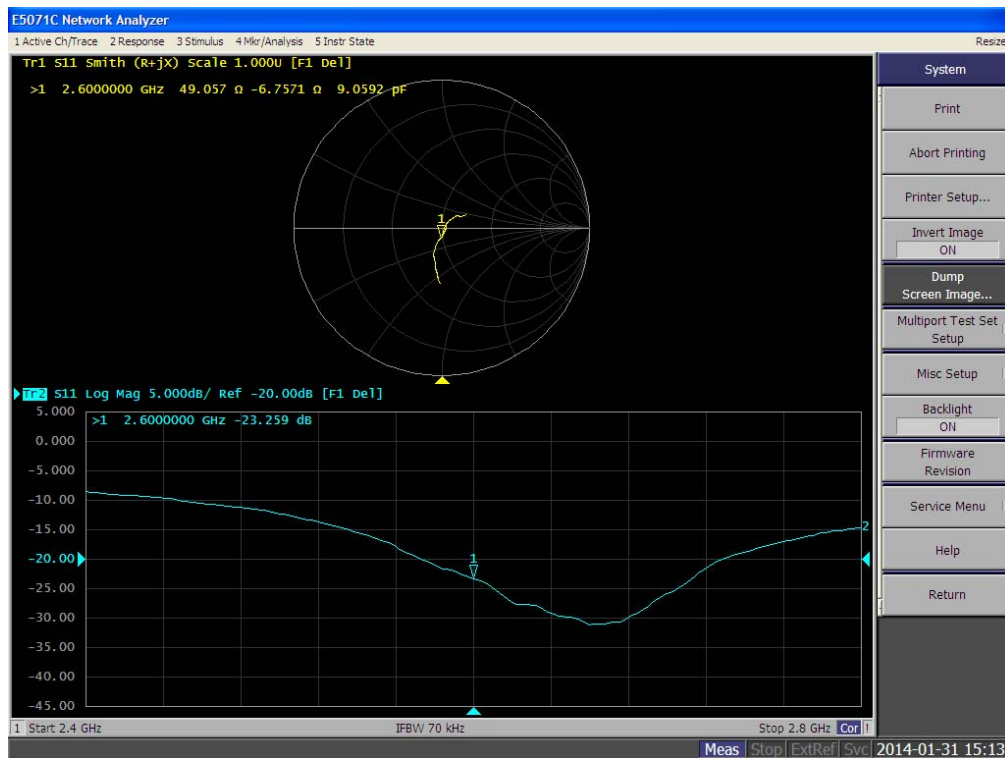
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	50.3 Ω - 5.1 j Ω	49.1 Ω - 6.8 j Ω
Return loss	-25.9 dB	-23.3 dB

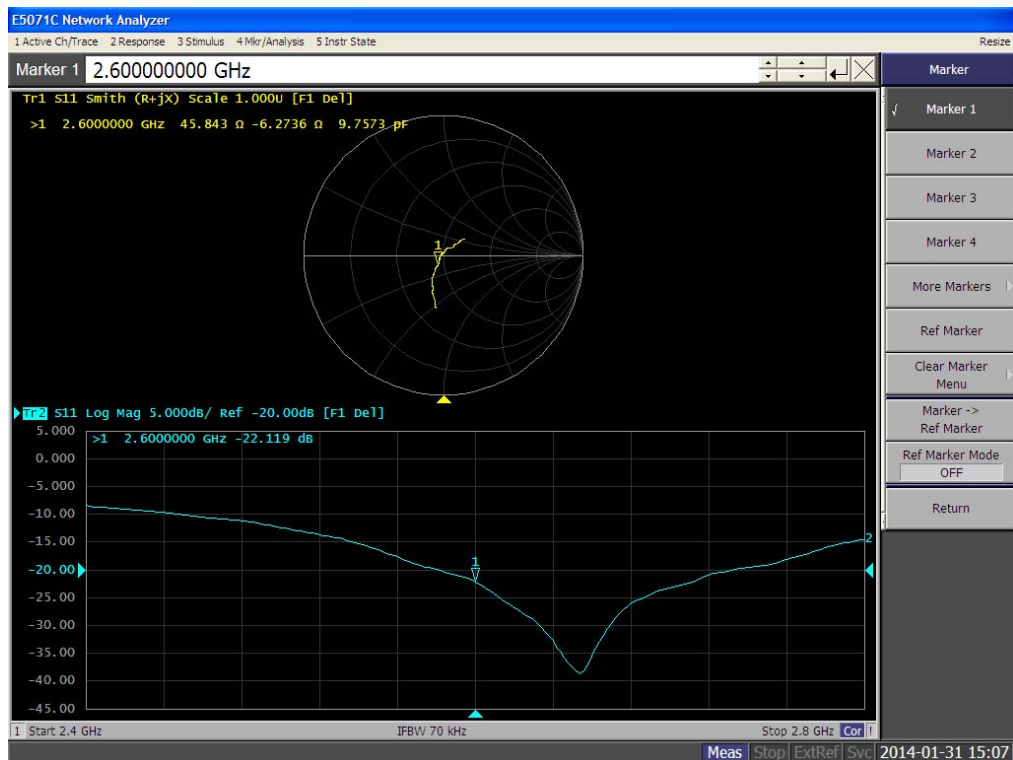
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	46.0 Ω - 4.4 j Ω	45.8 Ω - 6.3 j Ω
Return loss	-24.2 dB	-22.1 dB

Impedance Measurement Plot for Head TSL 2600



Impedance Measurement Plot for Body TSL 2600





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Accreditation No.: **SCS 108**

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Client **Nokia Salo TCC**

Certificate No: **D5GHzV2-1048_Dec12**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1048**

Calibration procedure(s) **QA CAL-22.v1**
Calibration procedure for dipole validation kits between 3-6 GHz

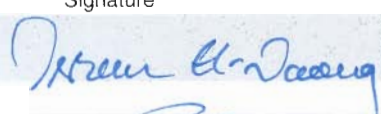
Calibration date: **December 11, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 11, 2012

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Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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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:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- 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:

- DASY4/5 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.6 $\pm$ 6 %	4.46 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.7 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.55 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.6 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.72 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	4.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.8 ± 6 %	5.04 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	71.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.6 ± 6 %	5.76 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.1 ± 6 %	6.17 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	71.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.00 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	54.0 Ω - 7.1 j Ω
Return Loss	- 22.1 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	49.0 Ω - 4.5 j Ω
Return Loss	- 26.7 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	59.1 Ω - 8.8 j Ω
Return Loss	- 18.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	59.7 Ω - 1.7 j Ω
Return Loss	- 21.0 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.8 Ω - 8.9 j Ω
Return Loss	- 20.0 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.7 Ω - 6.3 j Ω
Return Loss	- 23.0 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.3 Ω - 4.2 j Ω
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	58.7 Ω - 6.9 j Ω
Return Loss	- 19.8 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	60.7 Ω - 0.7 j Ω
Return Loss	- 20.3 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.7 Ω - 7.2 j Ω
Return Loss	- 20.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 ns
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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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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 09, 2006

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1048

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.46$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.55$ mho/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.72$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.81$ mho/m; $\epsilon_r = 34$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.04$ mho/m; $\epsilon_r = 33.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 30.12.2011, ConvF(5.1, 5.1, 5.1); Calibrated: 30.12.2011, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.551 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.266 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 31.3 W/kg

SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.4 W/kg

Maximum value of SAR (measured) = 19.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.310 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 32.5 W/kg

SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.574 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 33.1 W/kg

SAR(1 g) = 8.41 W/kg; SAR(10 g) = 2.4 W/kg

Maximum value of SAR (measured) = 20.1 W/kg

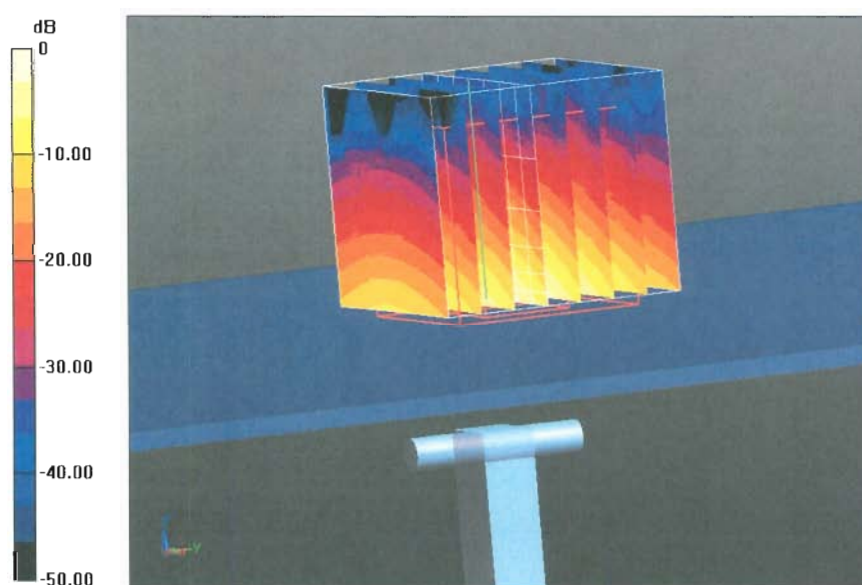
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 60.570 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 32.7 W/kg

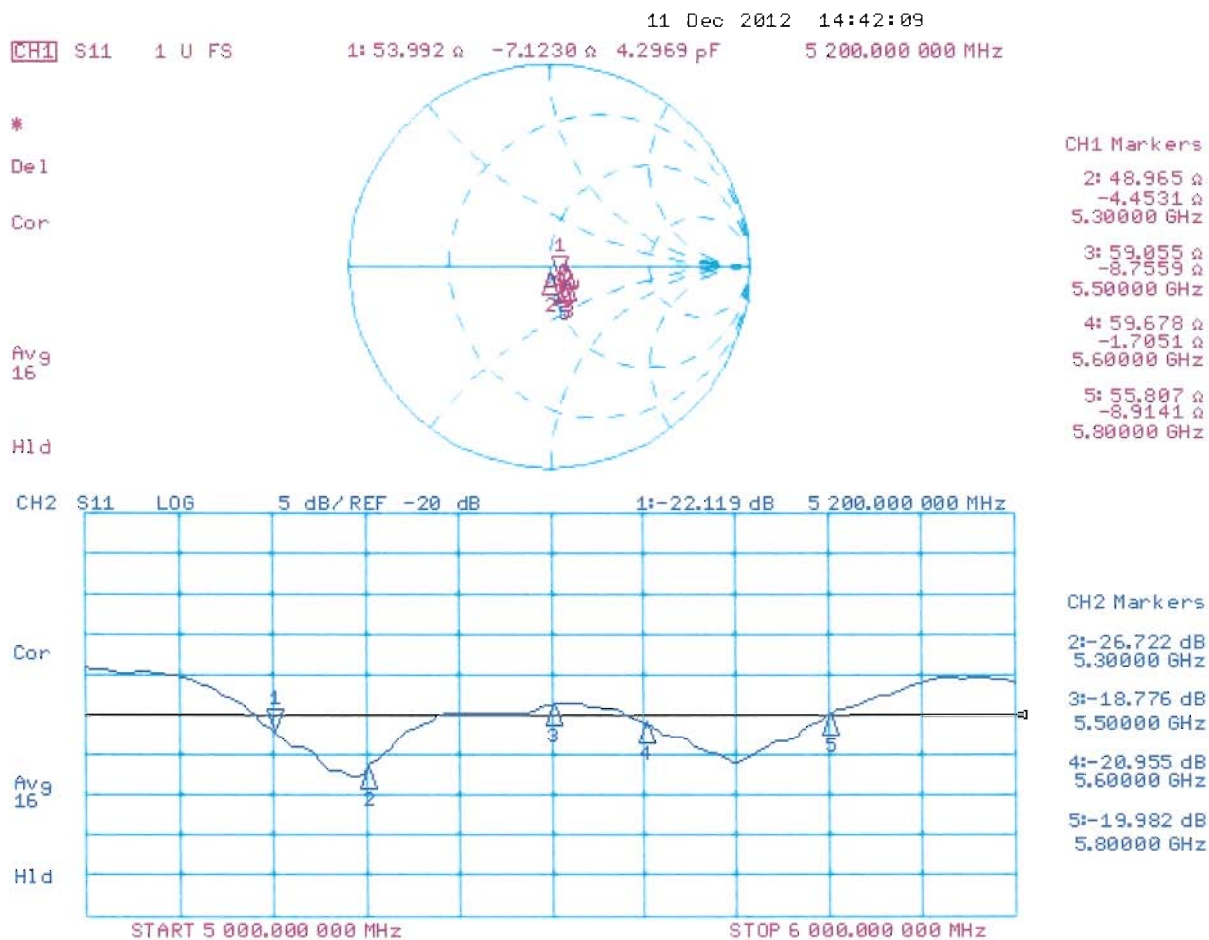
SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.26 W/kg

Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

Impedance Measurement Plot for Head TSL



Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1048

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.4$ mho/m; $\epsilon_r = 47.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.51$ mho/m; $\epsilon_r = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.76$ mho/m; $\epsilon_r = 46.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.88$ mho/m; $\epsilon_r = 46.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.17$ mho/m; $\epsilon_r = 46.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.67, 4.67, 4.67); Calibrated: 30.12.2011, ConvF(4.43, 4.43, 4.43); Calibrated: 30.12.2011, ConvF(4.22, 4.22, 4.22); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.320 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.3 W/kg

SAR(1 g) = 7.2 W/kg; SAR(10 g) = 2.02 W/kg

Maximum value of SAR (measured) = 17.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.849 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 30.1 W/kg

SAR(1 g) = 7.45 W/kg; SAR(10 g) = 2.09 W/kg

Maximum value of SAR (measured) = 17.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.354 V/m; Power Drift = -0.02 dB

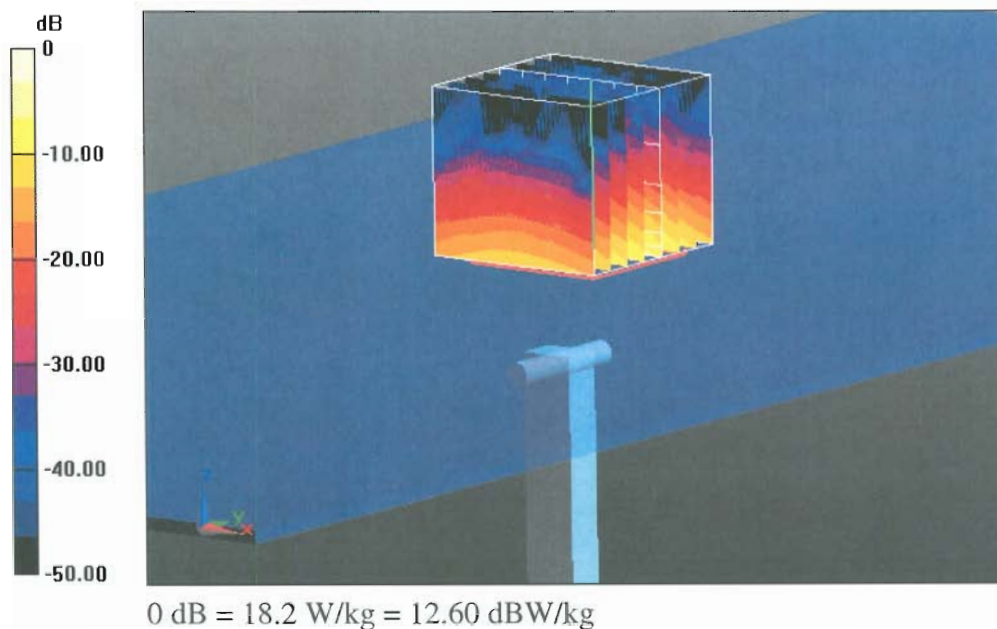
Peak SAR (extrapolated) = 32.8 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.12 W/kg

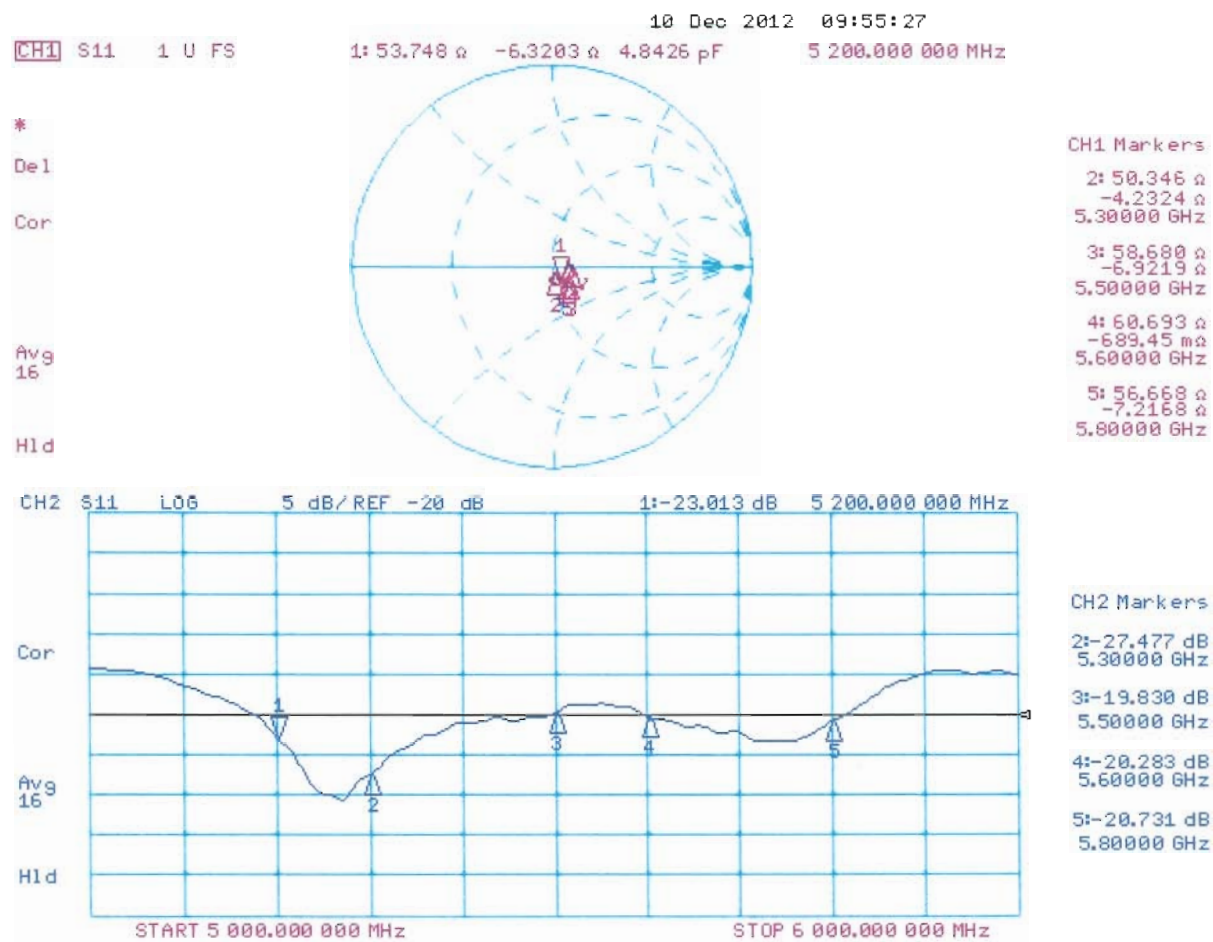
Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.041 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 34.3 W/kg
SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.14 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 52.474 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 33.8 W/kg
SAR(1 g) = 7.25 W/kg; SAR(10 g) = 2 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



Impedance Measurement Plot for Body TSL



Dipole D5000V2 – SN:1048 Antenna Parameters measured: 2014-04-07.

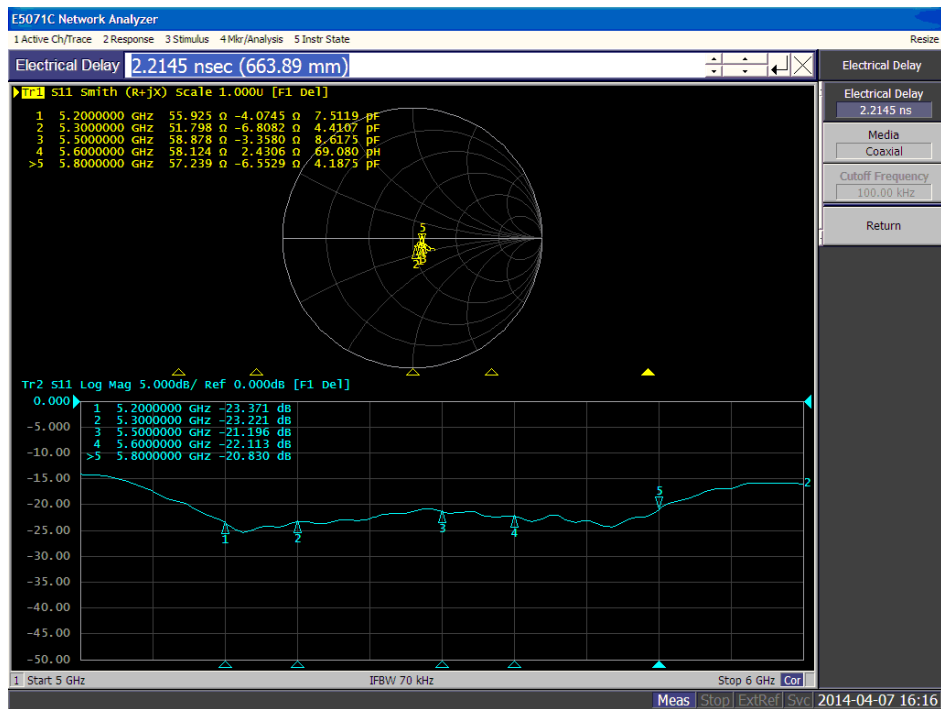
Antenna Parameters with Head TSL

MHz		Calibration certificate	Annual measurement
5200	Impedance, transformed to feed point	54.0 Ω - 7.1 j Ω	55.9 Ω - 4.1 j Ω
	Return loss	-22.0 dB	-23.4 dB
5300	Impedance, transformed to feed point	49.0 Ω - 4.5 j Ω	51.8 Ω - 6.8 j Ω
	Return loss	-26.7 dB	-23.2 dB
5500	Impedance, transformed to feed point	59.1 Ω - 8.8 j Ω	58.9 Ω - 3.4 j Ω
	Return loss	-18.8 dB	-21.2 dB
5600	Impedance, transformed to feed point	59.7 Ω - 1.7 j Ω	58.1 Ω 2.4 j Ω
	Return loss	-21.0 dB	-22.1 dB
5800	Impedance, transformed to feed point	55.8 Ω - 8.9 j Ω	57.2 Ω - 6.6 j Ω
	Return loss	-20.0dB	-20.8 dB

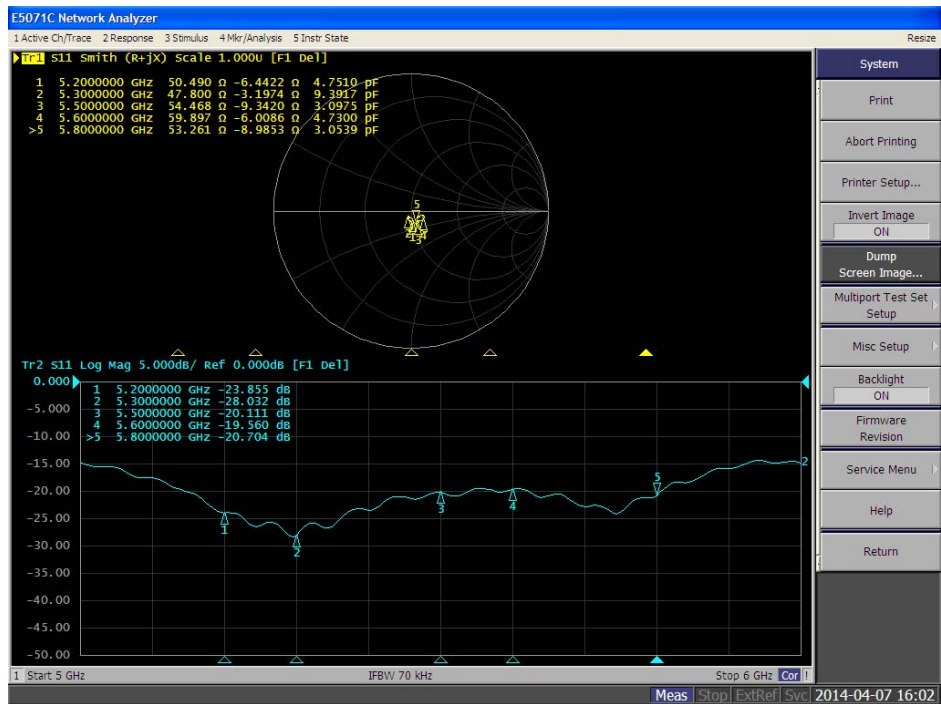
Antenna Parameters with Body TSL

MHz		Calibration certificate	Annual measurement
5200	Impedance, transformed to feed point	53.7 Ω - 6.3 j Ω	50.5 Ω - 6.4 j Ω
	Return loss	-23.0 dB	-23.9 dB
5300	Impedance, transformed to feed point	50.3 Ω - 4.2 j Ω	47.8 Ω - 3.2 j Ω
	Return loss	-27.5 dB	-28.0 dB
5500	Impedance, transformed to feed point	58.7 Ω - 6.9 j Ω	54.5 Ω - 9.3 j Ω
	Return loss	-19.8 dB	-20.1 dB
5600	Impedance, transformed to feed point	60.7 Ω - 0.7 j Ω	59.9 Ω -6.0 j Ω
	Return loss	-20.3 dB	-19.6 dB
5800	Impedance, transformed to feed point	56.7 Ω - 7.2 j Ω	53.3 Ω - 9.0 j Ω
	Return loss	-20.7dB	-20.7 dB

Impedance Measurement Plot for Head TSL 5000



Impedance Measurement Plot for Body TSL 5000



APPENDIX G: CONDUCTED POWER MEASUREMENTS FOR SUPPORTED LTE TRANSMISSION MODES

G.1 Power Tuning Targets

Band	Modulation	Target Tuning Power in Head, Body-worn and Wireless Router measurements					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
LTE2500 (Band 7)	QPSK	N/A	N/A	23.0	23.0	23.0	23.0
	16QAM	N/A	N/A	23.0	23.0	23.0	23.0

G.2 Conducted Power from the Samples used in the Testing

Type: RM-1045; Serial number: 004402/47/860032/7, HW:1004 SW: 02061.00037.14145.00001 used for LTE2500 (Band7) for Head, Body-worn and Wireless Router SAR measurements.

“Max Average Power (dBm)” column lists measured powers with MPR active. The “Reduced Power (dBm)” column lists measured powers with MPR and A-MPR active (as defined by 3GPP TS 36.101). A-MPR is not specified for LTE2500 (Band 7) in this specification (Table 6.2.4-1).

Frequency (MHz)	Channel Number	Bandwidth (MHz)	RB Number	RB Offset	Modulation	Max Average Power (dBm)	Reduced Power(dBm)
2502.5	20775	5	1	0	QPSK	23.2	-
2502.5	20775	5	1	12	QPSK	23.4	-
2502.5	20775	5	1	24	QPSK	23.3	-
2502.5	20775	5	12	0	QPSK	22.2	-
2502.5	20775	5	12	6	QPSK	22.3	-
2502.5	20775	5	12	13	QPSK	22.3	-
2502.5	20775	5	25	0	QPSK	22.2	-
2502.5	20775	5	1	0	16QAM	22.2	-
2502.5	20775	5	1	12	16QAM	22.3	-
2502.5	20775	5	1	24	16QAM	22.2	-
2502.5	20775	5	12	0	16QAM	21.1	-
2502.5	20775	5	12	6	16QAM	21.2	-
2502.5	20775	5	12	13	16QAM	21.2	-
2502.5	20775	5	25	0	16QAM	21.1	-

(Table continues)

(Table continues)

Frequency (MHz)	Channel Number	Bandwidth (MHz)	RB Number	RB Offset	Modulation	Max Average Power (dBm)	Reduced Power(dBm)
2535.0	21100	5	1	0	QPSK	23.3	-
2535.0	21100	5	1	12	QPSK	23.3	-
2535.0	21100	5	1	24	QPSK	23.3	-
2535.0	21100	5	12	0	QPSK	22.2	-
2535.0	21100	5	12	6	QPSK	22.2	-
2535.0	21100	5	12	13	QPSK	22.2	-
2535.0	21100	5	25	0	QPSK	22.1	-
2535.0	21100	5	1	0	16QAM	22.2	-
2535.0	21100	5	1	12	16QAM	22.2	-
2535.0	21100	5	1	24	16QAM	22.2	-
2535.0	21100	5	12	0	16QAM	21.2	-
2535.0	21100	5	12	6	16QAM	21.1	-
2535.0	21100	5	12	13	16QAM	21.1	-
2535.0	21100	5	25	0	16QAM	21.1	-
2567.5	21425	5	1	0	QPSK	23.3	-
2567.5	21425	5	1	12	QPSK	23.3	-
2567.5	21425	5	1	24	QPSK	23.3	-
2567.5	21425	5	12	0	QPSK	22.3	-
2567.5	21425	5	12	6	QPSK	22.2	-
2567.5	21425	5	12	13	QPSK	22.2	-
2567.5	21425	5	25	0	QPSK	22.1	-
2567.5	21425	5	1	0	16QAM	22.3	-
2567.5	21425	5	1	12	16QAM	22.4	-
2567.5	21425	5	1	24	16QAM	22.3	-
2567.5	21425	5	12	0	16QAM	21.2	-
2567.5	21425	5	12	6	16QAM	21.2	-
2567.5	21425	5	12	13	16QAM	21.2	-
2567.5	21425	5	25	0	16QAM	21.0	-
2505.0	20800	10	1	0	QPSK	23.1	-
2505.0	20800	10	1	24	QPSK	23.2	-
2505.0	20800	10	1	49	QPSK	23.1	-
2505.0	20800	10	25	0	QPSK	22.1	-
2505.0	20800	10	25	12	QPSK	22.1	-
2505.0	20800	10	25	25	QPSK	22.0	-
2505.0	20800	10	50	0	QPSK	22.0	-
2505.0	20800	10	1	0	16QAM	22.2	-
2505.0	20800	10	1	24	16QAM	22.3	-
2505.0	20800	10	1	49	16QAM	22.3	-
2505.0	20800	10	25	0	16QAM	21.0	-
2505.0	20800	10	25	12	16QAM	21.0	-
2505.0	20800	10	25	25	16QAM	20.9	-
2505.0	20800	10	50	0	16QAM	20.9	-

(Table continues)

(Table continues)

Frequency (MHz)	Channel Number	Bandwidth (MHz)	RB Number	RB Offset	Modulation	Max Average Power (dBm)	Reduced Power(dBm)
2535.0	21100	10	1	0	QPSK	23.2	-
2535.0	21100	10	1	24	QPSK	23.2	-
2535.0	21100	10	1	49	QPSK	23.3	-
2535.0	21100	10	25	0	QPSK	22.1	-
2535.0	21100	10	25	12	QPSK	22.1	-
2535.0	21100	10	25	25	QPSK	22.0	-
2535.0	21100	10	50	0	QPSK	21.9	-
2535.0	21100	10	1	0	16QAM	22.5	-
2535.0	21100	10	1	24	16QAM	22.4	-
2535.0	21100	10	1	49	16QAM	22.4	-
2535.0	21100	10	25	0	16QAM	21.0	-
2535.0	21100	10	25	12	16QAM	21.0	-
2535.0	21100	10	25	25	16QAM	20.9	-
2535.0	21100	10	50	0	16QAM	20.9	-
2565.0	21400	10	1	0	QPSK	23.2	-
2565.0	21400	10	1	24	QPSK	23.3	-
2565.0	21400	10	1	49	QPSK	23.3	-
2565.0	21400	10	25	0	QPSK	22.1	-
2565.0	21400	10	25	12	QPSK	22.1	-
2565.0	21400	10	25	25	QPSK	22.1	-
2565.0	21400	10	50	0	QPSK	22.0	-
2565.0	21400	10	1	0	16QAM	22.4	-
2565.0	21400	10	1	24	16QAM	22.5	-
2565.0	21400	10	1	49	16QAM	22.4	-
2565.0	21400	10	25	0	16QAM	21.0	-
2565.0	21400	10	25	12	16QAM	21.0	-
2565.0	21400	10	25	25	16QAM	21.0	-
2565.0	21400	10	50	0	16QAM	21.0	-
2507.5	20825	15	1	0	QPSK	23.1	-
2507.5	20825	15	1	36	QPSK	23.1	-
2507.5	20825	15	1	74	QPSK	23.0	-
2507.5	20825	15	37	0	QPSK	22.0	-
2507.5	20825	15	37	18	QPSK	21.9	-
2507.5	20825	15	37	38	QPSK	21.9	-
2507.5	20825	15	75	0	QPSK	21.9	-
2507.5	20825	15	1	0	16QAM	22.0	-
2507.5	20825	15	1	36	16QAM	22.0	-
2507.5	20825	15	1	74	16QAM	22.0	-
2507.5	20825	15	37	0	16QAM	20.9	-
2507.5	20825	15	37	18	16QAM	20.9	-
2507.5	20825	15	37	38	16QAM	20.9	-
2507.5	20825	15	75	0	16QAM	20.8	-

(Table continues)

(Table continues)

Frequency (MHz)	Channel Number	Bandwidth (MHz)	RB Number	RB Offset	Modulation	Max Average Power (dBm)	Reduced Power(dBm)
2535.0	21100	15	1	0	QPSK	23.0	-
2535.0	21100	15	1	36	QPSK	23.2	-
2535.0	21100	15	1	74	QPSK	23.1	-
2535.0	21100	15	37	0	QPSK	22.0	-
2535.0	21100	15	37	18	QPSK	22.0	-
2535.0	21100	15	37	38	QPSK	22.0	-
2535.0	21100	15	75	0	QPSK	21.9	-
2535.0	21100	15	1	0	16QAM	22.0	-
2535.0	21100	15	1	36	16QAM	22.1	-
2535.0	21100	15	1	74	16QAM	22.0	-
2535.0	21100	15	37	0	16QAM	21.0	-
2535.0	21100	15	37	18	16QAM	20.9	-
2535.0	21100	15	37	38	16QAM	20.9	-
2535.0	21100	15	75	0	16QAM	20.8	-
2562.5	21375	15	1	0	QPSK	23.1	-
2562.5	21375	15	1	36	QPSK	23.1	-
2562.5	21375	15	1	74	QPSK	23.1	-
2562.5	21375	15	37	0	QPSK	22.1	-
2562.5	21375	15	37	18	QPSK	22.0	-
2562.5	21375	15	37	38	QPSK	22.0	-
2562.5	21375	15	75	0	QPSK	22.0	-
2562.5	21375	15	1	0	16QAM	21.9	-
2562.5	21375	15	1	36	16QAM	21.9	-
2562.5	21375	15	1	74	16QAM	22.0	-
2562.5	21375	15	37	0	16QAM	20.9	-
2562.5	21375	15	37	18	16QAM	20.9	-
2562.5	21375	15	37	38	16QAM	21.0	-
2562.5	21375	15	75	0	16QAM	20.8	-
2510.0	20850	20	1	0	QPSK	23.0	-
2510.0	20850	20	1	49	QPSK	23.1	-
2510.0	20850	20	1	99	QPSK	23.1	-
2510.0	20850	20	50	0	QPSK	21.8	-
2510.0	20850	20	50	24	QPSK	21.8	-
2510.0	20850	20	50	50	QPSK	21.9	-
2510.0	20850	20	100	0	QPSK	21.9	-
2510.0	20850	20	1	0	16QAM	21.9	-
2510.0	20850	20	1	49	16QAM	21.9	-
2510.0	20850	20	1	99	16QAM	22.0	-
2510.0	20850	20	50	0	16QAM	20.8	-
2510.0	20850	20	50	24	16QAM	20.8	-
2510.0	20850	20	50	50	16QAM	20.8	-
2510.0	20850	20	100	0	16QAM	20.8	-

(Table continues)

(Table continues)

Frequency (MHz)	Channel Number	Bandwidth (MHz)	RB Number	RB Offset	Modulation	Max Average Power (dBm)	Reduced Power(dBm)
2535.0	21100	20	1	0	QPSK	23.0	-
2535.0	21100	20	1	49	QPSK	23.1	-
2535.0	21100	20	1	99	QPSK	23.1	-
2535.0	21100	20	50	0	QPSK	21.8	-
2535.0	21100	20	50	24	QPSK	21.8	-
2535.0	21100	20	50	50	QPSK	21.8	-
2535.0	21100	20	100	0	QPSK	21.8	-
2535.0	21100	20	1	0	16QAM	21.8	-
2535.0	21100	20	1	49	16QAM	21.9	-
2535.0	21100	20	1	99	16QAM	21.9	-
2535.0	21100	20	50	0	16QAM	20.8	-
2535.0	21100	20	50	24	16QAM	20.7	-
2535.0	21100	20	50	50	16QAM	20.7	-
2535.0	21100	20	100	0	16QAM	20.8	-
2560.0	21350	20	1	0	QPSK	23.2	-
2560.0	21350	20	1	49	QPSK	23.1	-
2560.0	21350	20	1	99	QPSK	23.1	-
2560.0	21350	20	50	0	QPSK	21.9	-
2560.0	21350	20	50	24	QPSK	21.9	-
2560.0	21350	20	50	50	QPSK	21.9	-
2560.0	21350	20	100	0	QPSK	21.9	-
2560.0	21350	20	1	0	16QAM	22.1	-
2560.0	21350	20	1	49	16QAM	22.1	-
2560.0	21350	20	1	99	16QAM	22.0	-
2560.0	21350	20	50	0	16QAM	20.8	-
2560.0	21350	20	50	24	16QAM	20.8	-
2560.0	21350	20	50	50	16QAM	20.8	-
2560.0	21350	20	100	0	16QAM	20.8	-

APPENDIX H: CONDUCTED POWER MEASUREMENTS FOR SUPPORTED GSM/GPRS/EGPRS TRANSMISSION MODES

H.1 Power Tuning Targets

GSM/GPRS/EGPRS 850 Head, Body-worn and Wireless Router Body			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	32.5	32.5	32.5
GPRS 2-slot	30.6	30.6	30.6
GPRS 3-slot	28.7	28.7	28.7
GPRS 4-slot	27.6	27.6	27.6
EGPRS 1-slot	26.5	26.5	26.5
EGPRS 2-slot	25.6	25.6	25.6
EGPRS 3-slot	24.8	24.8	24.8
EGPRS 4-slot	23.8	23.8	23.8

GSM/GPRS/EGPRS 1900 Head, Body-worn and Wireless Router Body			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	30.0	30.0	30.0
GPRS 2-slot	27.6	27.6	27.6
GPRS 3-slot	26.0	26.0	26.0
GPRS 4-slot	24.6	24.6	24.6
EGPRS 1-slot	25.5	25.5	25.5
EGPRS 2-slot	24.5	24.5	24.5
EGPRS 3-slot	24.0	24.0	24.0
EGPRS 4-slot	22.2	22.2	22.2

H.2 Conducted Power from the Samples used in the Testing

Type: RM-1045; Serial number: 004402/47/860070/7, HW:1004 and

Type: RM-1045; Serial number: 004402/47/862077/0, HW:1006

used for GSM/GPRS/EGPRS850 Head, Body-worn and Wireless Router SAR measurements

GSM/GPRS/EGPRS 850 Head, Body-worn and Wireless Router, HW 1004			
Slot configuration	CH 128 824.2 MHz	CH 190 836.6 MHz	CH 251 848.8 MHz
Antenna 1			
GSM 1-slot	32.5	32.8	32.7
GPRS 2-slot	30.4	30.5	30.3
GPRS 3-slot	28.6	28.9	28.5
GPRS 4-slot	27.3	27.5	27.2
EGPRS 1-slot	26.3	26.1	26.0
EGPRS 2-slot	25.7	25.5	25.3
EGPRS 3-slot	24.8	24.5	24.3
EGPRS 4-slot	23.7	23.5	23.4
Antenna 2			
GSM 1-slot	32.4	32.7	32.6
GPRS 2-slot	30.3	30.4	30.2
GPRS 3-slot	28.5	28.8	28.4
GPRS 4-slot	27.2	27.4	27.1
EGPRS 1-slot	26.2	26.0	25.9
EGPRS 2-slot	25.6	25.4	25.2
EGPRS 3-slot	24.7	24.4	24.2
EGPRS 4-slot	23.6	23.4	23.3

GSM/GPRS/EGPRS 850			
Head, Body-worn and Wireless Router, HW 1006			
Slot configuration	CH 128 824.2 MHz	CH 190 836.6 MHz	CH 251 848.8 MHz
Antenna 1			
GSM 1-slot	32.9	32.9	32.8
GPRS 2-slot	31.0	30.9	30.6
GPRS 3-slot	29.0	29.1	28.9
GPRS 4-slot	27.7	27.9	27.6
EGPRS 1-slot	26.6	26.3	26.1
EGPRS 2-slot	26.0	25.7	25.5
EGPRS 3-slot	25.0	24.7	24.5
EGPRS 4-slot	24.0	23.8	23.6
Antenna 2			
GSM 1-slot	32.8	32.8	32.7
GPRS 2-slot	30.9	30.8	30.5
GPRS 3-slot	28.9	29.0	28.8
GPRS 4-slot	27.6	27.8	27.5
EGPRS 1-slot	26.5	26.2	26.0
EGPRS 2-slot	25.9	25.6	25.4
EGPRS 3-slot	24.9	24.6	24.4
EGPRS 4-slot	23.9	23.7	23.5

Type: RM-1045; Serial number: 004402/47/860089/7, HW:1004 used for GSM/GPRS/EGPRS1900 Head and Body-worn and Wireless Router SAR measurements

GSM/GPRS/EGPRS 1900 Head, Body-worn and Wireless Router, HW 1004			
Slot configuration	CH 512 1850.2 MHz	CH 661 1880.0 MHz	CH 810 1909.8 MHz
Antenna 1			
GSM 1-slot	30.0	30.4	30.1
GPRS 2-slot	28.0	28.0	28.0
GPRS 3-slot	26.2	26.4	26.3
GPRS 4-slot	24.9	25.0	25.0
EGPRS 1-slot	25.4	25.4	25.2
EGPRS 2-slot	24.7	24.8	24.6
EGPRS 3-slot	24.0	24.1	23.9
EGPRS 4-slot	22.3	22.3	22.2
Antenna 2			
GSM 1-slot	29.9	30.3	30.0
GPRS 2-slot	27.9	27.9	27.9
GPRS 3-slot	26.1	26.3	26.2
GPRS 4-slot	24.8	24.9	24.9
EGPRS 1-slot	25.3	25.3	25.1
EGPRS 2-slot	24.6	24.7	24.5
EGPRS 3-slot	23.9	24.0	23.8
EGPRS 4-slot	22.2	22.2	22.1

APPENDIX I: CONDUCTED POWER MEASUREMENTS FOR SUPPORTED WCDMA TRANSMISSION MODES

I.1 Power Tuning Targets

WCDMA 850 (Band 5) Head, Body-worn and Wireless Router			
Mode	Low channel	Mid channel	High channel
WCDMA	23.5	23.5	23.5

WCDMA1900 (Band 2) Head and Body-worn			
Mode	Low channel	Mid channel	High channel
WCDMA	23.5	23.5	23.5

WCDMA1900 (Band 2) Wireless Router			
Mode	Low channel	Mid channel	High channel
WCDMA	22.0	22.0	22.0

I.2 Conducted Power from the Samples used in the Testing

Type: RM-1045; Serial number: 004402/47/860069/9, HW: 1004 and

Type: RM-1045; Serial number: 004402/47/860943/5, HW: 1006

used for WCDMA850 (Band 5) Head, Body-worn and Wireless router SAR measurements

WCDMA850 (Band 5)				
HW	Mode	Low channel	Mid channel	High channel
1004	WCDMA	23.9	23.9	23.8
1006	WCDMA	23.8	23.9	23.9

Type: RM-1045; Serial number: 004402/47/860067/3, HW:1004 used for WCDMA1900 (Band 2) Head and Body-worn measurements

WCDMA1900 (Band 2)				
HW	Mode	Low channel	Mid channel	High channel
1004	WCDMA	23.8	23.9	23.9

Type: RM-1045; Serial number: 004402/47/860085/5, HW:1004 used for WCDMA1900 (Band 2) Wireless Router measurements

WCDMA1900 (Band 2)				
HW	Mode	Low channel	Mid channel	High channel
1004	WCDMA	22.3	22.4	22.3

WCDMA and HSUPA Subtest mode conducted powers, measured from a separate, fully representative sample are presented in Appendix D.

APPENDIX J: CONDUCTED POWER RESULTS FOR WLAN2450 AND WLAN5000

J.1 Power Tuning Targets

WLAN 2.4 GHz: 20 MHz channel bandwidth								
Standard	Modulation	Data speed [Mbps]	CH 1	CH 2	CH 6	CH 7	CH 10	CH 11
802.11b	BPSK	1	17.0	17.0	17.0	17.0	17.0	17.0
802.11b	QPSK	2	16.5	16.5	16.5	16.5	16.5	16.5
802.11b	QPSK	5.5	16.5	16.5	16.5	16.5	16.5	16.5
802.11b	QPSK	11	16.5	16.5	16.5	16.5	16.5	16.5
802.11g	BPSK	6	14.5	16.5	16.5	16.5	16.5	16.5
802.11g	BPSK	9	14.5	16.0	16.0	16.0	16.0	16.0
802.11g	QPSK	12	14.5	15.0	15.0	15.0	15.0	15.0
802.11g	QPSK	18	14.5	15.0	15.0	15.0	15.0	15.0
802.11g	16QAM	24	14.5	15.0	15.0	15.0	15.0	15.0
802.11g	16QAM	36	14.5	15.0	15.0	15.0	15.0	15.0
802.11g	64QAM	48	14.5	15.0	15.0	15.0	15.0	15.0
802.11g	64QAM	54	14.5	15.0	15.0	15.0	15.0	15.0
802.11n	BPSK	6.5 / 7.25	14.5	16.0	16.0	16.0	16.0	16.0
802.11n	QPSK	13.0 / 14.4	14.5	15.5	15.5	15.5	15.5	15.5
802.11n	QPSK	19.5 / 21.7	14.5	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	26.0 / 28.9	14.5	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	39.0 / 43.3	14.5	15.0	15.0	15.0	15.0	15.0
802.11n	64QAM	52.0 / 57.8	14.5	15.0	15.0	15.0	15.0	15.0
802.11n	64QAM	58.5 / 65.0	14.5	15.0	15.0	15.0	15.0	15.0
802.11n	64QAM	65.0 / 72.2	13.0	13.0	13.0	13.0	13.0	13.0

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 20 MHz Tuning Targets					
			36	40	44	48	52	56
802.11a	BPSK	6	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	BPSK	9	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	12	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	18	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	48	12.0	12.0	12.0	12.0	12.0	12.0
802.11a	64QAM	54	11.0	11.0	11.0	11.0	11.0	11.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	58.5 / 65.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	BPSK	6.5 / 7.2	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	13 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	16QAM	26 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	16QAM	39 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	52 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	58.5 / 65	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	64QAM	65 / 72.2	10.0	10.0	10.0	10.0	10.0	10.0
802.11ac	256QAM	78 / 86.7	8.0	8.0	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [Mbps]	RLAN 5 GHz / 20 MHz Tuning Targets					
			60	64	100	104	108	112
802.11a	BPSK	6	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	BPSK	9	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	12	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	18	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	48	12.0	12.0	12.0	12.0	12.0	12.0
802.11a	64QAM	54	11.0	11.0	11.0	11.0	11.0	11.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	58.5 / 65.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	BPSK	6.5 / 7.2	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	13 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	16QAM	26 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	16QAM	39 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	52 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	58.5 / 65	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	64QAM	65 / 72.2	10.0	10.0	10.0	10.0	10.0	10.0
802.11ac	256QAM	78 / 86.7	8.0	8.0	8.0	8.0	8.0	8.0

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 20 MHz Tuning Targets					
			116	120	124	128	132	136
802.11a	BPSK	6	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	BPSK	9	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	12	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	18	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	48	12.0	12.0	12.0	12.0	12.0	12.0
802.11a	64QAM	54	11.0	11.0	11.0	11.0	11.0	11.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	58.5 / 65.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	BPSK	6.5 / 7.2	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	13 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	16QAM	26 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	16QAM	39 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	52 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	58.5 / 65	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	64QAM	65 / 72.2	10.0	10.0	10.0	10.0	10.0	10.0
802.11ac	256QAM	78 / 86.7	8.0	8.0	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 20 MHz Tuning Targets					
			140	149	153	157	161	165
802.11a	BPSK	6	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	BPSK	9	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	12	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	QPSK	18	14.5	14.5	14.5	14.5	14.5	14.5
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	48	12.0	12.0	12.0	12.0	12.0	12.0
802.11a	64QAM	54	11.0	11.0	11.0	11.0	11.0	11.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	58.5 / 65.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	BPSK	6.5 / 7.2	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	13 / 14.4	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	QPSK	19.5 / 21.7	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	16QAM	26 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	16QAM	39 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	52 / 57.8	13.0	13.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	58.5 / 65	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	64QAM	65 / 72.2	10.0	10.0	10.0	10.0	10.0	10.0
802.11ac	256QAM	78 / 86.7	8.0	8.0	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [Mbps]	RLAN 5 GHz / 40 MHz Tuning Targets						
			38 (36+40)	42 (40+44)	46 (44+48)	50 (48+52)	54 (52+56)	58 (56+60)	62 (60+64)
802.11n	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	54.0 / 60.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	81.0 / 90.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	108.0 / 120.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	121.5 / 135.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11ac	16QAM	54.0 / 60.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	16QAM	81.0 / 90.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	108.0 / 120.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	121.5 / 135.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	256QAM	162 / 180	9.0	9.0	9.0	9.0	9.0	9.0	9.0
802.11ac	256QAM	180 / 200	8.0	8.0	8.0	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 40 MHz Tuning Targets					
			102 (100+104)	106 (104+108)	110 (108+112)	114 (112+116)	118 (116+120)	122 (120+124)
802.11n	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	54.0 / 60.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	81.0 / 90.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	108.0 / 120.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	121.5 / 135.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11ac	16QAM	54.0 / 60.0	14.5	14.5	14.5	14.5	14.5	14.5
802.11ac	16QAM	81.0 / 90.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	108.0 / 120.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	121.5 / 135.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11ac	256QAM	162 / 180	9.0	9.0	9.0	9.0	9.0	9.0
802.11ac	256QAM	180 / 200	8.0	8.0	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 40 MHz Tuning Targets			
			126 (124+128)	130 (128+132)	134 (132+136)	138 (136+140)
802.11n	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0
802.11n	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0
802.11n	16QAM	54.0 / 60.0	14.0	14.0	14.0	14.0
802.11n	16QAM	81.0 / 90.0	13.0	13.0	13.0	13.0
802.11n	64QAM	108.0 / 120.0	13.0	13.0	13.0	13.0
802.11n	64QAM	121.5 / 135.0	12.0	12.0	12.0	12.0
802.11n	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0
802.11ac	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0
802.11ac	16QAM	54.0 / 60.0	14.5	14.5	14.5	14.5
802.11ac	16QAM	81.0 / 90.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	108.0 / 120.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	121.5 / 135.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0
802.11ac	256QAM	162 / 180	9.0	9.0	9.0	9.0
802.11ac	256QAM	180 / 200	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 40 MHz Tuning Targets			
			151 (149+153)	155 (153+157)	159 (157+161)	163 (161+165)
802.11n	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0
802.11n	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0
802.11n	16QAM	54.0 / 60.0	14.0	14.0	14.0	14.0
802.11n	16QAM	81.0 / 90.0	13.0	13.0	13.0	13.0
802.11n	64QAM	108.0 / 120.0	13.0	13.0	13.0	13.0
802.11n	64QAM	121.5 / 135.0	12.0	12.0	12.0	12.0
802.11n	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0
802.11ac	BPSK	13.5 / 15.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	27.0 / 30.0	15.0	15.0	15.0	15.0
802.11ac	QPSK	40.5 / 45.0	15.0	15.0	15.0	15.0
802.11ac	16QAM	54.0 / 60.0	14.5	14.5	14.5	14.5
802.11ac	16QAM	81.0 / 90.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	108.0 / 120.0	14.0	14.0	14.0	14.0
802.11ac	64QAM	121.5 / 135.0	13.0	13.0	13.0	13.0
802.11ac	64QAM	135.0 / 150.0	12.0	12.0	12.0	12.0
802.11ac	256QAM	162 / 180	9.0	9.0	9.0	9.0
802.11ac	256QAM	180 / 200	8.0	8.0	8.0	8.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 80 MHz Tuning Targets			
			42 (36-48)	58 (52-64)	106 (100-112)	155 (149+161)
802.11ac	BPSK	29.3 / 32.5	13.0	13.0	13.0	13.0
802.11ac	QPSK	58.5 / 65.0	13.0	13.0	13.0	13.0
802.11ac	QPSK	87.8 / 97.5	12.0	12.0	12.0	12.0
802.11ac	16QAM	117 / 130	12.0	12.0	12.0	12.0
802.11ac	16QAM	175.5 / 195.0	11.0	11.0	11.0	11.0
802.11ac	64QAM	234 / 260	11.0	11.0	11.0	11.0
802.11ac	64QAM	263.3 / 292.5	10.0	10.0	10.0	10.0
802.11ac	64QAM	292.5 / 325	8.0	8.0	8.0	8.0
802.11ac	256QAM	351 / 390	7.5	7.5	7.5	7.5
802.11ac	256QAM	390 / 433.3	7.5	7.5	7.5	7.5

J.2 Conducted Power from the Samples used in the Testing

Type: RM-1045; SN: 004402/47/763794/0; HW:1004; SW: 02061.00037.14145.00001 used for WLAN2450 for SAR Head, Body-worn and Wireless Router measurements.

WLAN 2.4 GHz: 20 MHz channel bandwidth								
Standard	Modulation	Data speed [Mbps]	CH 1	CH 2	CH 6	CH 7	CH 10	CH 11
802.11b	BPSK	1	17.4	17.3	17.5	17.4	17.4	17.6
802.11b	QPSK	2	16.9	16.9	16.8	17.0	17.0	17.0
802.11b	QPSK	5.5	17.2	17.0	16.9	17.1	16.9	17.2
802.11b	QPSK	11	17.1	17.0	16.9	17.1	17.1	17.0
802.11g	BPSK	6	14.8	16.9	16.7	16.8	16.8	16.9
802.11g	BPSK	9	14.8	16.4	16.3	16.4	16.4	16.3
802.11g	QPSK	12	14.8	15.4	15.4	15.5	15.2	15.3
802.11g	QPSK	18	15.1	15.4	15.2	15.5	15.3	15.3
802.11g	16QAM	24	14.9	15.2	15.2	15.4	15.2	15.3
802.11g	16QAM	36	14.9	15.2	15.2	15.6	15.2	15.4
802.11g	64QAM	48	14.9	15.2	15.2	15.3	15.3	15.2
802.11g	64QAM	54	14.9	15.2	15.2	15.3	15.3	15.3
802.11n	BPSK	6.5 / 7.25	14.9	16.4	16.4	16.5	16.4	16.4
802.11n	QPSK	13.0 / 14.4	14.9	16.0	15.8	15.9	15.8	16.0
802.11n	QPSK	19.5 / 21.7	14.9	15.2	15.5	15.6	15.3	15.3
802.11n	16QAM	26.0 / 28.9	14.9	15.5	15.3	15.3	15.3	15.4
802.11n	16QAM	39.0 / 43.3	15.0	15.2	15.3	15.3	15.3	15.4
802.11n	64QAM	52.0 / 57.8	14.9	15.2	15.3	15.4	15.3	15.4
802.11n	64QAM	58.5 / 65.0	14.9	15.2	15.3	15.4	15.4	15.3
802.11n	64QAM	65.0 / 72.2	13.4	13.1	13.3	13.4	13.1	13.4

Type: RM-1045; Serial number: 004402/47/763795/7; HW:1004; SW: 02061.00037.14145.00001 used for WLAN5000 Head and Body-worn measurements

Standard	Modulation	Data speed [Mbps]	RLAN 5 GHz / 20 MHz channel bandwidth: Measured values					
			36	40	44	48	52	56
802.11a	BPSK	6	15.4	15.4	15.6	15.5	15.5	15.5
802.11a	BPSK	9	14.3	14.2	14.2	14.4	14.4	14.4
802.11a	QPSK	12	14.3	14.2	14.2	14.4	14.4	14.4
802.11a	QPSK	18	14.3	14.2	14.6	14.4	14.4	14.5
802.11a	16QAM	24	13.6	13.8	13.8	14.0	14.0	13.6
802.11a	16QAM	36	12.6	12.9	13.0	13.0	12.7	12.7
802.11a	64QAM	48	11.7	12.0	11.5	11.7	11.7	11.7
802.11a	64QAM	54	11.0	11.0	10.9	10.7	10.8	10.7
802.11n	BPSK	6.5 / 7.25	14.8	15.0	15.0	14.9	14.9	14.9
802.11n	QPSK	13.0 / 14.4	14.4	14.6	14.6	14.4	14.4	14.5
802.11n	QPSK	19.5 / 21.7	14.4	14.4	14.6	14.5	14.5	14.6
802.11n	16QAM	26.0 / 28.9	13.9	13.8	13.8	14.0	13.7	14.1
802.11n	16QAM	39.0 / 43.3	13.1	12.9	12.8	12.7	12.7	12.8
802.11n	64QAM	52.0 / 57.8	12.7	13.1	12.6	12.7	12.8	12.8
802.11n	64QAM	58.5 / 65.0	11.7	12.0	12.0	11.9	11.8	11.9
802.11n	64QAM	65.0 / 72.2	10.7	11.1	11.0	10.8	10.8	10.8
802.11ac	BPSK	6.5 / 7.2	14.4	14.3	14.2	14.4	14.4	14.4
802.11ac	QPSK	13 / 14.4	14.4	14.3	14.2	14.4	14.4	14.5
802.11ac	QPSK	19.5 / 21.7	14.5	14.3	14.3	14.2	14.2	14.5
802.11ac	16QAM	26 / 28.9	13.5	13.8	13.8	13.6	14.0	13.7
802.11ac	16QAM	39 / 43.3	13.6	13.9	13.9	13.7	14.0	14.1
802.11ac	64QAM	52 / 57.8	12.8	13.1	13.0	12.8	12.8	12.9
802.11ac	64QAM	58.5 / 65	11.7	12.1	11.6	11.8	11.8	11.9
802.11ac	64QAM	65 / 72.2	9.8	9.7	10.0	9.8	9.8	9.4
802.11ac	256QAM	78 / 86.7	8.1	8.0	8.0	8.2	7.8	8.2

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 20 MHz channel bandwidth: Measured values					
			60	64	100	104	108	112
802.11a	BPSK	6	15.5	15.5	15.5	15.7	15.6	15.7
802.11a	BPSK	9	14.3	14.6	14.4	14.6	14.2	14.2
802.11a	QPSK	12	14.4	14.3	14.4	14.2	14.2	14.2
802.11a	QPSK	18	14.0	14.7	14.4	14.6	14.6	14.3
802.11a	16QAM	24	13.6	13.9	14.0	13.9	13.9	13.9
802.11a	16QAM	36	12.8	13.0	12.8	13.1	12.6	13.0
802.11a	64QAM	48	11.6	11.5	11.9	11.8	11.8	11.7
802.11a	64QAM	54	10.7	10.6	10.6	10.9	10.7	10.8
802.11n	BPSK	6.5 / 7.25	14.8	15.1	15.2	15.0	15.0	15.1
802.11n	QPSK	13.0 / 14.4	14.4	14.4	14.5	14.7	14.3	14.3
802.11n	QPSK	19.5 / 21.7	14.1	14.8	14.5	14.8	14.7	14.3
802.11n	16QAM	26.0 / 28.9	13.7	13.9	14.1	14.0	13.9	13.9
802.11n	16QAM	39.0 / 43.3	12.8	13.1	12.8	12.7	13.0	12.6
802.11n	64QAM	52.0 / 57.8	12.7	13.0	13.3	12.7	12.7	12.7
802.11n	64QAM	58.5 / 65.0	11.8	12.1	11.9	12.3	11.8	11.8
802.11n	64QAM	65.0 / 72.2	10.8	11.1	11.1	10.9	10.9	10.8
802.11ac	BPSK	6.5 / 7.2	14.4	14.7	14.4	14.3	14.6	14.3
802.11ac	QPSK	13 / 14.4	14.1	14.4	14.4	14.7	14.6	14.3
802.11ac	QPSK	19.5 / 21.7	14.5	14.4	14.5	14.8	14.4	14.4
802.11ac	16QAM	26 / 28.9	13.6	13.9	13.7	13.9	13.9	13.9
802.11ac	16QAM	39 / 43.3	13.7	14.0	13.7	14.0	13.9	13.9
802.11ac	64QAM	52 / 57.8	12.8	13.1	12.9	12.8	13.1	12.8
802.11ac	64QAM	58.5 / 65	11.8	12.9	13.5	11.9	11.8	11.8
802.11ac	64QAM	65 / 72.2	9.8	10.1	9.9	10.0	10.0	9.7
802.11ac	256QAM	78 / 86.7	8.1	8.0	7.9	8.1	7.7	7.8

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 20 MHz channel bandwidth: Measured values					
			116	120	124	128	132	136
802.11a	BPSK	6	15.7	15.6	15.4	15.5	16.4	15.4
802.11a	BPSK	9	14.6	14.4	14.3	14.4	14.4	14.3
802.11a	QPSK	12	14.2	14.4	14.3	14.4	14.5	14.3
802.11a	QPSK	18	14.6	14.5	14.3	14.4	14.5	14.4
802.11a	16QAM	24	13.9	13.7	14.0	13.7	13.7	14.0
802.11a	16QAM	36	12.8	12.8	12.8	12.8	12.9	12.8
802.11a	64QAM	48	11.9	11.7	11.8	11.6	11.7	11.9
802.11a	64QAM	54	11.0	10.8	10.6	10.8	10.8	10.6
802.11n	BPSK	6.5 / 7.25	15.1	14.9	15.1	14.9	14.9	14.8
802.11n	QPSK	13.0 / 14.4	14.7	14.5	14.4	14.5	14.5	14.4
802.11n	QPSK	19.5 / 21.7	14.8	14.6	14.4	14.5	14.6	14.5
802.11n	16QAM	26.0 / 28.9	13.9	13.7	13.9	13.7	14.1	14.1
802.11n	16QAM	39.0 / 43.3	13.2	13.0	12.8	12.8	12.9	12.8
802.11n	64QAM	52.0 / 57.8	13.2	12.9	12.8	12.9	13.1	12.8
802.11n	64QAM	58.5 / 65.0	12.1	11.8	12.0	11.7	11.9	12.0
802.11n	64QAM	65.0 / 72.2	11.1	10.9	10.7	10.8	10.9	10.8
802.11ac	BPSK	6.5 / 7.2	14.7	14.5	14.3	14.4	14.5	14.4
802.11ac	QPSK	13 / 14.4	14.3	14.5	14.4	14.5	14.5	14.4
802.11ac	QPSK	19.5 / 21.7	14.4	14.6	14.5	14.6	14.6	14.5
802.11ac	16QAM	26 / 28.9	14.0	13.8	14.0	14.1	13.8	13.7
802.11ac	16QAM	39 / 43.3	14.0	13.8	13.7	13.7	13.8	14.1
802.11ac	64QAM	52 / 57.8	13.2	13.1	12.9	13.0	13.1	12.9
802.11ac	64QAM	58.5 / 65	12.0	11.8	11.7	11.8	11.8	11.7
802.11ac	64QAM	65 / 72.2	10.2	9.5	9.8	9.9	9.5	9.9
802.11ac	256QAM	78 / 86.7	7.8	8.1	7.9	8.0	7.6	7.9

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 20 MHz channel bandwidth: Measured values					
			140	149	153	157	161	165
802.11a	BPSK	6	15.6	15.8	15.7	15.7	15.6	15.5
802.11a	BPSK	9	14.8	14.9	14.9	14.9	14.7	14.7
802.11a	QPSK	12	14.8	14.9	14.9	14.6	14.7	14.7
802.11a	QPSK	18	14.8	14.9	14.9	14.7	14.8	14.7
802.11a	16QAM	24	14.4	14.4	14.3	14.2	14.2	14.1
802.11a	16QAM	36	13.2	13.1	13.2	13.0	13.1	13.0
802.11a	64QAM	48	11.9	12.0	12.0	11.7	11.8	11.8
802.11a	64QAM	54	10.9	10.9	10.9	10.8	10.7	10.7
802.11n	BPSK	6.5 / 7.25	15.4	15.6	15.5	15.3	15.4	15.4
802.11n	QPSK	13.0 / 14.4	14.8	15.0	15.0	14.7	14.8	14.8
802.11n	QPSK	19.5 / 21.7	14.9	15.0	15.0	15.0	14.8	14.8
802.11n	16QAM	26.0 / 28.9	14.3	14.4	14.4	14.4	14.5	14.2
802.11n	16QAM	39.0 / 43.3	13.3	13.3	13.3	13.0	13.1	13.0
802.11n	64QAM	52.0 / 57.8	13.1	13.3	13.3	12.9	13.1	13.1
802.11n	64QAM	58.5 / 65.0	12.2	12.2	12.1	12.2	12.0	11.9
802.11n	64QAM	65.0 / 72.2	11.1	11.1	11.0	11.0	10.8	10.9
802.11ac	BPSK	6.5 / 7.2	14.8	15.0	15.0	14.7	15.1	14.7
802.11ac	QPSK	13 / 14.4	14.9	15.0	15.0	14.7	14.8	14.8
802.11ac	QPSK	19.5 / 21.7	14.7	15.1	15.1	14.8	14.9	14.8
802.11ac	16QAM	26 / 28.9	14.3	14.4	14.4	14.1	14.2	14.2
802.11ac	16QAM	39 / 43.3	14.1	14.4	14.4	14.1	14.2	14.2
802.11ac	64QAM	52 / 57.8	13.0	13.3	13.3	13.0	13.2	13.1
802.11ac	64QAM	58.5 / 65	11.9	12.2	12.1	11.8	12.0	11.9
802.11ac	64QAM	65 / 72.2	9.9	10.4	9.9	9.6	10.1	10.0
802.11ac	256QAM	78 / 86.7	7.7	7.7	7.7	7.8	7.9	7.5

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 40 MHz channel bandwidth: Measured values						
			38 (36+40)	42 (40+44)	46 (44+48)	50 (48+52)	54 (52+56)	58 (56+60)	62 (60+64)
802.11n	BPSK	13.5 / 15.0	14.9	13.8	13.8	13.5	13.9	13.5	13.6
802.11n	QPSK	27.0 / 30.0	13.4	13.9	13.9	14.0	13.6	13.5	13.7
802.11n	QPSK	40.5 / 45.0	13.5	13.4	13.4	13.5	13.6	13.6	13.7
802.11n	16QAM	54.0 / 60.0	12.4	12.4	12.4	12.5	12.6	12.5	12.7
802.11n	16QAM	81.0 / 90.0	11.5	11.5	11.5	11.3	11.4	11.6	11.4
802.11n	64QAM	108.0 / 120.0	11.6	11.5	11.5	11.6	11.4	11.4	11.4
802.11n	64QAM	121.5 / 135.0	10.7	10.5	10.5	10.3	10.4	10.3	10.5
802.11n	64QAM	135.0 / 150.0	10.3	10.6	10.6	10.4	10.4	10.4	10.5
802.11ac	BPSK	13.5 / 15.0	13.4	13.3	13.3	13.4	13.5	13.4	13.6
802.11ac	QPSK	27.0 / 30.0	13.4	13.8	13.4	13.5	13.6	13.6	13.7
802.11ac	QPSK	40.5 / 45.0	13.5	13.5	13.5	13.6	13.6	13.6	13.5
802.11ac	16QAM	54.0 / 60.0	12.9	12.9	12.9	13.0	13.1	13.1	12.9
802.11ac	16QAM	81.0 / 90.0	12.5	12.5	12.5	12.3	12.3	12.6	12.4
802.11ac	64QAM	108.0 / 120.0	12.5	12.5	12.5	12.3	12.7	12.6	12.4
802.11ac	64QAM	121.5 / 135.0	11.6	11.6	11.6	11.4	11.4	11.4	11.5
802.11ac	64QAM	135.0 / 150.0	10.3	10.2	10.6	10.4	10.4	10.4	10.5
802.11ac	256QAM	162 / 180	7.6	7.6	7.6	7.7	7.7	7.7	7.9
802.11ac	256QAM	180 / 200	7.2	6.7	7.2	6.8	7.3	6.8	7.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [Mbps]	RLAN 5 GHz / 40 MHz channel bandwidth: Measured values					
			102 (100+104)	106 (104+108)	110 (108+112)	114 (112+116)	118 (116+120)	122 (120+124)
802.11n	BPSK	13.5 / 15.0	13.7	14.1	14.1	13.6	14.0	13.8
802.11n	QPSK	27.0 / 30.0	13.8	13.7	13.7	14.1	14.1	13.9
802.11n	QPSK	40.5 / 45.0	13.8	14.2	13.7	13.8	13.7	13.9
802.11n	16QAM	54.0 / 60.0	12.8	12.8	12.7	12.4	12.9	12.6
802.11n	16QAM	81.0 / 90.0	11.7	11.6	11.6	11.6	11.7	11.4
802.11n	64QAM	108.0 / 120.0	11.7	11.6	11.6	11.7	11.6	11.5
802.11n	64QAM	121.5 / 135.0	10.8	10.8	10.7	10.8	10.4	10.6
802.11n	64QAM	135.0 / 150.0	10.8	10.8	10.8	10.3	10.8	10.6
802.11ac	BPSK	13.5 / 15.0	14.1	14.1	13.6	13.6	14.0	13.8
802.11ac	QPSK	27.0 / 30.0	13.8	14.1	13.7	13.7	14.0	13.9
802.11ac	QPSK	40.5 / 45.0	13.9	13.8	13.8	13.8	13.8	13.8
802.11ac	16QAM	54.0 / 60.0	13.3	13.2	13.2	13.3	13.3	13.1
802.11ac	16QAM	81.0 / 90.0	12.6	12.9	12.5	12.9	12.6	12.8
802.11ac	64QAM	108.0 / 120.0	12.6	12.5	12.5	12.5	12.5	12.7
802.11ac	64QAM	121.5 / 135.0	11.8	11.7	11.7	11.7	11.7	11.6
802.11ac	64QAM	135.0 / 150.0	10.5	10.8	10.8	10.8	10.8	10.6
802.11ac	256QAM	162 / 180	8.1	8.0	8.0	7.6	7.6	7.9
802.11ac	256QAM	180 / 200	7.2	7.1	6.7	6.8	7.2	7.0

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 40 MHz channel bandwidth: Measured values			
			126 (124+128)	130 (128+132)	134 (132+136)	138 (136+140)
802.11n	BPSK	13.5 / 15.0	13.8	13.8	13.8	13.7
802.11n	QPSK	27.0 / 30.0	13.8	13.9	13.9	13.8
802.11n	QPSK	40.5 / 45.0	13.9	13.6	13.7	13.9
802.11n	16QAM	54.0 / 60.0	12.6	12.6	12.8	12.6
802.11n	16QAM	81.0 / 90.0	11.4	11.6	11.5	11.4
802.11n	64QAM	108.0 / 120.0	11.4	11.5	12.7	11.4
802.11n	64QAM	121.5 / 135.0	10.7	10.7	10.7	10.5
802.11n	64QAM	135.0 / 150.0	10.5	10.3	10.7	10.6
802.11ac	BPSK	13.5 / 15.0	13.8	13.8	13.8	13.7
802.11ac	QPSK	27.0 / 30.0	13.9	13.9	13.9	13.8
802.11ac	QPSK	40.5 / 45.0	14.0	13.6	13.7	14.0
802.11ac	16QAM	54.0 / 60.0	13.1	13.1	13.2	13.1
802.11ac	16QAM	81.0 / 90.0	12.7	12.8	12.8	12.7
802.11ac	64QAM	108.0 / 120.0	12.7	12.8	12.4	12.7
802.11ac	64QAM	121.5 / 135.0	11.5	11.6	11.6	11.5
802.11ac	64QAM	135.0 / 150.0	10.6	10.6	10.7	10.6
802.11ac	256QAM	162 / 180	7.8	7.9	7.9	7.8
802.11ac	256QAM	180 / 200	7.0	7.0	7.0	6.9

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 40 MHz channel bandwidth: Measured values			
			151 (149+153)	155 (153+157)	159 (157+161)	163 (161+165)
802.11n	BPSK	13.5 / 15.0	12.1	12.7	12.2	12.8
802.11n	QPSK	27.0 / 30.0	12.2	12.7	12.3	12.3
802.11n	QPSK	40.5 / 45.0	12.3	12.2	12.4	12.4
802.11n	16QAM	54.0 / 60.0	11.6	11.6	11.5	11.4
802.11n	16QAM	81.0 / 90.0	11.0	11.1	10.7	10.7
802.11n	64QAM	108.0 / 120.0	11.1	11.0	10.7	11.3
802.11n	64QAM	121.5 / 135.0	10.3	10.3	10.6	10.5
802.11n	64QAM	135.0 / 150.0	10.4	10.3	10.0	10.5
802.11ac	BPSK	13.5 / 15.0	12.1	12.1	12.8	12.2
802.11ac	QPSK	27.0 / 30.0	12.2	12.2	12.3	12.3
802.11ac	QPSK	40.5 / 45.0	12.2	12.3	12.4	12.4
802.11ac	16QAM	54.0 / 60.0	12.0	12.0	11.6	12.2
802.11ac	16QAM	81.0 / 90.0	11.7	11.7	11.6	11.6
802.11ac	64QAM	108.0 / 120.0	11.7	11.4	11.5	11.6
802.11ac	64QAM	121.5 / 135.0	11.2	11.2	10.8	11.3
802.11ac	64QAM	135.0 / 150.0	10.4	10.3	10.0	10.5
802.11ac	256QAM	162 / 180	7.9	7.9	7.6	7.6
802.11ac	256QAM	180 / 200	6.9	6.5	7.1	7.1

(Table continues)

(Table continues)

Standard	Modulation	Data speed [MBPS]	RLAN 5 GHz / 80 MHz channel bandwidth: Measured values			
			42 (36-48)	58 (52-64)	106 (100-112)	155 (149+161)
802.11ac	BPSK	29.3 / 32.5	13.9	14.0	14.1	12.8
802.11ac	QPSK	58.5 / 65.0	13.9	14.0	14.2	12.9
802.11ac	QPSK	87.8 / 97.5	12.9	13.0	12.8	12.0
802.11ac	16QAM	117 / 130	13.0	12.6	12.9	12.0
802.11ac	16QAM	175.5 / 195.0	10.5	11.1	11.0	10.8
802.11ac	64QAM	234 / 260	10.7	10.7	11.2	10.9
802.11ac	64QAM	263.3 / 292.5	9.6	10.1	10.1	10.1
802.11ac	64QAM	292.5 / 325	8.1	8.1	8.2	7.9
802.11ac	256QAM	351 / 390	7.1	7.2	7.4	6.9
802.11ac	256QAM	390 / 433.3	7.4	7.2	9.0	7.3