APPENDIX F: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORTS

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

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

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

Accreditation No.: SCS 108

Client Nokia Salo TCC

Certificate No: D835V2-462_Sep11

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 462
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 13, 2011

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 13, 2011

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.6 Ω - 1.8 jΩ
Return Loss	- 32.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 3.7 jΩ
Return Loss	- 27.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 27, 2002

Date: 13.09.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 462

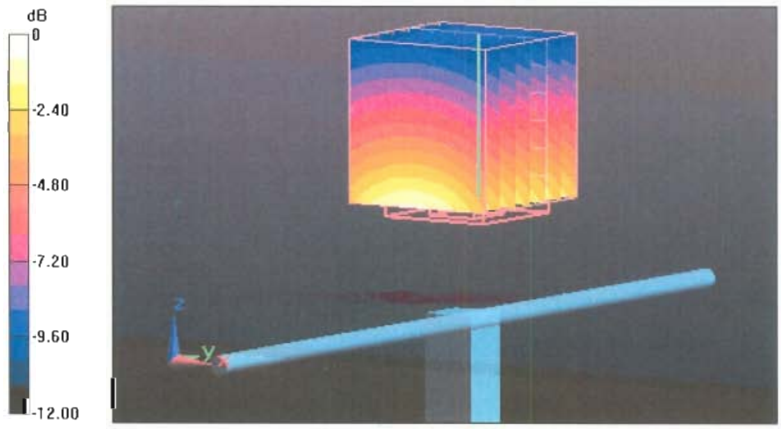
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.89 mho/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

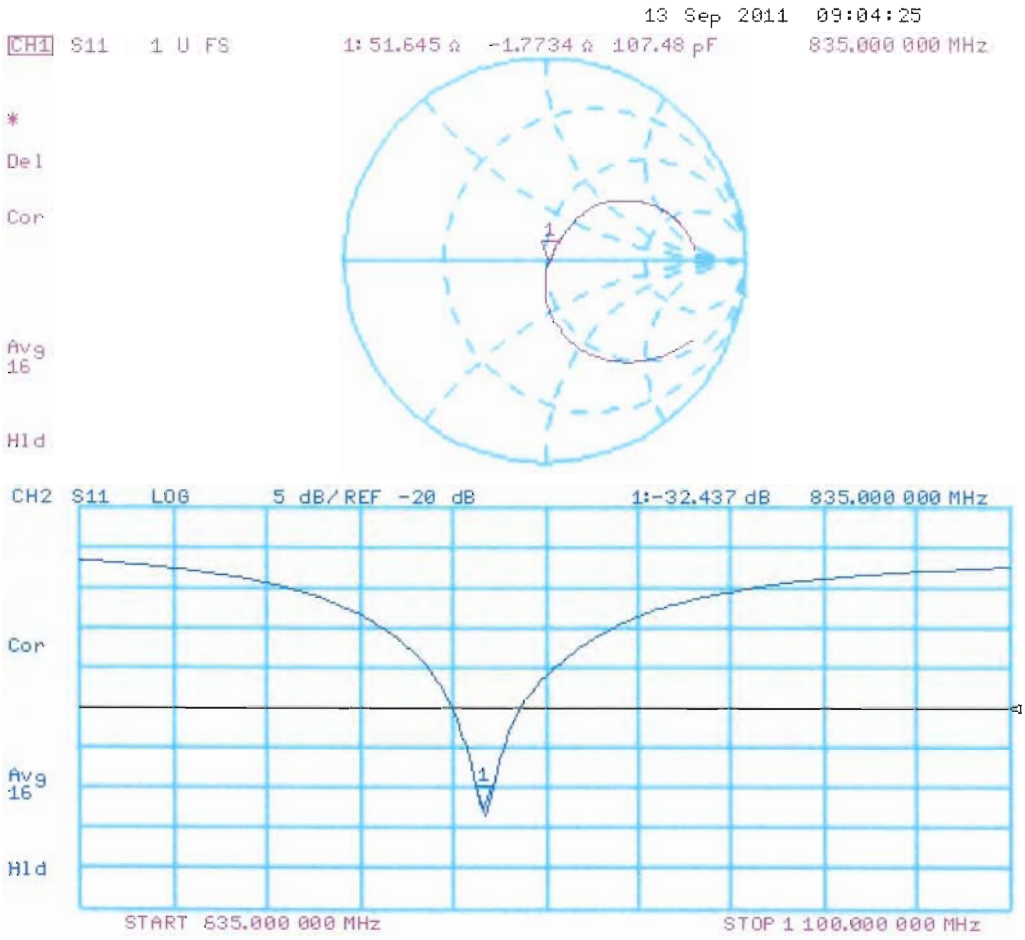
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.987 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.423 W/kg
SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.52 mW/g
Maximum value of SAR (measured) = 2.708 mW/g



0 dB = 2.710mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.09.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 462

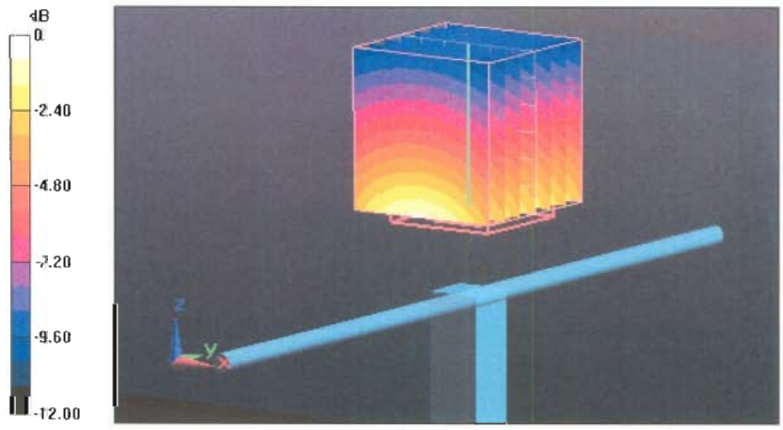
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

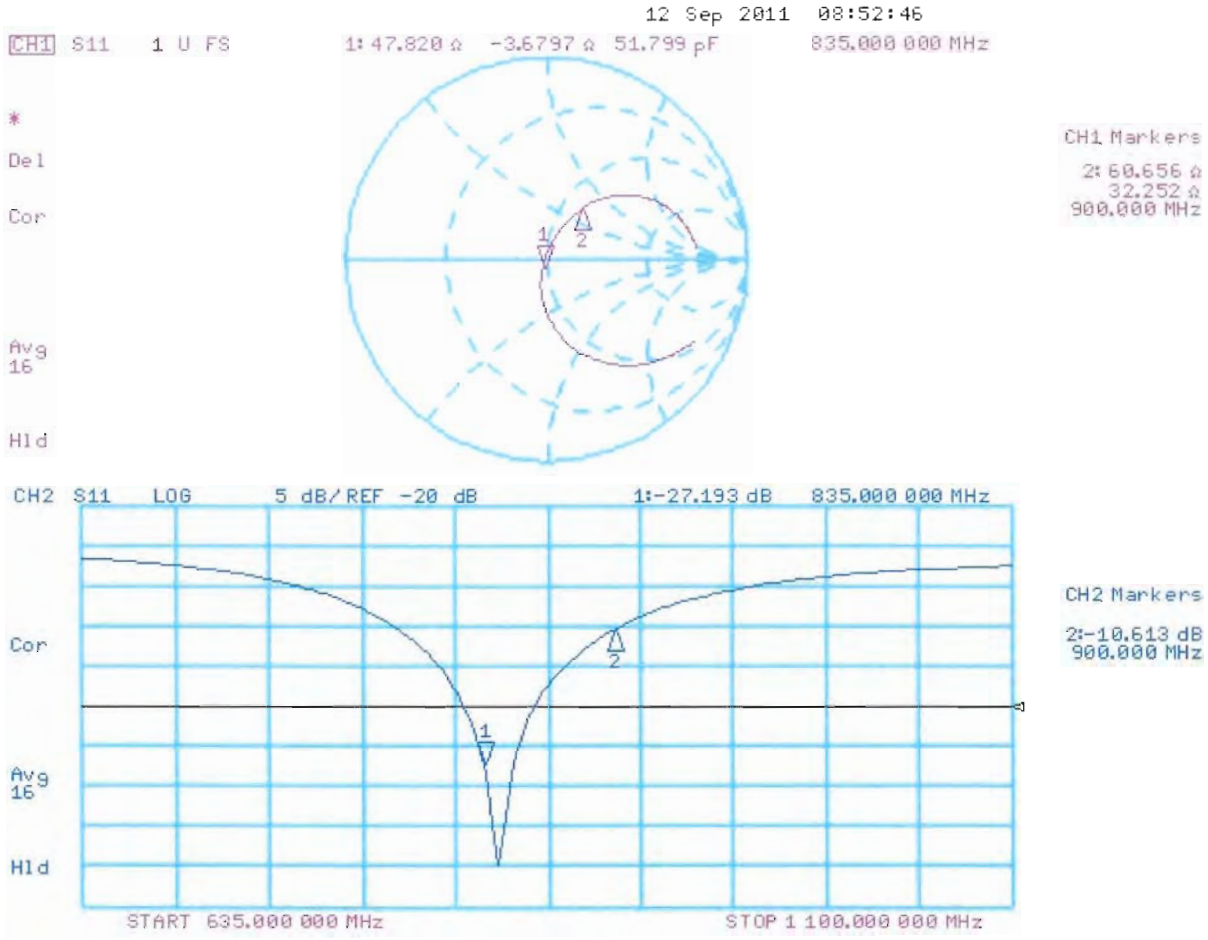
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.464 V/m; Power Drift = 0.0033 dB
Peak SAR (extrapolated) = 3.540 W/kg
SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.61 mW/g
Maximum value of SAR (measured) = 2.851 mW/g



0 dB = 2.850mW/g

Impedance Measurement Plot for Body TSL



Dipole D835V2 – SN: 462 Antenna Parameters measured: 2013-04-16.

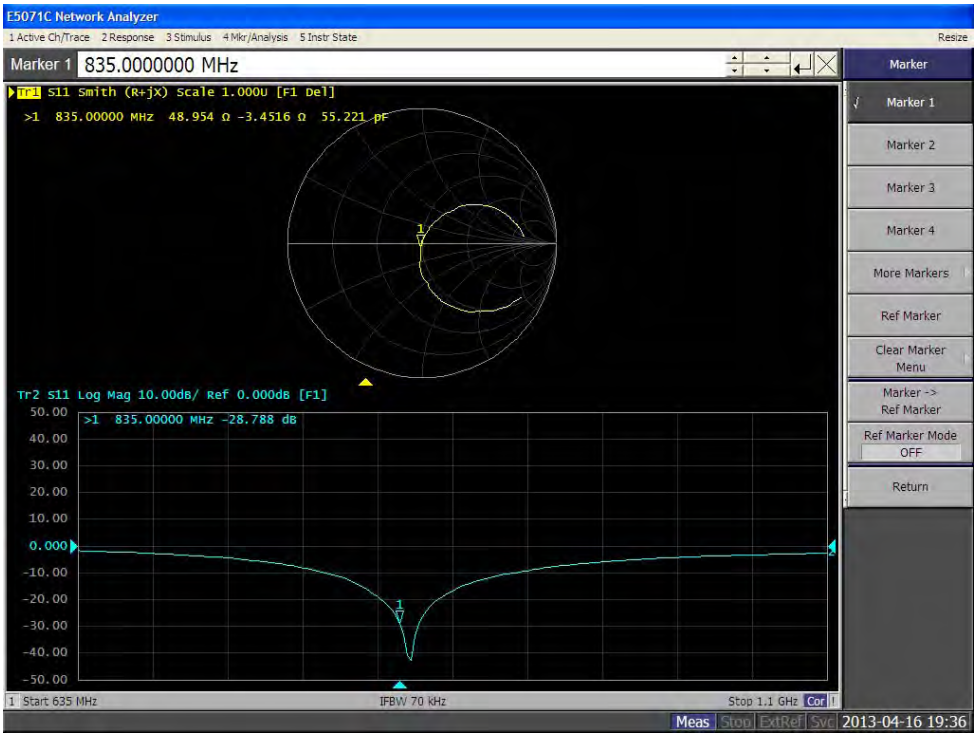
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	50.7 Ω - 2.8 jΩ	49.0 Ω -3.5 jΩ
Return loss	-30.7 dB	-28.8 dB

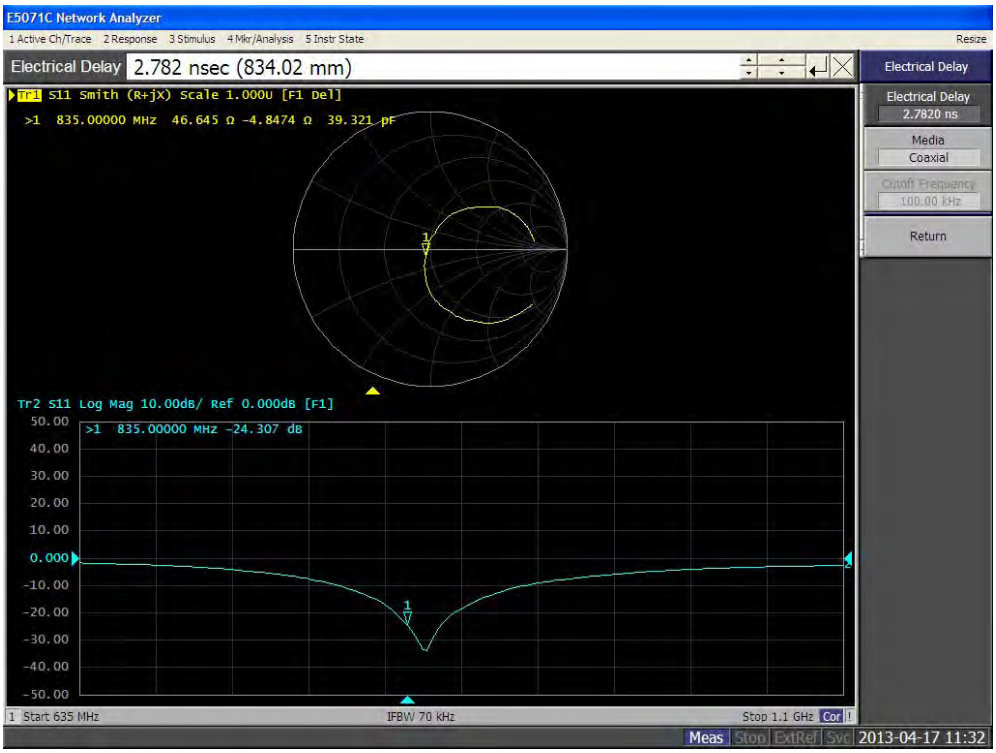
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	47.4 Ω - 3.8 jΩ	46.6 Ω -4.8 jΩ
Return loss	-26.5 dB	-24.3 dB

Impedance Measurement Plot for Head TSL 835



Impedance Measurement Plot for Body TSL 835



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Accreditation No.: SCS 108

Client Nokia Salo TCC

Certificate No: D1900V2-5d030_Feb12

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d030

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

Calibration date: February 22, 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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

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-11)	In house check: Oct-12

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

Issued: February 22, 2012

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0 Ω + 5.3 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 Ω + 5.4 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 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 17, 2002

DASY5 Validation Report for Head TSL

Date: 22.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d030

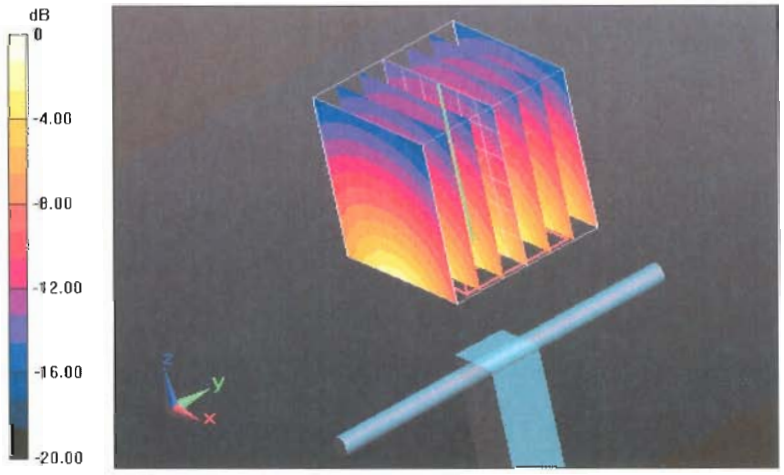
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.4 mho/m; ε_r = 40.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

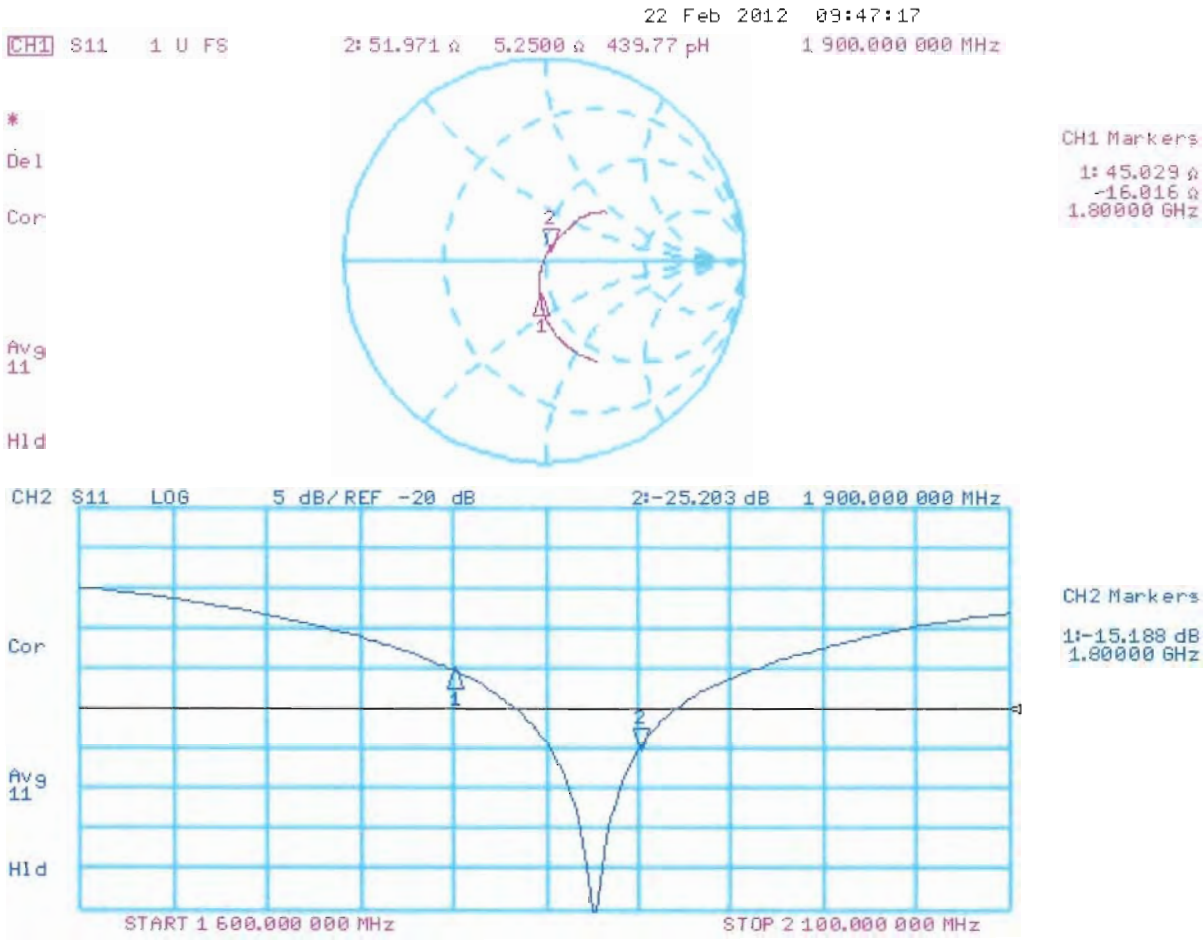
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.565 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 17.4270
SAR(1 g) = 9.79 mW/g; SAR(10 g) = 5.18 mW/g
Maximum value of SAR (measured) = 12.117 mW/g



0 dB = 12.120mW/g = 21.67 dB mW/g

Impedance Measurement Plot for Head TSL



Date: 22.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d030

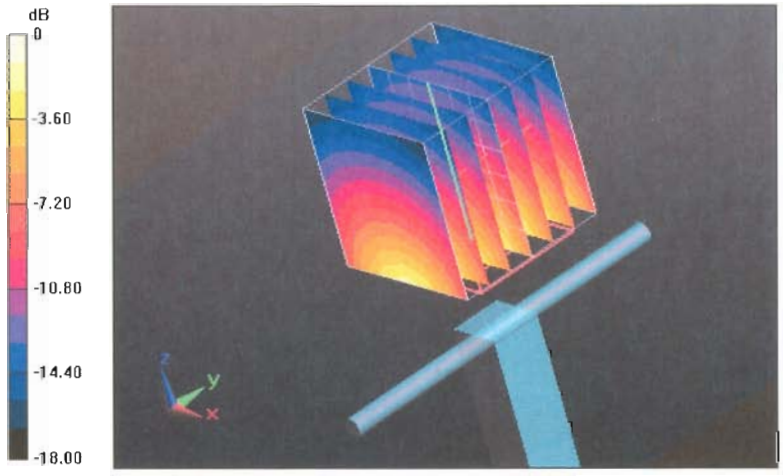
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.56 mho/m; ε_r = 53; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

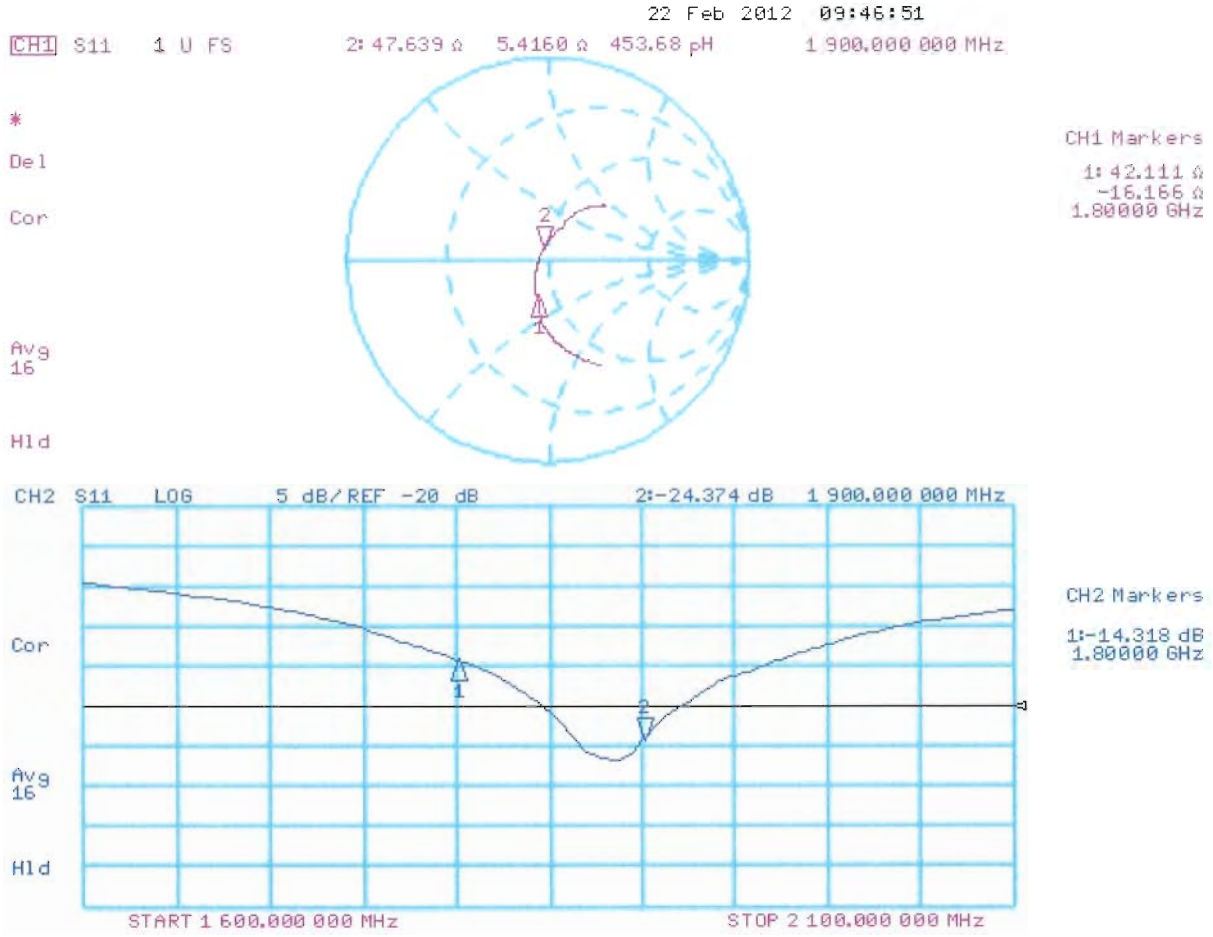
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.541 V/m; Power Drift = -0.0095 dB
Peak SAR (extrapolated) = 17.4260
SAR(1 g) = 9.87 mW/g; SAR(10 g) = 5.17 mW/g
Maximum value of SAR (measured) = 12.485 mW/g



0 dB = 12.480mW/g = 21.92 dB mW/g

Impedance Measurement Plot for Body TSL



Dipole D1900V2 - SN5d030 Antenna Parameters measured: 2013-04-12.

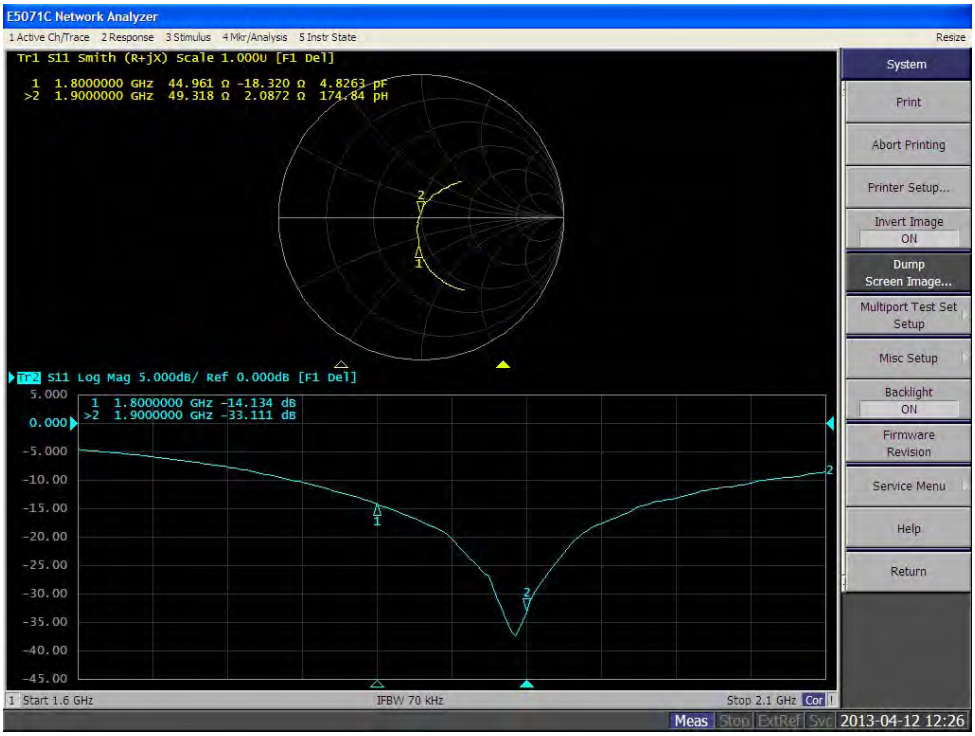
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	52.0 Ω 5.3 jΩ	49.3 Ω 2.1 jΩ
Return loss	-25.2 dB	-33.1 dB

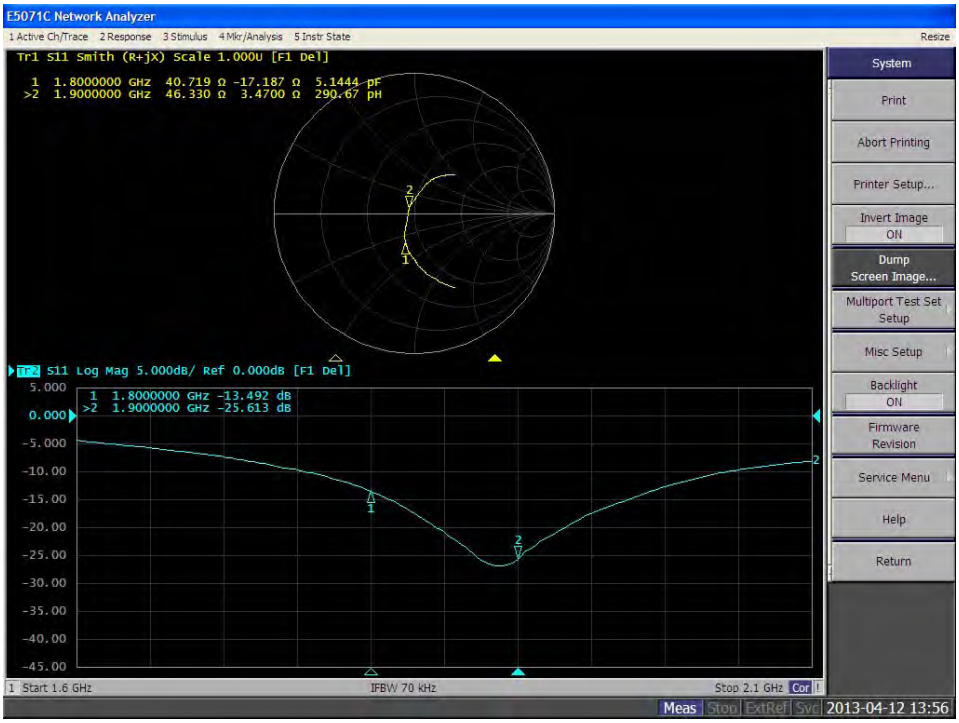
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	47.6 Ω 5.4 jΩ	46.3 Ω 3.5 jΩ
Return loss	-24.4 dB	-25.6 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: D2450V2-729_Sep11

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 729
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 13, 2011

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 13, 2011

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 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.

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
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 ± 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 ± 0.2) °C	38.3 ± 6 %	1.85 mho/m ± 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	13.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**54.6 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.45 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**25.6 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.7 ± 6 %	2.04 mho/m ± 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	13.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.8 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.18 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.4 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω - 0.6 jΩ
Return Loss	- 34.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.7 Ω + 1.1 jΩ
Return Loss	- 35.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.148 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 09, 2003

Date: 13.09.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 729

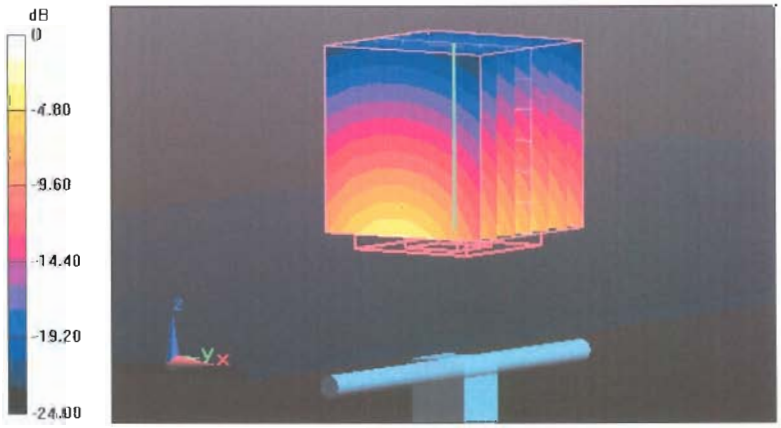
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 mho/m; ε_r = 38.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

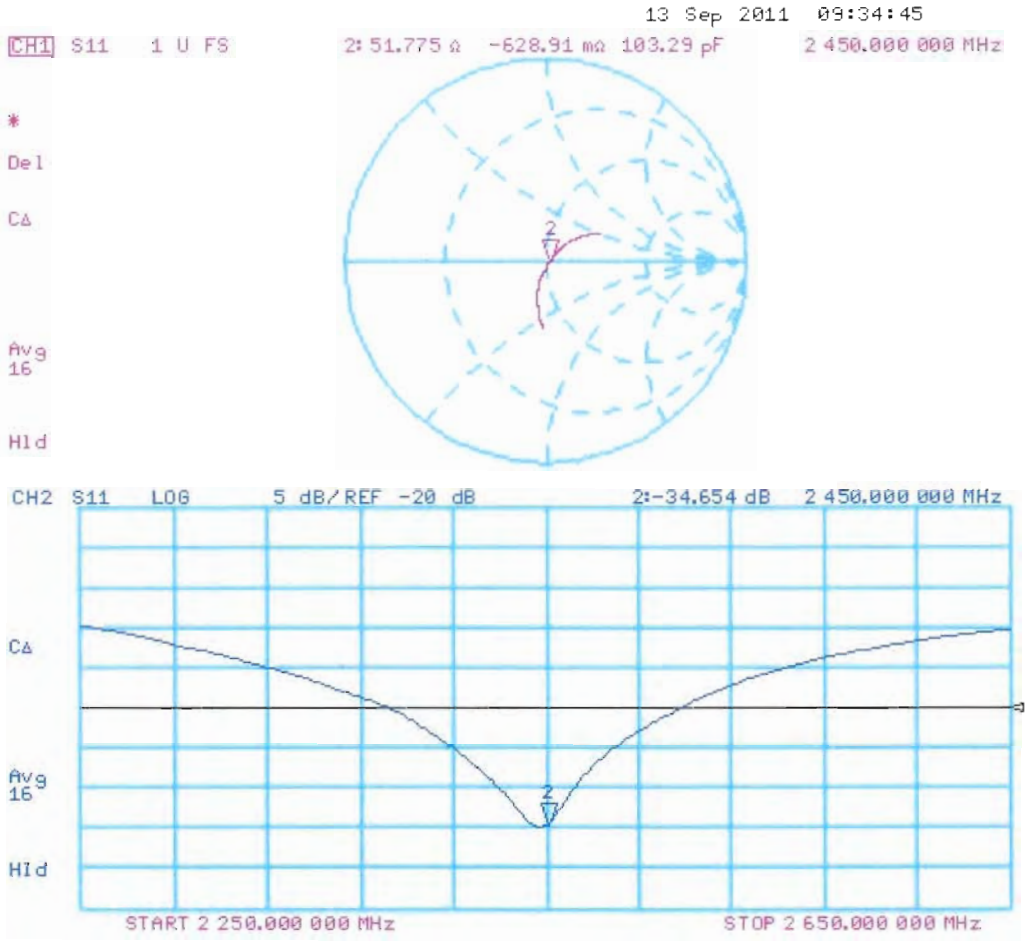
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.5 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 28.852 W/kg
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.45 mW/g
Maximum value of SAR (measured) = 18.134 mW/g



0 dB = 18.130mW/g

Impedance Measurement Plot for Head TSL



Date: 12.09.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 729

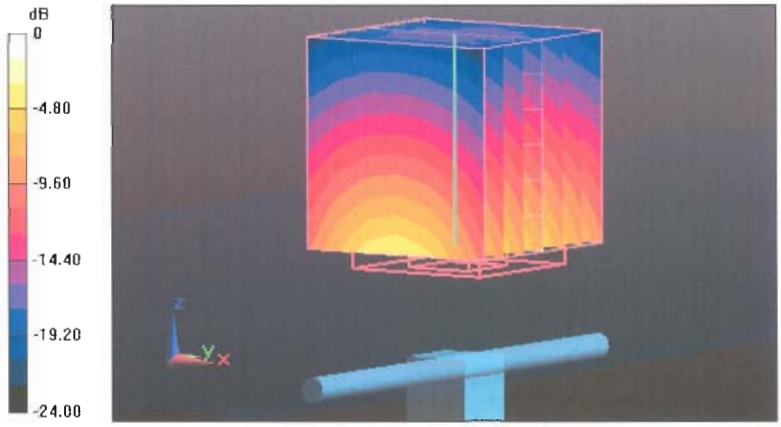
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.04 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

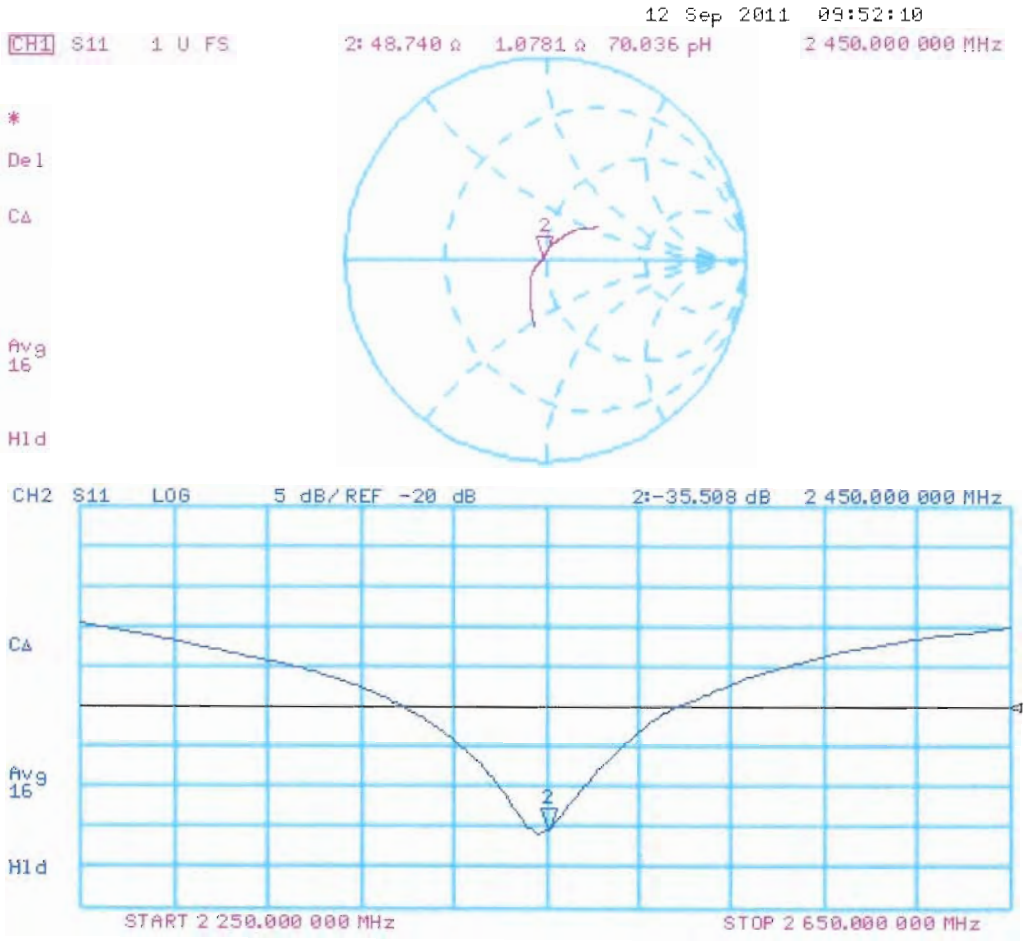
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.035 V/m; Power Drift = -0.0016 dB
Peak SAR (extrapolated) = 27.393 W/kg
SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.18 mW/g
Maximum value of SAR (measured) = 17.569 mW/g



0 dB = 17.570mW/g

Impedance Measurement Plot for Body TSL



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

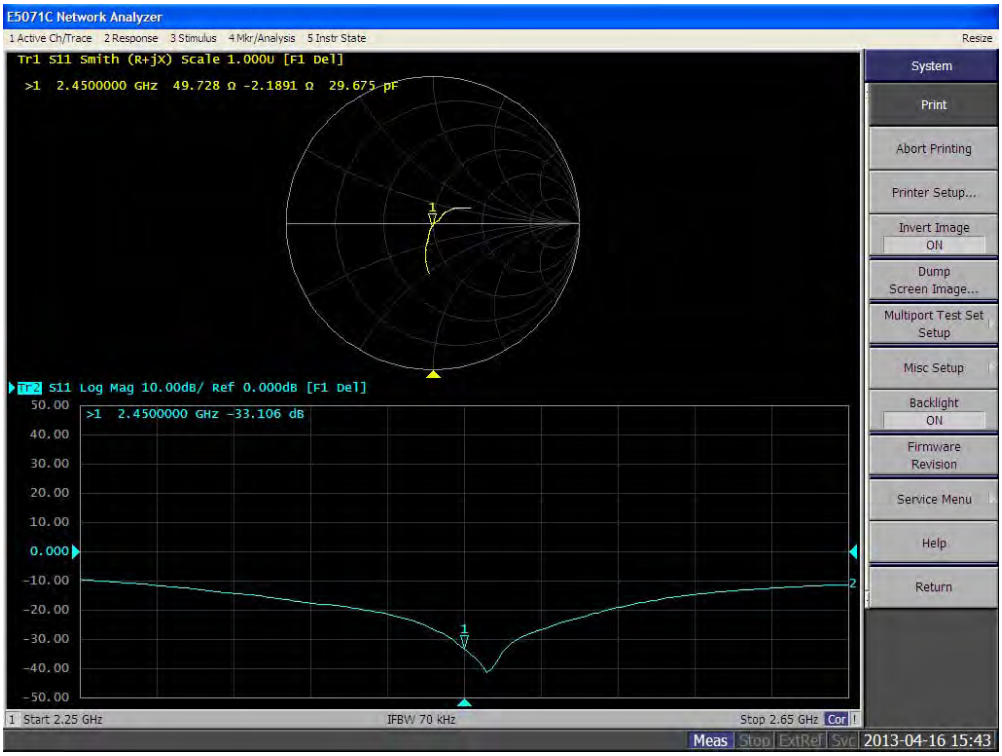
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	51.8 Ω - 0.6 jΩ	49.7 Ω - 2.2 jΩ
Return loss	-34.7 dB	-33.1 dB

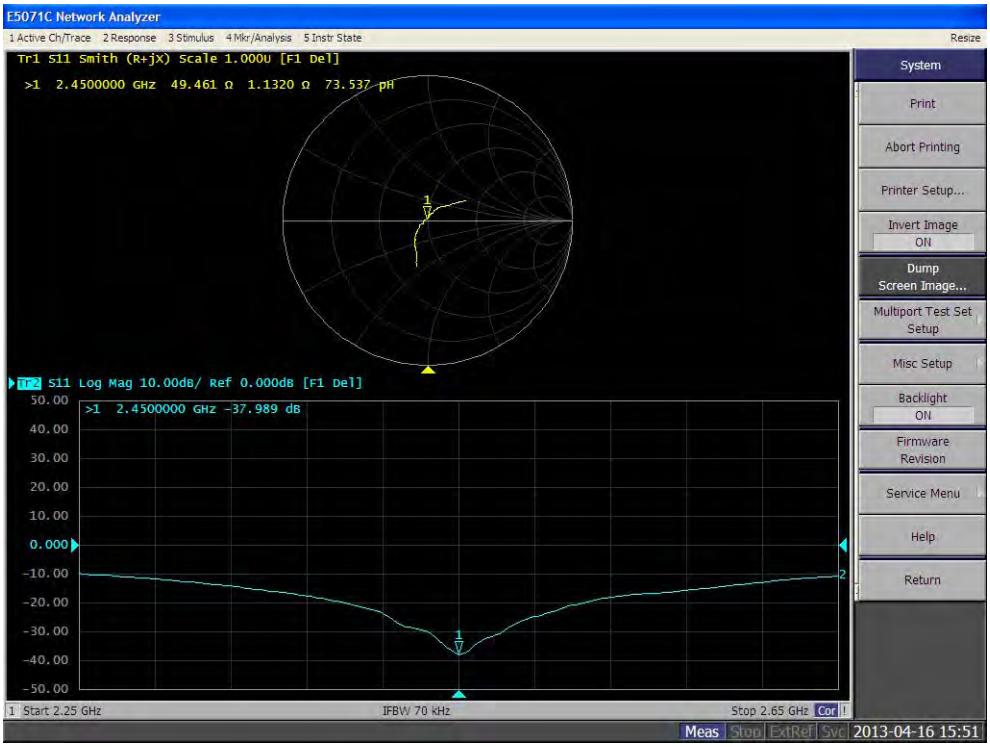
Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	48.7 Ω - 1.1 jΩ	49.5 Ω 1.1 jΩ
Return loss	-35.5 dB	-38.0 dB

Impedance Measurement Plot for Head TSL 2450



Impedance Measurement Plot for Body TSL 2450



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

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

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

Accreditation No.: SCS 108

Client 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

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

Issued: December 11, 2012

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

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

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

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) 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

b) 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:

c) 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 ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 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 ± 0.2) °C	34.6 ± 6 %	4.46 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (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 ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (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 ± 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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (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 jΩ
Return Loss	- 22.1 dB

Antenna Parameters with Head TSL at 5300 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5600 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5300 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

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

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 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	June 09, 2006

DASY5 Validation Report for Head TSL

Date: 11.12.2012

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; σ = 4.46 mho/m; ε_r = 34.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.55 mho/m; ε_r = 34.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.72 mho/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.81 mho/m; ε_r = 34; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.04 mho/m; ε_r = 33.8; ρ = 1000 kg/m^3
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)

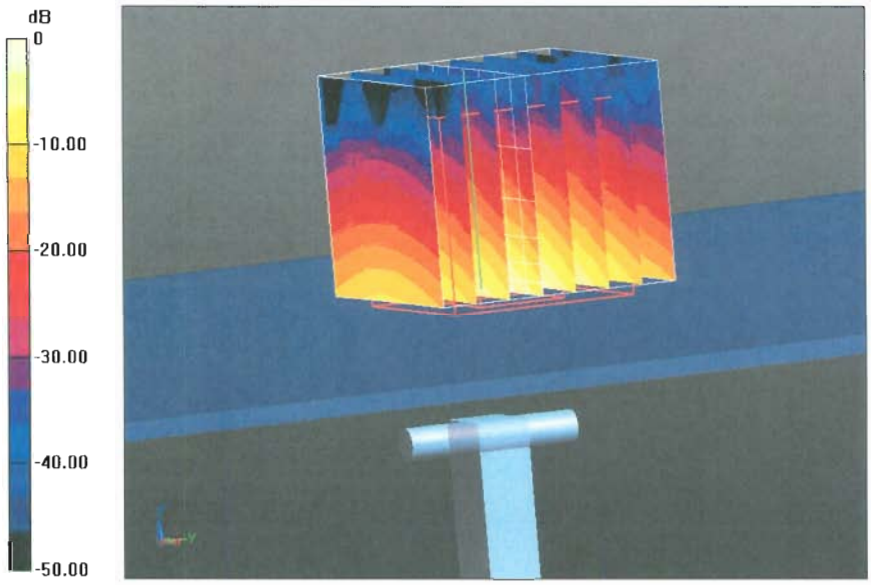
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.551 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.31 W/kg
Maximum value of SAR (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

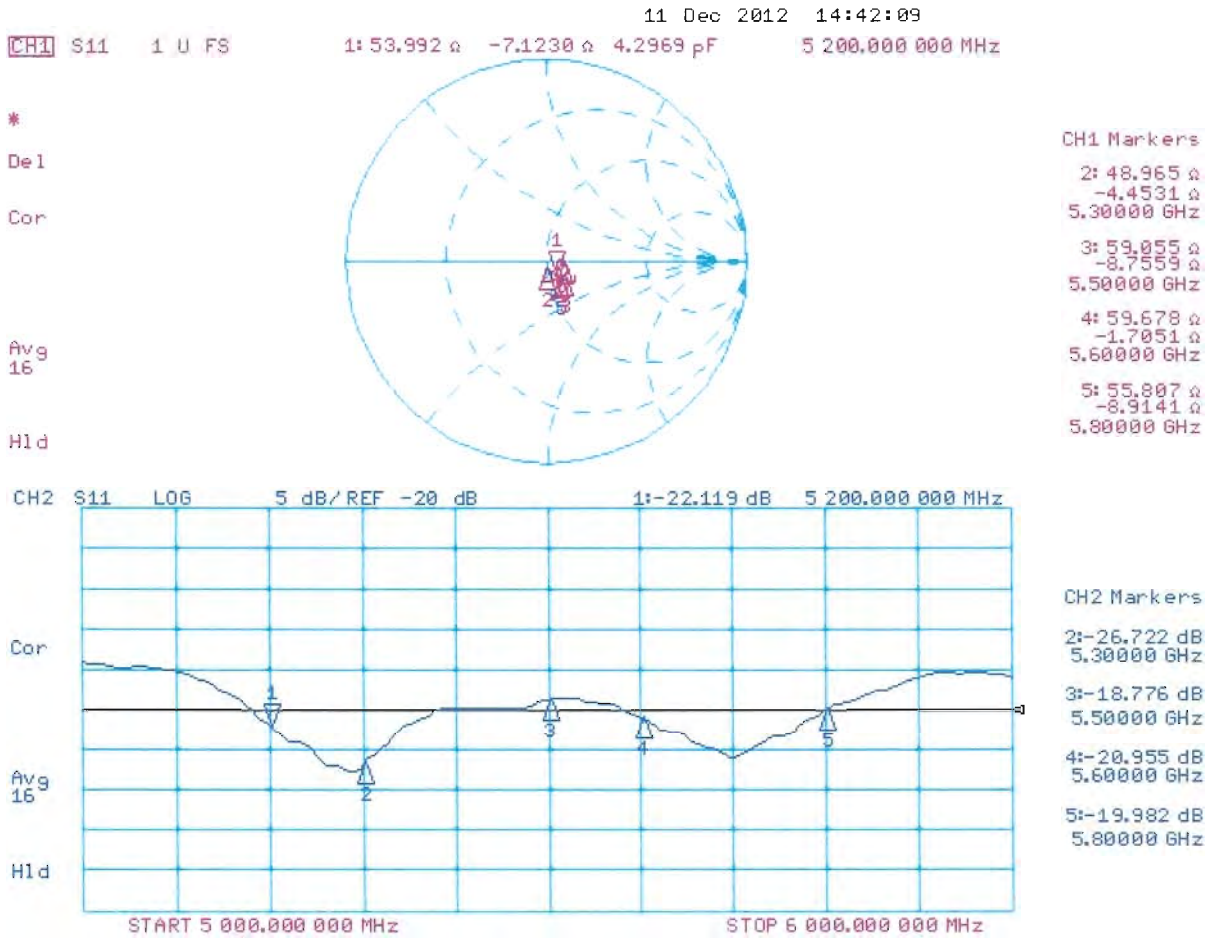
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.574 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.1 W/kg
SAR(1 g) = 8.41 W/kg; SAR(10 g) = 2.4 W/kg
Maximum value of SAR (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



DASY5 Validation Report for Body TSL

Date: 10.12.2012

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; σ = 5.4 mho/m; ε_r = 47.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.51 mho/m; ε_r = 46.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.76 mho/m; ε_r = 46.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.88 mho/m; ε_r = 46.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.17 mho/m; ε_r = 46.1; ρ = 1000 kg/m^3
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)

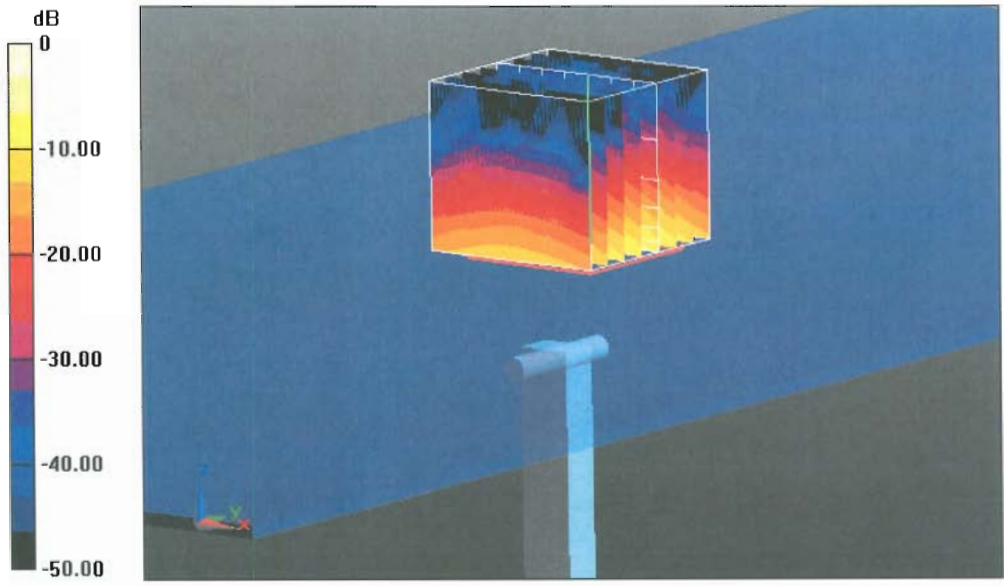
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.320 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 7.2 W/kg; SAR(10 g) = 2.02 W/kg
Maximum value of SAR (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

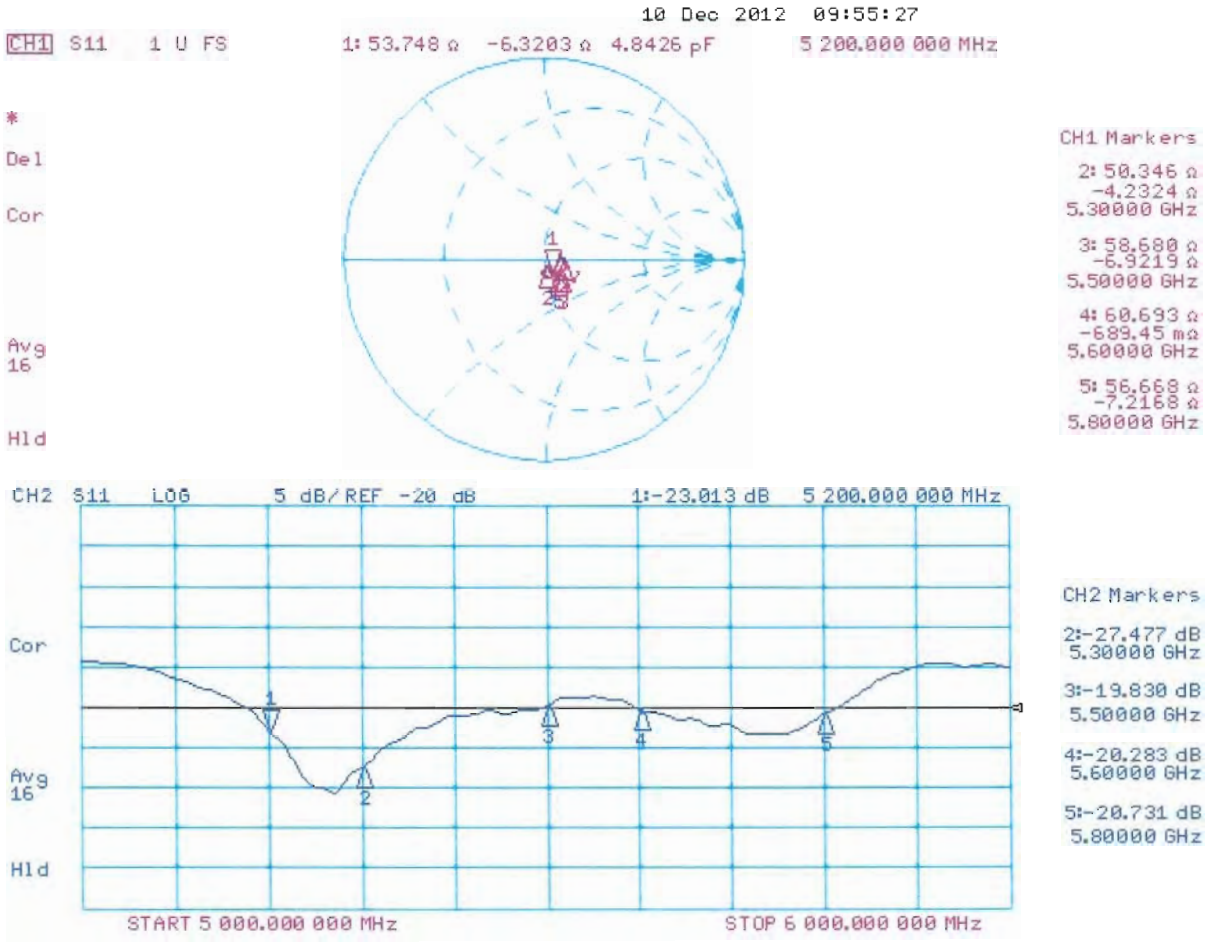
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.041 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 34.3 W/kg
SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.14 W/kg
Maximum value of SAR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



0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Body TSL



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

G.1 Power Tuning Targets

Tuning targets GSM850			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	32.5	32.5	32.5
GPRS 2-slot	30.5	30.5	30.5
GPRS 3-slot	28.5	28.5	28.5
GPRS 4-slot	27.5	27.5	27.5
EGRPS 1-slot	26.5	26.5	26.5
EGPRS 2-slot	26.0	26.0	26.0
EGRPS 3-slot	25.0	25.0	25.0
EGPRS 4-slot	24.0	24.0	24.0

Tuning targets GSM1900			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	30.0	30.0	30.0
GPRS 2-slot	27.5	27.5	27.5
GPRS 3-slot	25.5	25.5	25.5
GPRS 4-slot	24.5	24.5	24.5
EGRPS 1-slot	25.5	25.5	25.5
EGPRS 2-slot	25.0	25.0	25.0
EGRPS 3-slot	24.0	24.0	24.0
EGPRS 4-slot	23.0	23.0	23.0

Tuning targets GSM1900 in WR mode			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	30.0	30.0	30.0
GPRS 2-slot	26.7	26.7	26.7
GPRS 3-slot	24.7	24.7	24.7
GPRS 4-slot	23.7	23.7	23.7
EGRPS 1-slot	25.5	25.5	25.5
EGPRS 2-slot	25.0	25.0	25.0
EGRPS 3-slot	24.0	24.0	24.0
EGPRS 4-slot	23.0	23.0	23.0

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

Type: RM-892; Serial number: 004402/47/223451/1 used for GSM/GPRS/EGPRS850 for SAR Head, Body-worn measurements and Wireless Router mode testing

Type: RM-892; Serial number: 004402/47/223453/7 used for GSM/GPRS/EGPRS1900 for SAR Head and Body-worn measurements.

GSM850			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	33.43	33.10	33.47
GPRS 2-slot	31.38	31.33	31.28
GPRS 3-slot	29.57	29.42	29.57
GPRS 4-slot	28.62	28.44	28.56
EGRPS 1-slot	27.48	27.46	27.41
EGPRS 2-slot	26.94	26.91	26.83
EGRPS 3-slot	26.34	26.23	26.18
EGPRS 4-slot	25.23	25.10	25.03

GSM1900			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	30.70	30.93	31.03
GPRS 2-slot	28.54	28.56	28.53
GPRS 3-slot	26.55	26.69	26.81
GPRS 4-slot	25.60	25.64	25.70
EGRPS 1-slot	26.82	27.02	26.95
EGPRS 2-slot	26.36	26.43	26.46
EGRPS 3-slot	25.27	25.43	25.40
EGPRS 4-slot	23.88	24.03	23.96

Type: RM-892; Serial number: 004402/47/223437/0 used for GSM/GPRS/EGPRS1900 Wireless Router mode testing.

GSM1900 in WR mode			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	30.49	30.46	30.55
GPRS 2-slot	27.22	27.48	27.24
GPRS 3-slot	25.25	25.49	25.25
GPRS 4-slot	24.38	24.39	24.28
EGRPS 1-slot	26.60	26.74	26.60
EGPRS 2-slot	25.61	25.63	25.51
EGRPS 3-slot	25.13	25.22	25.06
EGPRS 4-slot	24.11	24.20	24.03

APPENDIX H: CONDUCTED POWER MEASUREMENTS FOR SUPPORTED WCDMA TRANSMISSION MODES

H.1 Power Tuning Targets

Tuning targets			
Mode	Low channel	Mid channel	High channel
WCDMA850	23.5	23.5	23.5
WCDMA1900	23.5	23.5	23.5

Tuning targets in WR mode			
Mode	Low channel	Mid channel	High channel
WCDMA1900	20.2	20.2	20.2

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

Type: RM-892; Serial number: 004402/47/223451/1used for WCDMA850 for SAR Head and Body-worn and Wireless router measurements

Type: RM-892; Serial number: 004402/47/223453/7 used for WCDMA1900 for SAR Head and Body-worn measurements

WCDMA850 (Band 5)			
Mode	Low channel	Mid channel	High channel
WCDMA	24.00	24.16	24.12

WCDMA1900 (Band 2)			
Mode	Low channel	Mid channel	High channel
WCDMA	23.99	24.31	24.23

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

Type: RM-892; Serial number: 004402/47/223437/0 used for WCDMA1900 Wireless Router mode testing.

WCDMA1900 (Band 2) in WR mode			
Mode	Low channel	Mid channel	High channel
WCDMA	20.76	21.04	20.72

APPENDIX I: CONDUCTED POWER RESULTS FOR WLAN2450 AND WLAN5000

I.1 Power Tuning Targets

WLAN 2.4 GHz: 20 MHz channel bandwidth							
			Tuning target				
Standard	Modulation	Data speed [MBPS]	CH 1	CH 2	CH 6	CH 10	CH 11
802.11b	BPSK	1	16.0	16.0	16.0	16.0	16.0
802.11b	QPSK	2	15.5	15.5	15.5	15.5	15.5
802.11b	QPSK	5.5	15.5	15.5	15.5	15.5	15.5
802.11b	QPSK	11	15.5	15.5	15.5	15.5	15.5
802.11g	BPSK	6	16.0	16.0	16.0	16.0	16.0
802.11g	BPSK	9	15.5	15.5	15.5	15.5	15.5
802.11g	QPSK	12	15.5	15.5	15.5	15.5	15.5
802.11g	QPSK	18	15.5	15.5	15.5	15.5	15.5
802.11g	16QAM	24	15.0	15.0	15.0	15.0	15.0
802.11g	16QAM	36	15.0	15.0	15.0	15.0	15.0
802.11g	64QAM	48	14.0	14.0	14.0	14.0	14.0
802.11g	64QAM	54	13.0	13.0	13.0	13.0	13.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	19.5 / 21.7	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	14.0	14.0	14.0	14.0	14.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	58.5 / 65.0	13.0	13.0	13.0	13.0	13.0
802.11n	64QAM	65.0 / 72.2	12.0	12.0	12.0	12.0	12.0

RLAN 5 GHz / 20 MHz channel bandwidth: TUNING TARGETS									
Standard	Modulation	Data speed [MBPS]	Channel						
			36	40	44	48	52	56	60	64
802.11a	BPSK	6	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
802.11a	BPSK	9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	QPSK	12	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	QPSK	18	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	64QAM	48	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	54	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	19.5 / 21.7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	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	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	256QAM	78.0 / 86.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(Tuning targets for WLAN 5 GHz continues)

(Tuning targets for WLAN 5 GHz continues)

RLAN 5 GHz / 20 MHz channel bandwidth: TUNING TARGETS										
Standard	Modulation	Data speed [MBPS]	Channel							
			100	104	108	112	116	120	124	128
802.11a	BPSK	6	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
802.11a	BPSK	9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	QPSK	12	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	QPSK	18	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	64QAM	48	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	54	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	19.5 / 21.7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	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	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	256QAM	78.0 / 86.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(Tuning targets for WLAN 5 GHz continues)

(Tuning targets for WLAN 5 GHz continues)

RLAN 5 GHz / 20 MHz channel bandwidth: TUNING TARGETS										
Standard	Modulation	Data speed [MBPS]	Channel							
			132	136	140	149	153	157	161	165
802.11a	BPSK	6	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
802.11a	BPSK	9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	QPSK	12	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	QPSK	18	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11a	16QAM	24	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	16QAM	36	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11a	64QAM	48	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
802.11a	64QAM	54	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
802.11n	BPSK	6.5 / 7.25	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	13.0 / 14.4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	QPSK	19.5 / 21.7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
802.11n	16QAM	26.0 / 28.9	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	16QAM	39.0 / 43.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	64QAM	52.0 / 57.8	13.0	13.0	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	12.0	12.0
802.11n	64QAM	65.0 / 72.2	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	256QAM	78.0 / 86.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(Tuning targets for WLAN 5 GHz continues)

(Tuning targets for WLAN 5 GHz continues)

RLAN 5 GHz / 40 MHz channel bandwidth: TUNING TARGETS									
Standard	Modulation	Data speed [MBPS]	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	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	QPSK	27.0 / 30.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	QPSK	40.5 / 45.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
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	14.0	14.0	14.0	14.0	14.0	14.0	14.0
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	11.0	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	256QAM	162 / 180	0.0	0.0	0.0	0.0	0.0	0.0	0.0
802.11ac	256QAM	180 / 200	0.0	0.0	0.0	0.0	0.0	0.0	0.0

RLAN 5 GHz / 40 MHz channel bandwidth: TUNING TARGETS									
Standard	Modulation	Data speed [MBPS]	102 (100+104)	106 (104+108)	110 (108+112)	114 (112+116)	118 (116+120)	122 (120+124)	126 (124+128)
802.11n	BPSK	13.5 / 15.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	QPSK	27.0 / 30.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	QPSK	40.5 / 45.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
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	14.0	14.0	14.0	14.0	14.0	14.0	14.0
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	11.0	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	256QAM	162 / 180	0.0	0.0	0.0	0.0	0.0	0.0	0.0
802.11ac	256QAM	180 / 200	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(Tuning targets for WLAN 5 GHz continues)

(Tuning targets for WLAN 5 GHz continues)

RLAN 5 GHz / 40 MHz channel bandwidth: TUNING TARGETS									
Standard	Modulation	Data speed [MBPS]	130 (128+132)	134 (132+136)	138 (136+140)	151 (149+153)	155 (153+157)	159 (157+161)	163 (161+165)
802.11n	BPSK	13.5 / 15.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	QPSK	27.0 / 30.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
802.11n	QPSK	40.5 / 45.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
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	14.0	14.0	14.0	14.0	14.0	14.0	14.0
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	11.0	11.0	11.0	11.0	11.0	11.0	11.0
802.11ac	256QAM	162 / 180	0.0	0.0	0.0	0.0	0.0	0.0	0.0
802.11ac	256QAM	180 / 200	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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

Type: RM-892; Serial number: 004402/47/223449/5 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 10	CH 11
802.11b	BPSK	1	16.17	16.44	16.35	16.40	16.58
802.11b	QPSK	2	15.79	15.79	15.71	16.09	15.89
802.11b	QPSK	5.5	15.64	15.98	15.76	16.21	16.03
802.11b	QPSK	11	15.89	15.78	16.24	15.90	15.91
802.11g	BPSK	6	16.00	16.01	16.22	15.89	16.12
802.11g	BPSK	9	15.30	15.55	15.73	15.78	15.59
802.11g	QPSK	12	15.24	15.48	15.61	15.84	15.77
802.11g	QPSK	18	15.69	15.70	15.34	15.44	15.46
802.11g	16QAM	24	15.35	15.42	15.48	15.29	15.09
802.11g	16QAM	36	14.88	14.97	15.40	15.17	15.39
802.11g	64QAM	48	14.06	13.80	13.99	14.47	14.34
802.11g	64QAM	54	13.38	13.24	13.49	13.11	13.63
802.11n	BPSK	6.5 / 7.25	15.02	15.42	14.97	15.01	15.08
802.11n	QPSK	13.0 / 14.4	15.33	15.05	15.15	15.38	15.19
802.11n	QPSK	19.5 / 21.7	15.44	14.78	15.48	14.97	15.36
802.11n	16QAM	26.0 / 28.9	14.24	14.27	13.95	14.57	14.04
802.11n	16QAM	39.0 / 43.3	14.11	14.09	14.38	14.26	13.94
802.11n	64QAM	52.0 / 57.8	13.38	13.01	13.13	13.10	13.17
802.11n	64QAM	58.5 / 65.0	13.32	13.09	13.31	13.12	13.16
802.11n	64QAM	65.0 / 72.2	12.44	12.29	12.14	12.31	12.04

Type: RM-892; Serial number: 004402/47/223426/3 used for WLAN5000 for SAR Head and Body-worn measurements.

RLAN 5 GHz / 20 MHz channel bandwidth:										
Standard	Modulation	Data speed [MBPS]	Channel							
			36	40	44	48	52	56	60	64
802.11a	BPSK	6	16.22	16.25	16.27	16.53	16.34	16.61	16.24	16.44
802.11a	BPSK	9	15.67	16.02	15.95	15.99	16.16	15.73	16.08	15.58
802.11a	QPSK	12	16.10	15.78	15.55	15.58	15.54	15.93	15.81	15.68
802.11a	QPSK	18	15.97	16.05	15.48	15.87	15.96	16.03	15.68	15.83
802.11a	16QAM	24	14.50	15.01	14.77	14.48	14.62	14.59	14.91	14.59
802.11a	16QAM	36	14.62	15.03	14.90	14.41	14.56	14.75	14.75	14.70
802.11a	64QAM	48	13.98	13.68	13.75	14.00	13.90	13.87	14.06	13.50
802.11a	64QAM	54	12.96	12.98	12.41	12.42	12.45	12.80	12.57	12.41
802.11n	BPSK	6.5 / 7.25	15.50	15.72	15.73	15.51	15.70	15.24	15.34	15.53
802.11n	QPSK	13.0 / 14.4	14.31	14.37	14.92	15.82	15.17	15.31	15.75	15.79
802.11n	QPSK	19.5 / 21.7	15.07	14.46	15.01	15.52	15.83	15.22	15.25	15.38
802.11n	16QAM	26.0 / 28.9	14.54	14.50	15.06	14.47	14.81	14.30	14.33	14.24
802.11n	16QAM	39.0 / 43.3	15.08	14.61	15.07	14.52	14.52	14.67	14.49	14.42
802.11n	64QAM	52.0 / 57.8	14.52	14.30	14.55	13.56	13.11	13.56	13.73	13.66
802.11n	64QAM	58.5 / 65.0	13.90	13.32	14.06	12.67	12.75	12.56	12.65	12.15
802.11n	64QAM	65.0 / 72.2	12.29	12.86	12.53	11.45	11.25	11.36	11.16	11.31
802.11ac	256QAM	78.0 / 86.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(Conducted powers for WLAN 5 GHz continues)

(Conducted powers for WLAN 5 GHz continues)

RLAN 5 GHz / 20 MHz channel bandwidth:									
Standard	Modulation	Data speed [MBPS]	Channel						
			100	104	108	112	116	120	124	128
802.11a	BPSK	6	16.11	16.14	16.28	16.49	16.61	16.73	16.17	16.58
802.11a	BPSK	9	15.88	16.06	15.86	15.62	16.12	15.79	15.85	16.15
802.11a	QPSK	12	15.86	15.89	15.71	15.76	15.99	16.17	15.61	16.05
802.11a	QPSK	18	15.73	16.00	15.82	16.22	15.57	15.78	15.63	15.82
802.11a	16QAM	24	14.58	14.61	14.52	14.76	14.73	14.78	14.58	15.08
802.11a	16QAM	36	14.99	15.07	15.09	14.71	14.71	15.11	14.61	15.01
802.11a	64QAM	48	13.80	13.89	13.60	13.56	14.07	14.03	13.98	13.71
802.11a	64QAM	54	12.66	12.46	12.71	13.05	12.65	12.62	12.90	12.47
802.11n	BPSK	6.5 / 7.25	15.66	15.70	15.25	15.81	15.74	15.77	15.89	15.74
802.11n	QPSK	13.0 / 14.4	15.68	15.22	15.81	15.88	15.46	15.84	15.27	15.91
802.11n	QPSK	19.5 / 21.7	15.64	15.64	15.43	15.25	15.77	15.67	15.68	15.33
802.11n	16QAM	26.0 / 28.9	14.88	14.36	14.29	14.69	14.45	14.27	14.80	14.45
802.11n	16QAM	39.0 / 43.3	14.61	14.35	14.55	14.64	14.47	14.74	14.41	14.62
802.11n	64QAM	52.0 / 57.8	13.21	13.82	13.74	13.19	13.40	13.48	13.28	13.86
802.11n	64QAM	58.5 / 65.0	12.67	12.82	12.78	12.80	12.54	12.30	12.92	12.55
802.11n	64QAM	65.0 / 72.2	11.35	11.90	11.46	11.30	11.36	11.94	11.25	11.72
802.11ac	256QAM	78.0 / 86.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(Conducted powers for WLAN 5 GHz continues)

(Conducted powers for WLAN 5 GHz continues)

RLAN 5 GHz / 20 MHz channel bandwidth:										
Standard	Modulation	Data speed [MBPS]	Channel							
			132	136	140	149	153	157	161	165
802.11a	BPSK	6	16.30	16.59	16.47	16.75	16.75	16.49	16.76	16.30
802.11a	BPSK	9	15.65	15.69	15.85	16.21	15.79	15.92	16.30	15.98
802.11a	QPSK	12	16.25	16.04	16.09	15.67	15.85	15.84	15.96	15.96
802.11a	QPSK	18	16.06	15.75	16.10	15.85	16.20	16.05	15.83	15.97
802.11a	16QAM	24	15.05	14.77	14.88	14.89	15.07	14.94	14.70	14.82
802.11a	16QAM	36	14.51	14.73	14.85	14.85	15.19	15.11	14.75	14.86
802.11a	64QAM	48	13.66	14.16	14.03	13.83	13.76	13.72	13.70	13.94
802.11a	64QAM	54	12.69	12.94	13.02	13.07	13.03	12.94	13.12	12.76
802.11n	BPSK	6.5 / 7.25	15.43	15.76	15.41	15.88	15.69	15.44	15.58	15.61
802.11n	QPSK	13.0 / 14.4	15.93	15.42	15.39	15.32	15.72	15.81	15.98	15.74
802.11n	QPSK	19.5 / 21.7	15.66	15.38	15.45	15.83	15.79	15.41	15.76	15.57
802.11n	16QAM	26.0 / 28.9	14.59	14.31	14.64	14.71	14.93	14.97	14.43	14.46
802.11n	16QAM	39.0 / 43.3	14.92	14.80	14.40	14.45	14.70	14.84	14.64	14.56
802.11n	64QAM	52.0 / 57.8	13.41	13.54	13.29	13.67	13.62	13.82	13.71	13.37
802.11n	64QAM	58.5 / 65.0	12.84	12.92	12.26	12.55	12.90	12.45	12.67	12.79
802.11n	64QAM	65.0 / 72.2	11.46	11.94	11.76	11.72	11.82	11.38	11.93	11.95
802.11ac	256QAM	78.0 / 86.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(Conducted powers for WLAN 5 GHz continues)

(Conducted powers for WLAN 5 GHz continues)

RLAN 5 GHz / 40 MHz channel bandwidth:									
Standard	Modulation	Data speed [MBPS]	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	14.37	14.85	14.18	14.56	14.29	14.86	14.90
802.11n	QPSK	27.0 / 30.0	14.41	14.96	14.29	14.39	14.91	14.36	14.99
802.11n	QPSK	40.5 / 45.0	14.86	14.41	14.86	14.38	14.85	14.75	14.29
802.11n	16QAM	54.0 / 60.0	14.55	14.61	14.88	14.84	14.58	14.54	14.15
802.11n	16QAM	81.0 / 90.0	14.28	14.88	14.94	14.14	14.30	14.51	14.42
802.11n	64QAM	108.0 / 120.0	13.55	13.39	13.21	13.25	13.15	13.19	13.83
802.11n	64QAM	121.5 / 135.0	12.47	12.33	12.42	12.48	12.12	12.60	12.35
802.11n	64QAM	135.0 / 150.0	11.90	11.38	11.84	11.12	11.11	11.71	11.87
802.11ac	256QAM	162 / 180	0.00	0.00	0.00	0.00	0.00	0.00	0.00
802.11ac	256QAM	180 / 200	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RLAN 5 GHz / 40 MHz channel bandwidth:									
Standard	Modulation	Data speed [MBPS]	102 (100+104)	106 (104+108)	110 (108+112)	114 (112+116)	118 (116+120)	122 (120+124)	126 (124+128)
802.11n	BPSK	13.5 / 15.0	14.17	14.96	14.72	14.54	14.91	14.31	14.91
802.11n	QPSK	27.0 / 30.0	14.50	14.97	15.01	14.23	14.59	14.17	14.72
802.11n	QPSK	40.5 / 45.0	14.55	14.29	14.34	14.20	14.85	14.52	14.59
802.11n	16QAM	54.0 / 60.0	14.83	14.18	14.67	14.37	14.22	14.98	14.34
802.11n	16QAM	81.0 / 90.0	14.67	14.26	14.36	14.26	14.92	14.71	14.88
802.11n	64QAM	108.0 / 120.0	13.78	13.70	13.13	13.18	13.51	13.46	13.36
802.11n	64QAM	121.5 / 135.0	12.73	12.54	12.76	12.55	12.32	12.75	12.16
802.11n	64QAM	135.0 / 150.0	11.50	11.98	11.86	11.94	11.63	11.95	11.67
802.11ac	256QAM	162 / 180	0.00	0.00	0.00	0.00	0.00	0.00	0.00
802.11ac	256QAM	180 / 200	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(Conducted powers for WLAN 5 GHz continues)

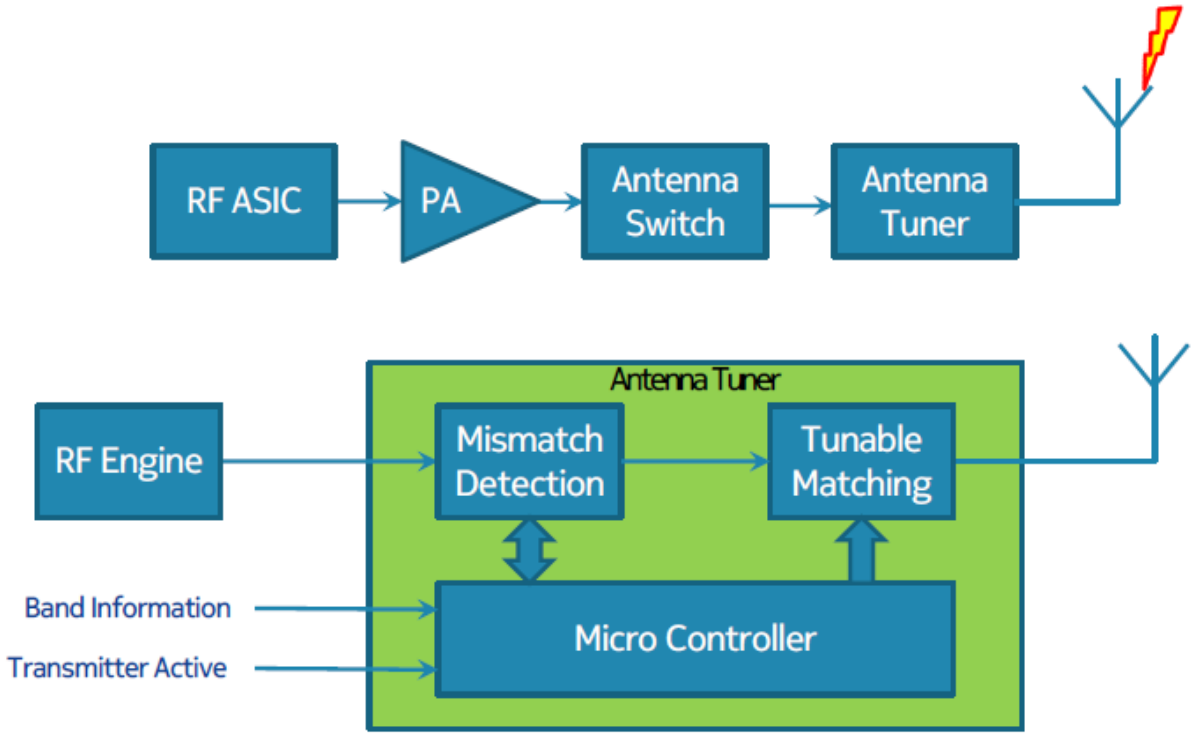
(Conducted powers for WLAN 5 GHz continues)

RLAN 5 GHz / 40 MHz channel bandwidth:									
Standard	Modulation	Data speed [MBPS]	130 (128+132)	134 (132+136)	138 (136+140)	151 (149+153)	155 (153+157)	159 (157+161)	163 (161+165)
802.11n	BPSK	13.5 / 15.0	14.27	14.38	14.41	14.25	15.07	14.57	14.55
802.11n	QPSK	27.0 / 30.0	14.19	14.43	14.35	15.07	14.68	14.65	14.33
802.11n	QPSK	40.5 / 45.0	14.21	14.84	14.21	14.34	14.98	14.83	14.89
802.11n	16QAM	54.0 / 60.0	15.01	14.42	14.93	14.75	14.24	15.02	14.84
802.11n	16QAM	81.0 / 90.0	14.41	14.49	14.38	14.36	14.27	14.44	14.44
802.11n	64QAM	108.0 / 120.0	13.27	13.98	13.98	13.36	13.76	13.85	13.84
802.11n	64QAM	121.5 / 135.0	12.77	12.31	12.52	12.50	12.41	12.59	12.84
802.11n	64QAM	135.0 / 150.0	11.54	11.72	11.21	11.77	11.33	11.40	11.98
802.11ac	256QAM	162 / 180	0.00	0.00	0.00	0.00	0.00	0.00	0.00
802.11ac	256QAM	180 / 200	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX J: ANTENNA TUNER STATE VS. SAR COMPARATIVE MEASUREMENTS

Antenna Tuner

- Antenna tuner is used to match the antenna feedpoint impedance to transmitter output.
- Antenna tuner does not improve the antenna radiated efficiency.
- Antenna tuner only reduces the mismatch loss between transmitter and antenna.
- Reducing the loss between transmitter and antenna can increase radiated output power and that way keep the call ongoing.



- Antenna tuner needs information from engine about current frequency band and also information when engine is transmitting.
- Antenna tuner measures the mismatch condition.
- Micro controller selects the correct matching network components according measured mismatch information.

Supported state = tuner states that are initially possible for the given frequency band and communications system.

Selected state = optimal tuner state that gets selected when device is positioned in the SAR test setup.

Results show that maximum, or equal to maximum, powers are always transmitted and conservative maximum SAR results are obtained.

Test cases in table below are the ones giving highest SAR results in this report.

= Supported states
= Selected state

WCDMA1900 WR bottom edge 10mm

Shunt mode	Series state	mW/g	% from ref
0	2	1,20	-2,68
0	3	1,21	-1,54
0	4	1,21	-1,46
0	5	1,22	-0,81
0	6	1,24	0,57
0	7	1,24	0,98
0	8	1,25	1,71
0	9	1,25	1,54
0	10	1,23	0,00
1	0	0,83	-32,93
1	1	0,90	-26,67
1	2	0,93	-24,31
1	3	0,94	-23,33
1	4	0,95	-22,93
1	5	0,96	-21,71
1	6	0,92	-25,28

WCDMA1900 Body back 15mm w/o headset

Shunt mode	Series state	mW/g	% from ref
0	2	0,71	-0,98
0	3	0,72	0,00
0	4	0,72	1,12
0	5	0,73	2,10
0	6	0,72	0,00
0	7	0,72	0,84
0	8	0,72	1,12
0	9	0,73	1,82
0	10	0,72	0,00
1	0	0,56	-21,54
1	1	0,59	-17,48
1	2	0,61	-15,38
1	3	0,61	-14,83
1	4	0,62	-13,15
1	5	0,62	-12,87
1	6	0,60	-15,52

WCDMA1900 head left cheek

Shunt mode	Series state	mW/g	% from ref
0	2	1,02	-9,47
0	3	1,04	-7,61
0	4	1,07	-5,66
0	5	1,11	-2,12
0	6	1,09	-3,89
0	7	1,11	-2,21
0	8	1,11	-2,04
0	9	1,13	-0,44
0	10	1,13	0,00
1	0	0,72	-36,37
1	1	0,83	-26,73
1	2	0,89	-21,50
1	3	0,91	-19,73
1	4	0,94	-16,90
1	5	0,94	-16,81
1	6	0,91	-19,82

WCDMA850 WR back 10mm

Shunt mode	Series state	scaled mW/g	% from ref
0	1	0,33	-53,94
0	2	0,46	-35,49
0	3	0,50	-29,01
0	4	0,61	-14,65
0	5	0,64	-9,86
0	6	0,67	-6,34
0	7	0,67	-5,77
0	8	0,62	-13,10
0	9	0,60	-16,06
0	10	0,49	-31,27
2	2	0,58	-18,73
2	3	0,62	-13,38
2	4	0,70	-1,13
2	5	0,71	0,56
2	6	0,71	0,00
2	7	0,72	1,69

GPRS850 Body back 15mm w/o headset

Shunt mode	Series state	mW/g	% from ref
0	1	0,24	-64,58
0	2	0,39	-41,67
0	3	0,46	-31,70
0	4	0,62	-8,18
0	5	0,66	-1,64
0	6	0,67	-0,15
0	7	0,66	-2,38
0	8	0,50	-25,89
0	9	0,47	-30,80
0	10	0,33	-51,19
2	2	0,49	-27,08
2	3	0,55	-18,01
2	4	0,65	-3,27
2	5	0,67	0,00
2	6	0,65	-3,57
2	7	0,65	-4,02
2	8	0,50	-25,60

GPRS850 4-slot head right cheek

Shunt mode	Series state	mW/g	% from ref
0	1	0,28	-61,73
0	2	0,44	-40,97
0	3	0,52	-29,38
0	4	0,71	-4,45
0	5	0,75	0,81
0	6	0,75	0,67
0	7	0,72	-3,64
0	8	0,54	-27,22
0	9	0,50	-32,88
0	10	0,37	-50,67
2	2	0,60	-19,81
2	3	0,66	-11,59
2	4	0,74	0,00
2	5	0,75	1,62
2	6	0,70	-5,39
2	7	0,68	-8,63
2	8	0,56	-25,20

APPENDIX K (INFORMATIVE): ADDRESSING CONCERNS ON PA LINEARITY ABOVE UPPER LIMIT OF TUNING TOLERANCE

The conducted powers of SAR samples tested in this report are above upper limit of tuning tolerance. While this power over-tuning gives conservative SAR results, it is not fully according to KDB requirements and has raised concerns on PA linearity above upper limit of tuning tolerance during KDB Inquiry process. To address these concerns, this appendix presents re-measurements of worst case SAR for each communication system and exposure configuration at power levels below upper limit of tuning tolerance. These re-measured values are scaled to same conducted powers as used in this reporting. Results show that scaled results are close to the original ones i.e. well within measurement uncertainty, confirming that PA operates linearly and that SAR results presented in this SAR report are conservative. SAR system check results and liquid parameters are also included to prove that repeated measurements are done in full compliance to the requirements.

K.1. System validation status

Probe Calibration Point f / MHz	Test System	DASY SW	Dipole Type / SN	Probe Type / SN	DAE unit Type / SN	Validation done	
						Head tissue simulant	Body tissue simulant
835	TCC Salo / SAR-3	V52.8	D835V2 / 480	ES3DV4 / 3165	DAE4 / 1355	2013-05	2013-05
1900	TCC Salo / SAR-1	V52.8	D1900V2 / 5d013	ES3DV3 / 3194	DAE4 / 538	2013-05	2013-05

K.2. System checking

System checking, head tissue simulant

f[MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		SAR 1g Deviation from target	Dielectric Parameters Deviation from target		Temp
			ε_r	σ [S/m]	dSAR [%]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	[°C]
	Tolerances				±10 %	±5 %	±5 %	
	IEEE1528 / IEC62209		41.5	0.90				
	Reference result SN:480	2.39	41.4	0.92	TCC Salo/SAR-3 ES3DV4 SN:3165 Head 835MHz			
835	2013-06-27	2.28	40.9	0.93	-4.60	-1.21	1.09	22.5
	IEEE1528 / IEC62209		40.0	1.40				
	Reference result SN:5d013	10.1	39.5	1.38	TCC Salo/SAR-1 ES3DV3 SN:3194 Head 1900MHz			
1900	2013-06-27	10.5	39.4	1.38	3.96	-0.25	0.00	22.4

System checking, body tissue simulant

f[MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		SAR 1g Deviation from target	Dielectric Parameters Deviation from target		Temp
			ε_r	σ [S/m]	dSAR [%]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	[°C]
	Deviation of tolerances				±10 %	±5 %	±5 %	
	IEEE1528 / IEC62209		55.2	0.97				
	Reference result SN:480	2.42	54.5	0.99	TCC Salo/SAR-3 ES3DV4 SN:3165 Body 835MHz			
835	2013-06-27	2.28	53.6	0.99	-5.79	-1.65	0.00	22.4
	IEEE1528 / IEC62209		53.3	1.52				
	Reference result SN:5d013	10.3	52.2	1.52	TCC Salo/SAR-1 ES3DV3 SN:3194 Body 1900MHz			
1900	2013-06-27	10.4	52.5	1.53	0.97	0.57	0.66	20.7

K.3. Tissue Simulants

Head tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Dielectric Parameters Deviation from Standard target		Temp [°C]
		ε_r	σ [S/m]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	
	Tolerances			±5 %	±5 %	
	Recommended value	41.5	0.90			
835	2013-06-27	40.9	0.93	-1.45	3.33	22.5
	Recommended value	41.5	0.90			
836	2013-06-27	40.9	0.93	-1.45	3.33	22.5
	Recommended value	40.0	1.40			
1880	2013-06-27	39.4	1.36	-1.50	-2.86	22.4

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Dielectric Parameters Deviation from Standard target		Temp [°C]
		ε_r	σ [S/m]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	
	Tolerances			±5 %	±5 %	
	Recommended value	55.2	0.97			
835	2013-06-27	53.6	0.99	-2.90	2.06	22.4
	Recommended value	55.2	0.97			
836	2013-06-27	53.6	0.99	-2.90	2.06	22.4
	Recommended value	53.3	1.52			
1880	2013-06-27	52.5	1.51	-1.50	-0.66	20.7

K.4. Results

Mode	Device orientation	Ch / f (MHz)	Window between {tuning target} and {tuning target} + 0.35dB	Conducted power - original [dBm]	Measured 1g SAR - original [W/kg]	Conducted power - reduced [dBm]	Measured 1g SAR - reduced [W/kg]	dCond. powers [dB]	Scaling factor [Lin]	Scaled SAR [W/kg]	dSAR [%]
4-slot GPRS850	Right, Cheek	251 / 848.8	27.5 - 27.85	28.56	**0.742**	27.76	0.561	0.80	1.20	**0.674**	**9.10**
WCDMA850	Right, Cheek	4233 / 846.6	23.5 - 23.85	24.12	**0.642**	23.72	0.516	0.40	1.10	**0.566**	**11.87**
2-slot GPRS1900	Left, Cheek	810 / 1909.8	27.5 - 27.85	28.53	**0.643**	27.63	0.500	0.90	1.23	**0.615**	**4.33**
WCDMA1900	Left, Cheek	9538 / 1907.6	23.5 - 23.85	24.23	**1.13**	23.73	0.945	0.50	1.12	**1.06**	**6.17**
4-slot GPRS850	Body 15.0 mm	251 / 848.8	27.5 - 27.85	28.56	**0.672**	27.76	0.552	0.80	1.20	**0.664**	**1.24**
WCDMA850	Body 15.0 mm	4175 / 835.0	23.5 - 23.85	24.16	**0.518**	23.76	0.470	0.40	1.10	**0.515**	**0.51**
2-slot GPRS1900	Body 15.0 mm	512 / 1850.2	27.5 - 27.85	28.54	**0.249**	27.64	0.199	0.90	1.23	**0.245**	**1.68**
WCDMA1900	Body 15.0 mm	9400 / 1880.0	23.5 - 23.85	24.31	**0.715**	23.81	0.555	0.50	1.12	**0.623**	**12.91**
4-slot GPRS850	Body 10.0 mm	251 / 848.8	27.5 - 27.85	28.56	**0.886**	27.76	0.680	0.80	1.20	**0.818**	**7.73**
WCDMA850	Body 10.0 mm	4233 / 846.6	23.5 - 23.85	24.12	**0.712**	23.72	0.691	0.40	1.10	**0.758**	**-6.41**
GSM1900	Body 10.0 mm	512 / 1850.2	30.0 - 30.35	30.49	**1.05**	30.19	0.886	0.30	1.07	**0.949**	**9.58**
WCDMA1900	Body 10.0 mm	9262 / 1852.4	20.2 - 20.55	20.76	**1.23**	20.26	1.05	0.50	1.12	**1.18**	**4.22**