

DASY5 Validation Report for Head TSL

Date: 08.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1097

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 41.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.49, 10.49, 10.49); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

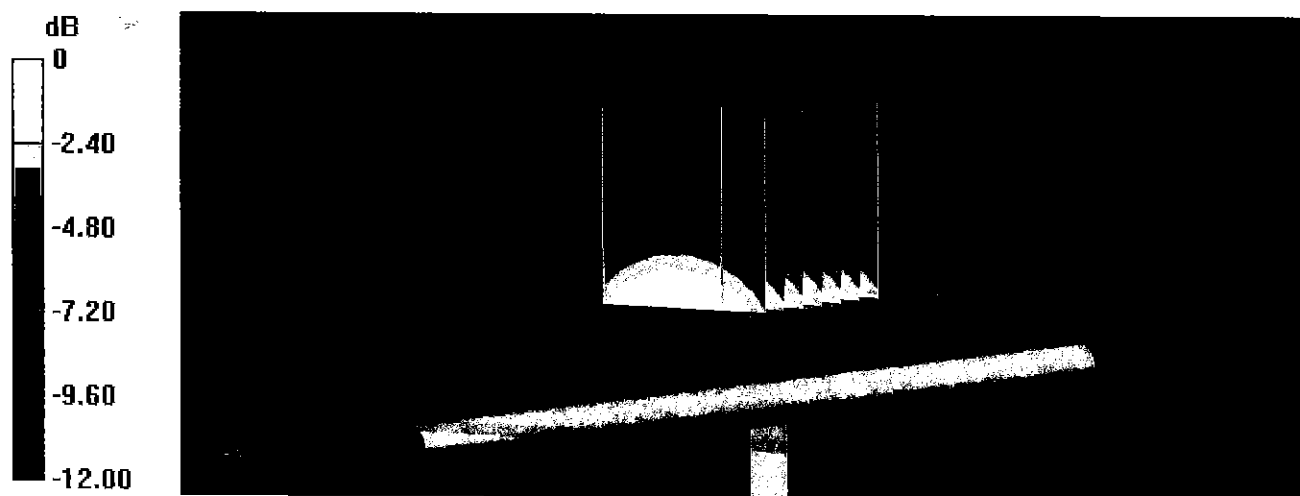
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.59 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

SAR(1 g) = 2.08 W/kg; SAR(10 g) = 1.36 W/kg

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



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL

8 Sep 2017 13:09:24
 CH1 S11 1 U FS 1: 54.383 Ω -552.73 m Ω 383.92 pF 750.000 000 MHz

*

De1

CA

Avg
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.463 dB 750.000 000 MHz

CA

Avg
16

H1d

START 550.000 000 MHz

STOP 950.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 08.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1097

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.96 \text{ S/m}$; $\epsilon_r = 55.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.35, 10.35, 10.35); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

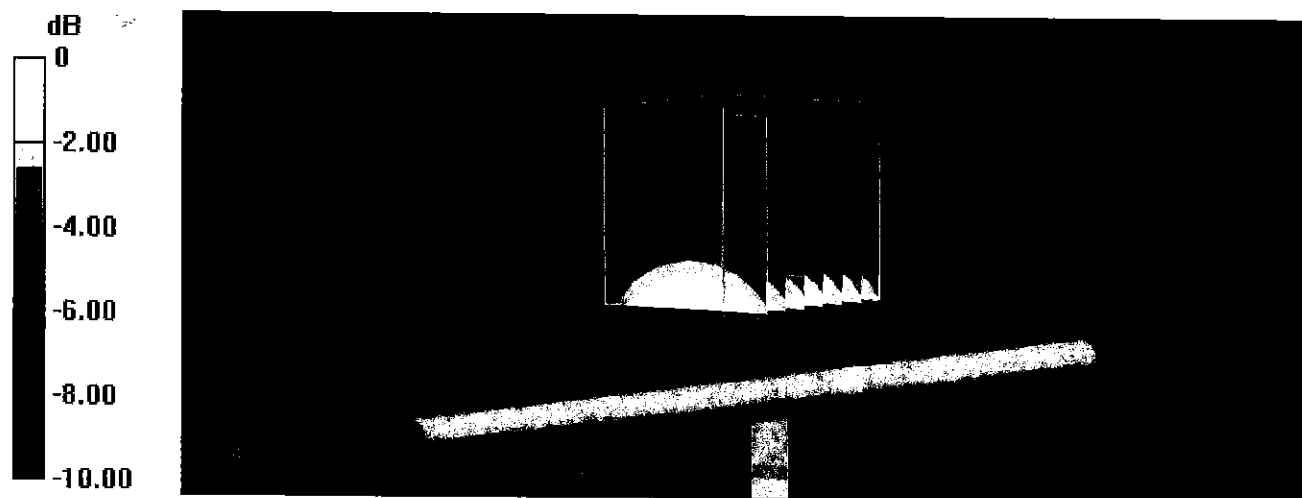
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.96 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.16 W/kg

SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.42 W/kg

Maximum value of SAR (measured) = 2.81 W/kg



0 dB = 2.81 W/kg = 4.49 dBW/kg

Impedance Measurement Plot for Body TSL

8 Sep 2017 13:08:43
 CH1 S11 1 U FS 1: 49.951 Ω -3.6172 Ω 58.666 pF 750.000 000 MHz

*
 De1
 CA

Avg
 15

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -28.833 dB 750.000 000 MHz

CA

Avg
 15

H1d

START 550.000 000 MHz

STOP 950.000 000 MHz

Certification of Calibration

Object D750V3 – SN: 1097

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

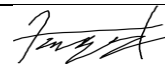
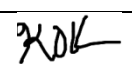
Extended Calibration date: September 08, 2018

Description: SAR Validation Dipole at 750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7416
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/18/2018	Annual	1/18/2019	793

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

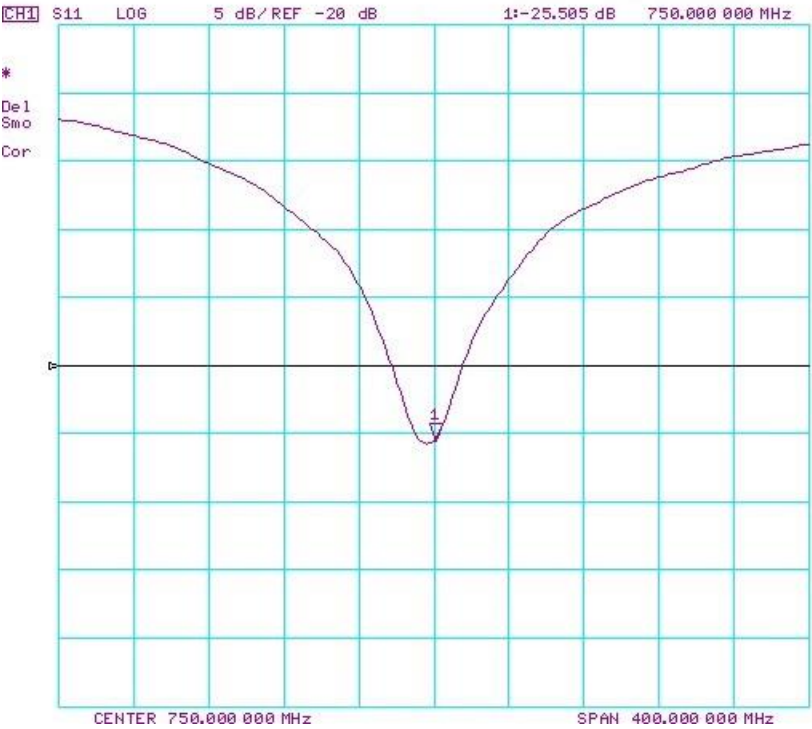
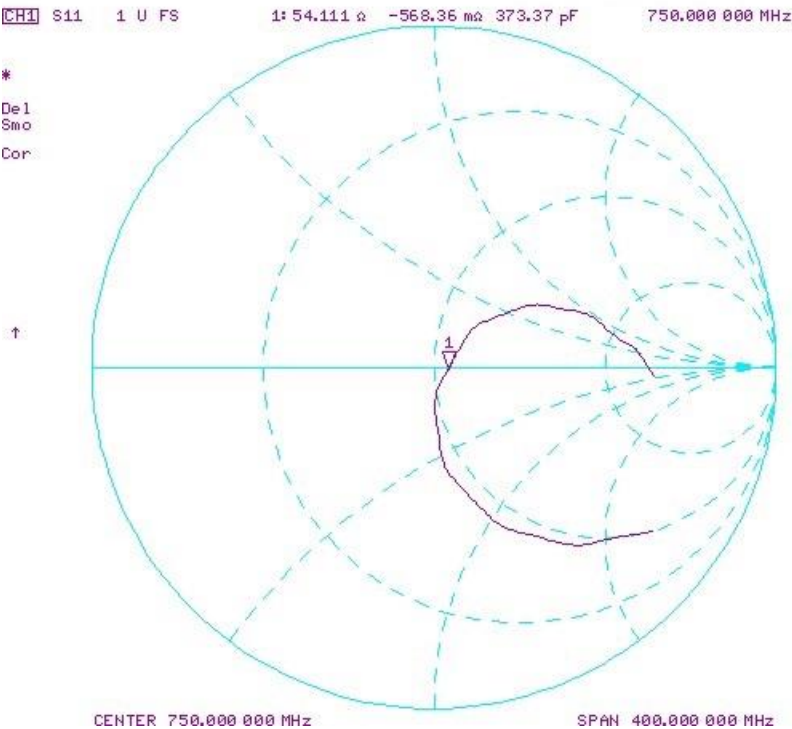
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

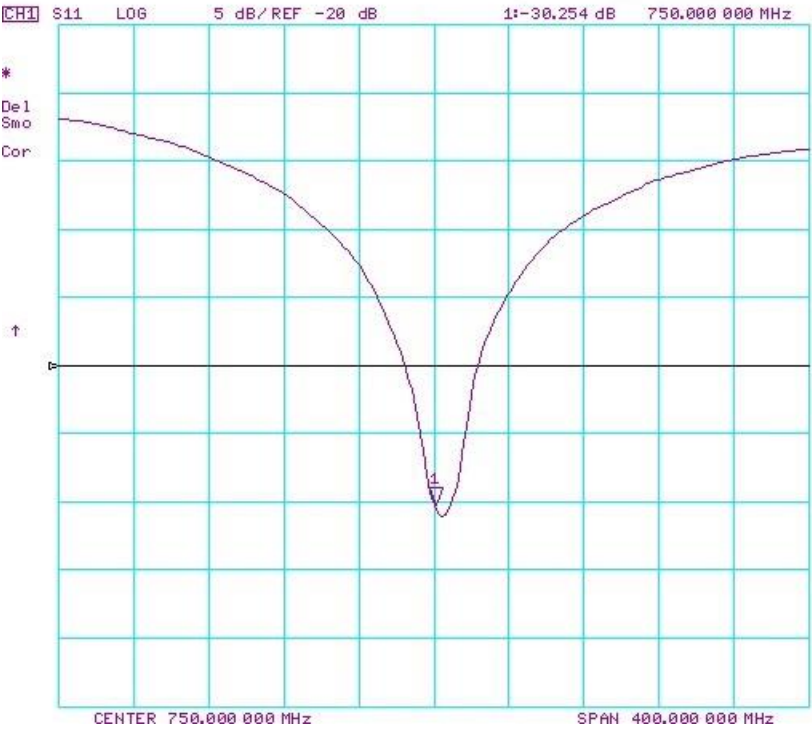
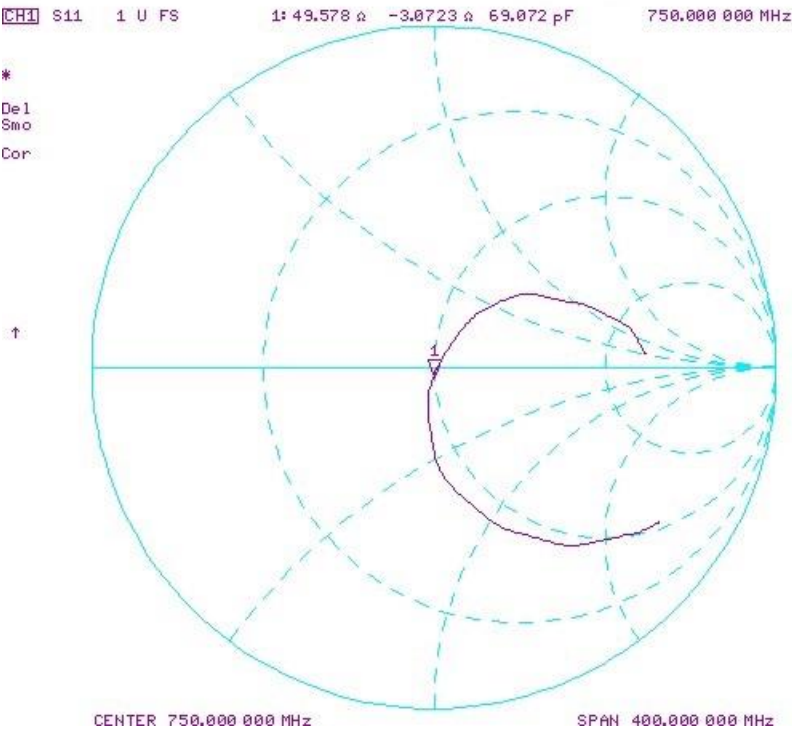
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 23.0 dBm	Measured Head SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	Measured Body SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/8/2017	9/8/2018	1.034	1.644	1.7	3.41%	1.078	1.12	3.90%	54.4	54.1	0.3	-0.6	-0.6	0	-27.5	-25.5	7.30%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 23.0 dBm	Measured Body SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	Measured Body SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/8/2017	9/8/2018	1.034	1.712	1.78	3.97%	1.136	1.17	2.99%	50	49.6	0.4	-3.6	-3.1	0.5	-28.8	-30.3	-5.20%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D835V2-4d180_May18**

CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d180**

Calibration procedure(s) **QA CAL-05.v10**
Calibration procedure for dipole validation kits above 700 MHz

SCV
 5/31/2018

Calibration date: **May 18, 2018**

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

Calibrated by:	Name Manu Seitz	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Technical Manager	

Issued: May 22, 2018

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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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.1
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	40.8 $\pm$ 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 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.60 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.22 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	54.6 $\pm$ 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 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.59 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.31 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7 Ω - 5.1 j Ω
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.2 Ω - 8.2 j Ω
Return Loss	- 21.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.396 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	September 24, 2014

DASY5 Validation Report for Head TSL

Date: 17.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d180

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\epsilon_r = 40.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.9, 9.9, 9.9) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

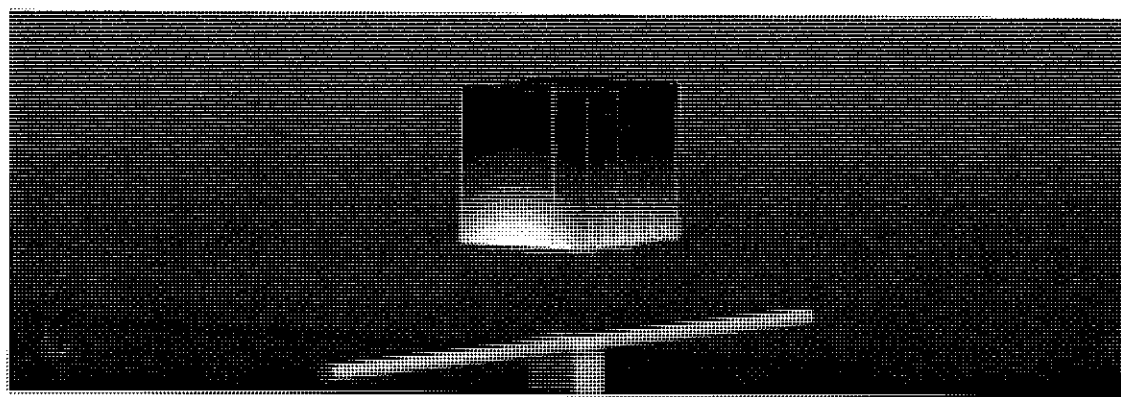
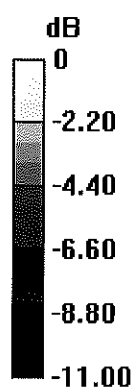
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 65.39 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 3.78 W/kg

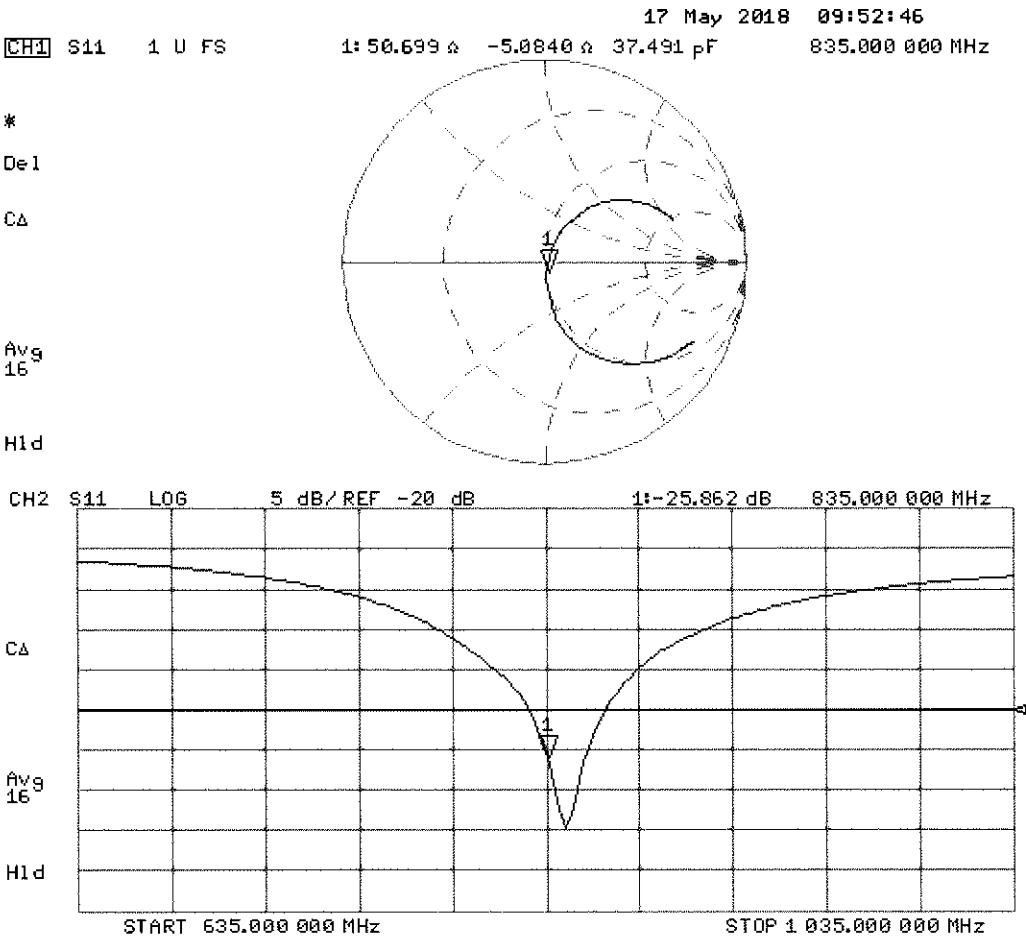
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.58 W/kg

Maximum value of SAR (measured) = 3.32 W/kg



0 dB = 3.32 W/kg = 5.21 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d180

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.99$ S/m; $\epsilon_r = 54.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.05, 10.05, 10.05) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

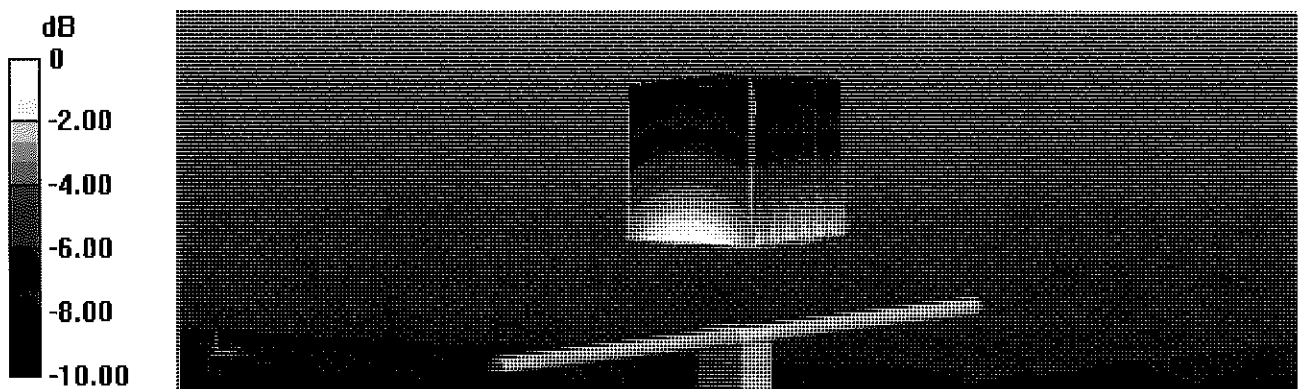
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.80 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.62 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.23 W/kg

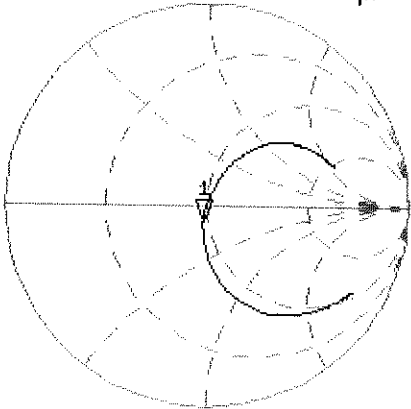


0 dB = 3.23 W/kg = 5.09 dBW/kg

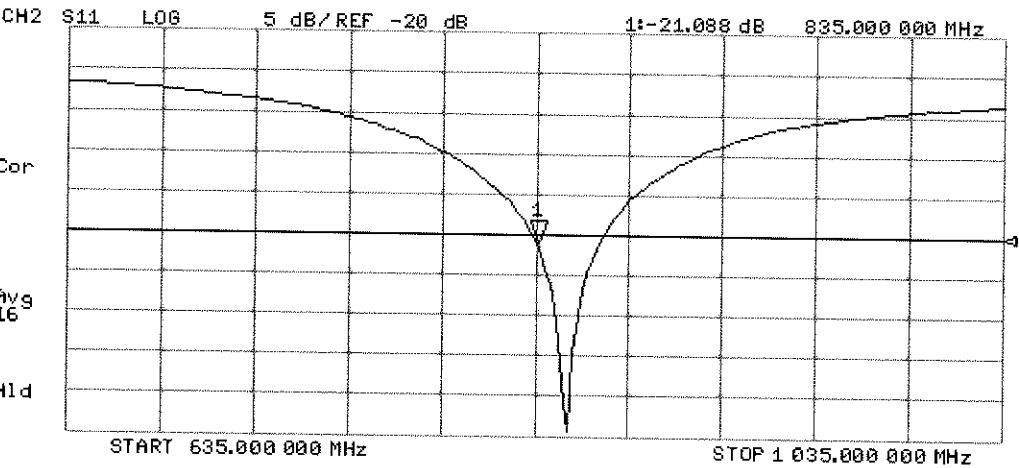
Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS 18 May 2018 10:19:30
1: 47.234 Ω -8.1504 Ω 23.386 pF 835.000 000 MHz

*
Del
Cor



Avg
16
H1d



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



S Schweizerischer Kallbrierdienst
S Service suisse d'étalonnage
S Servizio svizzero di taratura
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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1104_Sep17**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1104**

Calibration procedure(s) **QA CAL-05.v9**
 Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **September 07, 2017**

SC ✓
 10/03/2017

SC ✓
 9/11/2018

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB97480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

[Signature]

[Signature]

Issued: September 7, 2017

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Accreditation No.: **SCS 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.81 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 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	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	1.46 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.85 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.6 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 0.2 j Ω
Return Loss	- 41.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.5 Ω - 0.7 j Ω
Return Loss	- 28.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 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	May 16, 2013

DASY5 Validation Report for Head TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1104

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750 \text{ MHz}$; $\sigma = 1.36 \text{ S/m}$; $\epsilon_r = 39.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.73, 8.73, 8.73); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

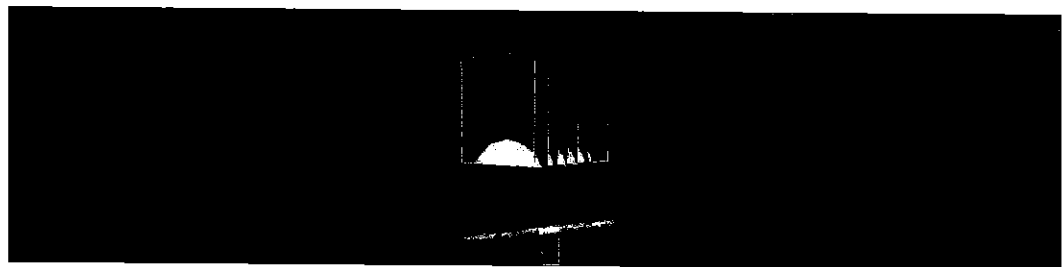
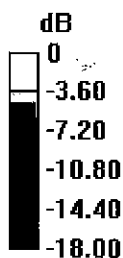
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 104.9 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.81 W/kg

Maximum value of SAR (measured) = 13.9 W/kg

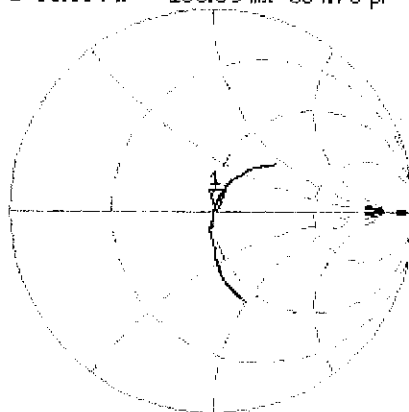


0 dB = 13.9 W/kg = 11.43 dBW/kg

Impedance Measurement Plot for Head TSL

7 Sep 2017 12:19:31
 CH1 S11 1 U FS 1: 50.834 Ω -150.39 m Ω 604.73 pF 1 750.000 000 MHz

*
 Del
 CA



Avg
 16

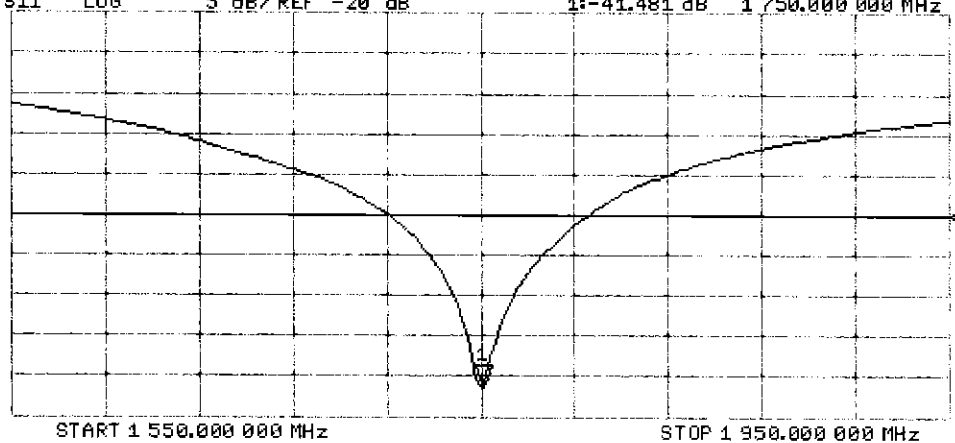
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-41.481 dB 1 750.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1104

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.46$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.46, 8.46, 8.46); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

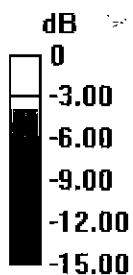
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.30 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 15.6 W/kg

SAR(1 g) = 9.03 W/kg; SAR(10 g) = 4.85 W/kg

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

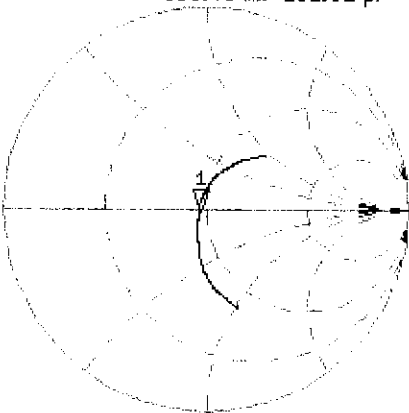


0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL

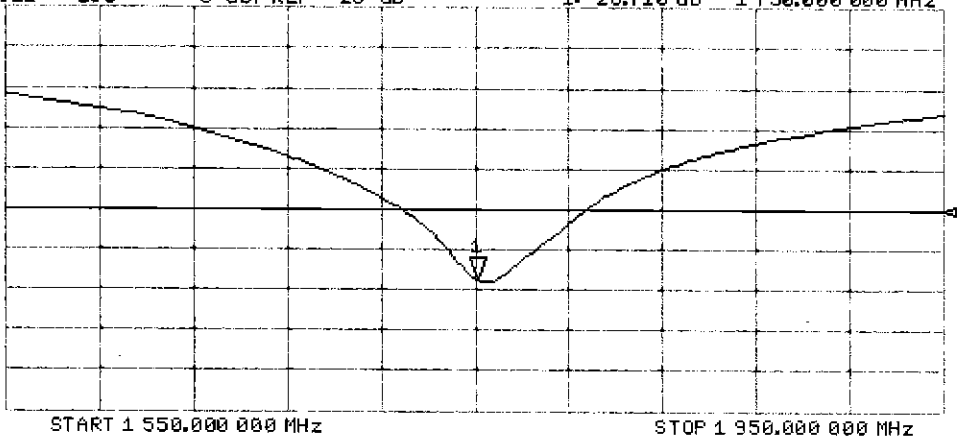
7 Sep 2017 12:18:38
CH1 S11 1 U FS 1: 46.527 Ω -689.45 m Ω 131.91 pF 1 750.000 000 MHz

*
Del
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -28.710 dB 1 750.000 000 MHz

CA
Avg
16
H1d



Certification of Calibration

Object D1750V2 – SN: 1104

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

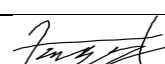
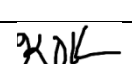
Extended Calibration date: September 07, 2018

Description: SAR Validation Dipole at 1750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

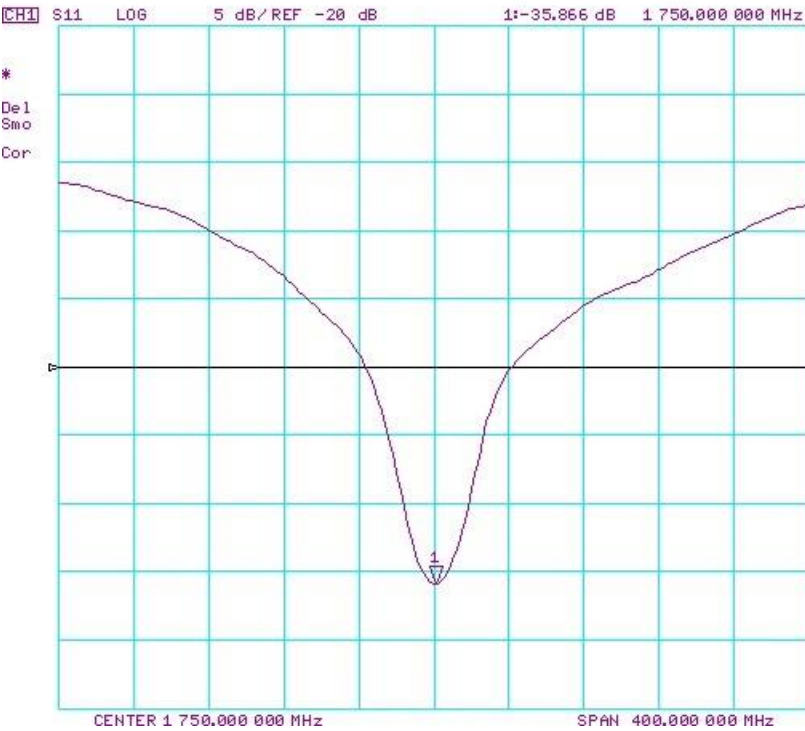
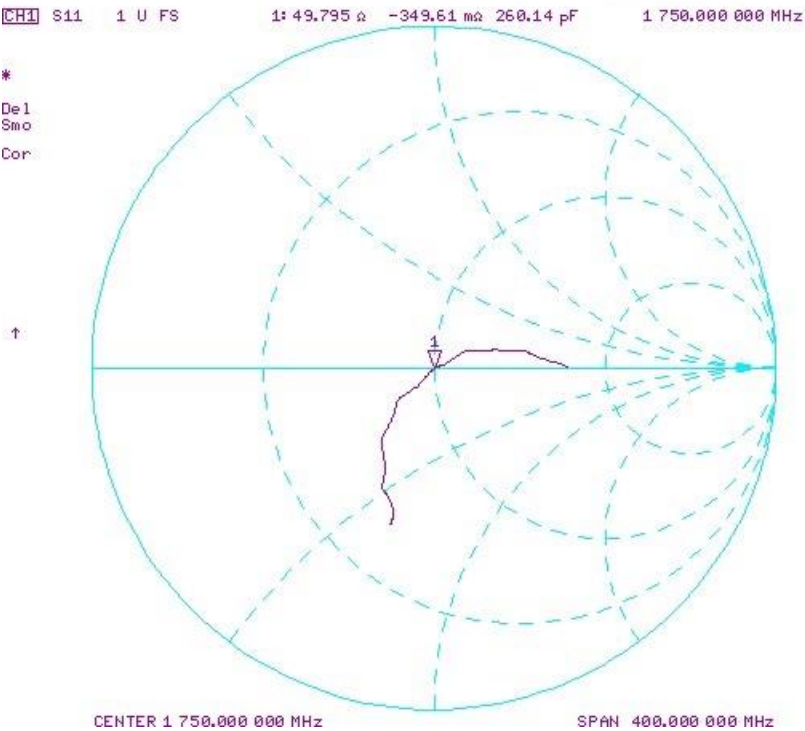
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

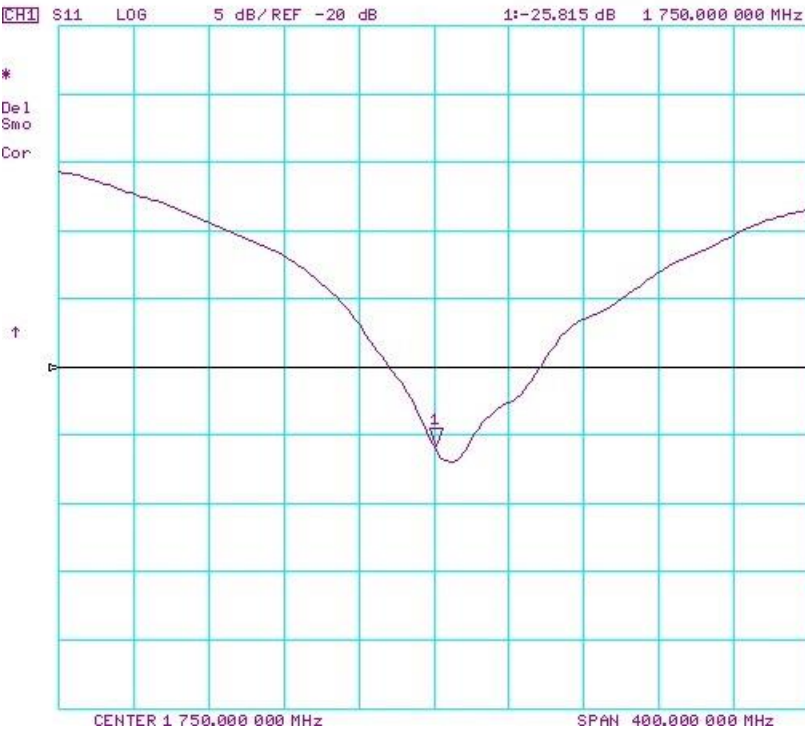
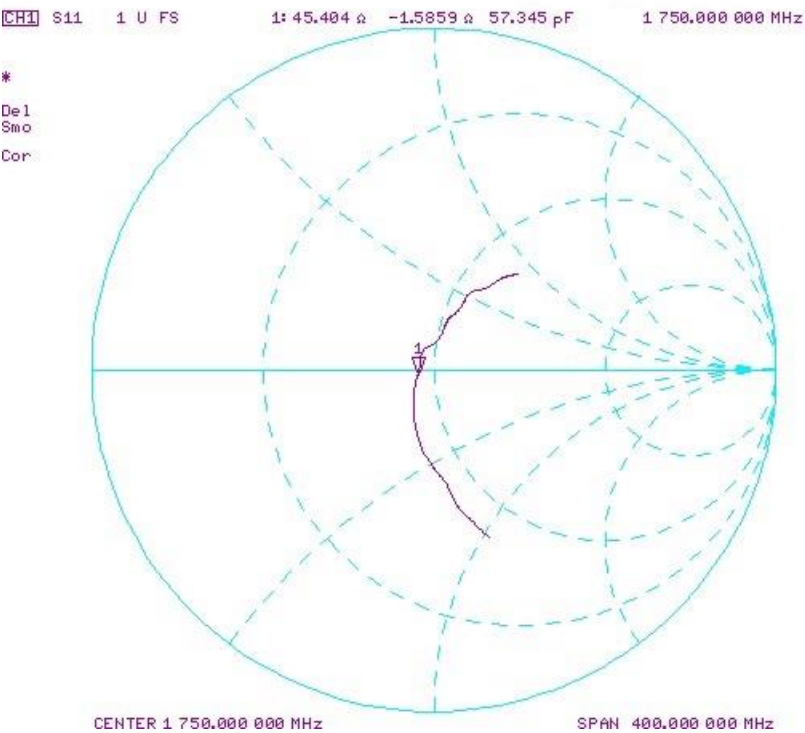
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/7/2017	9/7/2018	1.217	3.64	3.62	-0.55%	1.92	1.94	1.04%	50.8	49.8	1	-0.2	-0.3	0.1	-41.5	-35.9	13.50%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/7/2017	9/7/2018	1.217	3.66	3.84	4.92%	1.96	2.07	5.61%	46.527	45.4	1.1	-0.69	-1.6	0.9	-28.7	-25.8	10.10%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d180_Aug17**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d180**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 16, 2017**

PMV
8/27/17
SCV
8/1/18

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Johannes Kurikka** **Laboratory Technician**

Signature

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

Issued: August 16, 2017

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
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Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
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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	V52.10.0
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	40.6 $\pm$ 6 %	1.36 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	9.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.2 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	5.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.6 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	54.1 $\pm$ 6 %	1.48 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	9.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.5 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	5.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0 Ω + 5.7 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω + 6.5 j Ω
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 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 23, 2013

DASY5 Validation Report for Head TSL

Date: 16.08.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d180

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 40.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

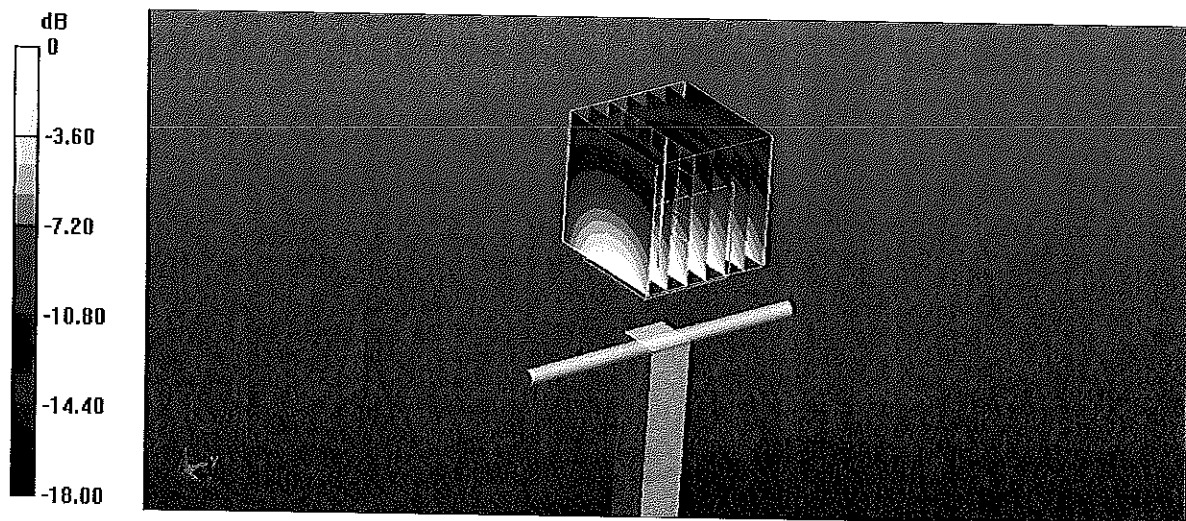
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.7 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.6 W/kg; SAR(10 g) = 5.09 W/kg

Maximum value of SAR (measured) = 14.1 W/kg

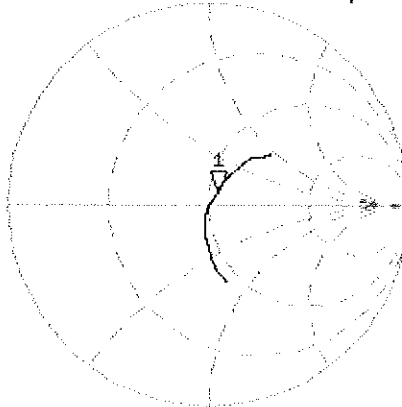


0 dB = 14.1 W/kg = 11.49 dBW/kg

Impedance Measurement Plot for Head TSL

16 Aug 2017 13:06:53
 CH1 S11 1 U FS 1: 54.041 Ω 5.7129 Ω 478.54 μH 1 900.000 000 MHz

*
 Del
 CA



Avg
 16

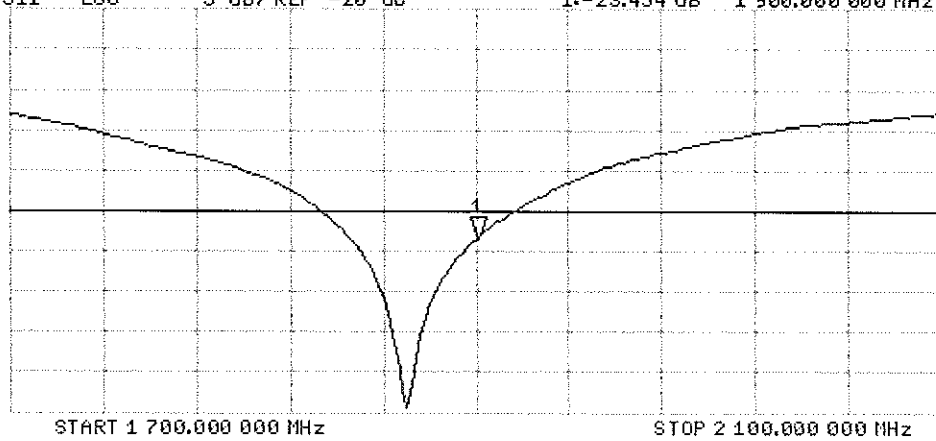
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -23.454 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 16.08.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d180

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.48$ S/m; $\epsilon_r = 54.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

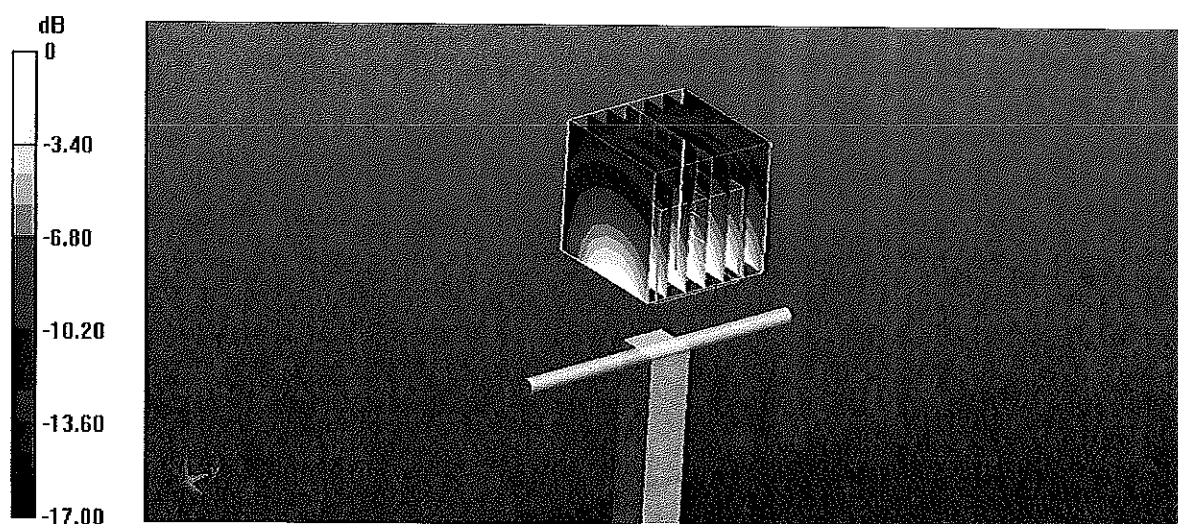
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.33 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 16.9 W/kg

SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.17 W/kg

Maximum value of SAR (measured) = 14.1 W/kg

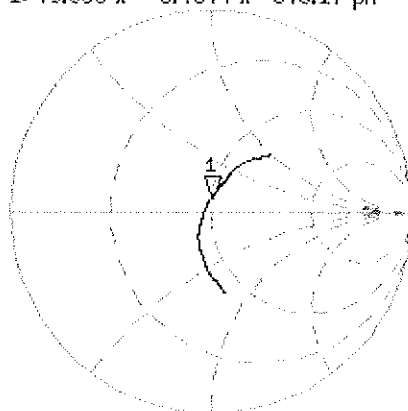


0 dB = 14.1 W/kg = 11.49 dBW/kg

Impedance Measurement Plot for Body TSL

16 Aug 2017 13:06:08
 [CH1] S11 1 U FS 1: 49.605 Ω 6.4844 Ω 543.17 μH 1 900.000 000 MHz

*
 Del
 CA



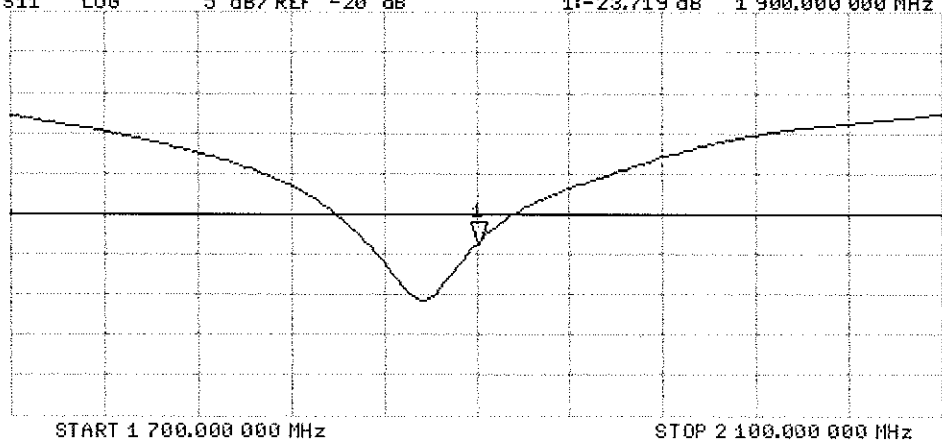
Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.719 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



Certification of Calibration

Object D1900V2 – SN: 5d180

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

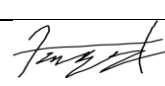
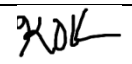
Extended Calibration date: August 01, 2018

Description: SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAKS-3.5	Portable DAK	9/5/2017	Annual	9/5/2018	1045
SPEAG	ES3DV3	SAR Probe	2/13/2018	Annual	2/13/2019	3329
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/8/2018	Annual	2/8/2019	1403

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Biomedical Engineer II	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

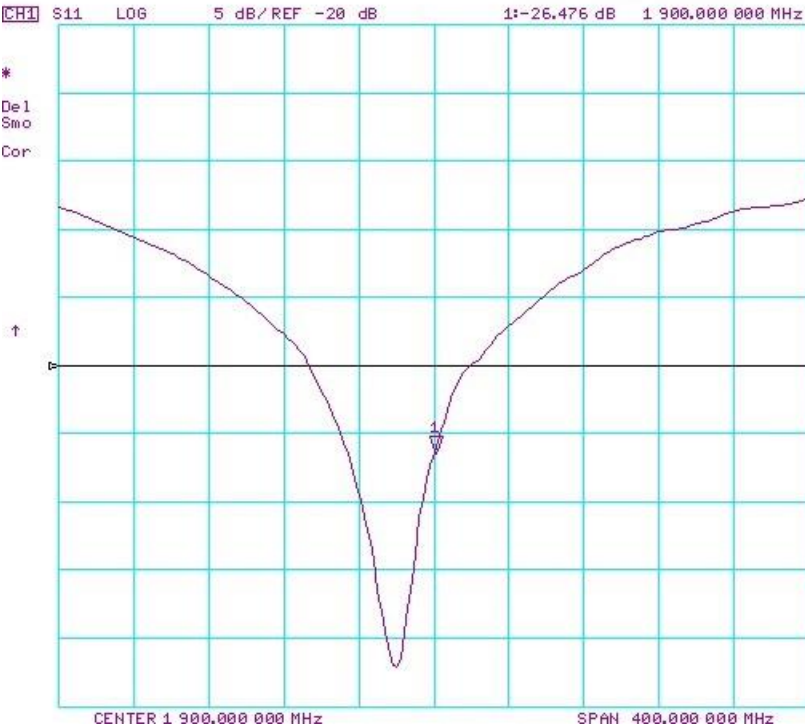
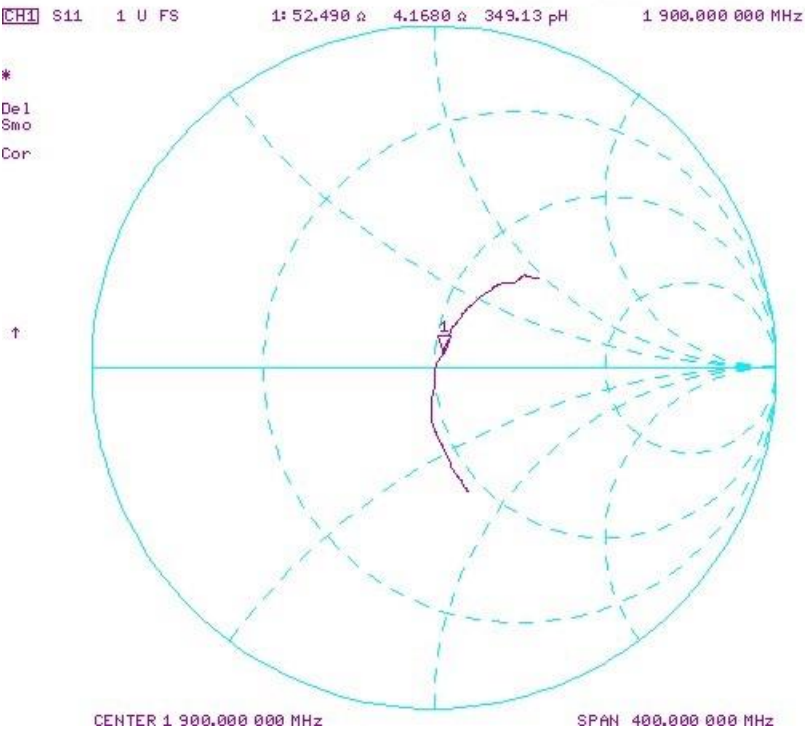
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

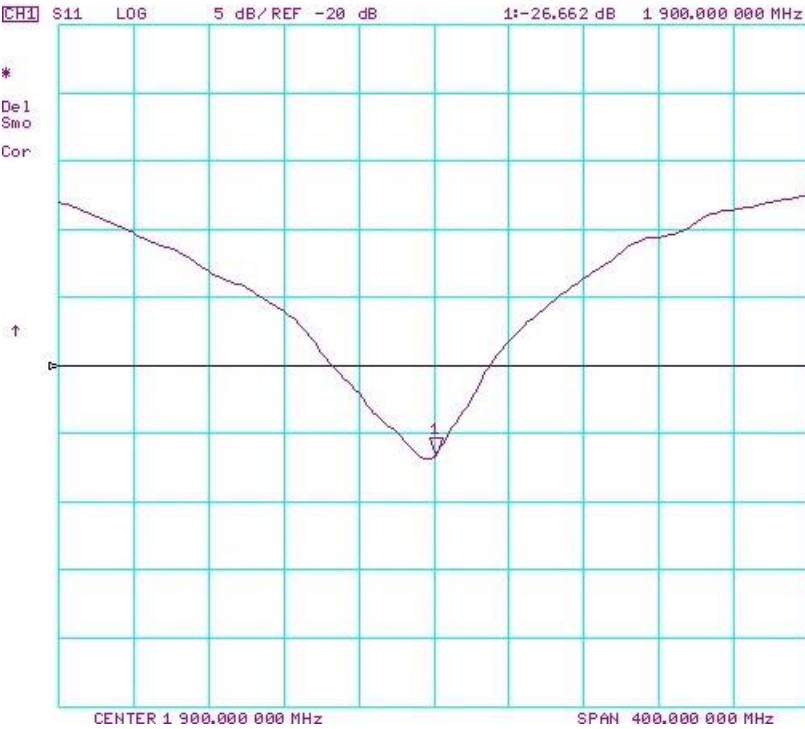
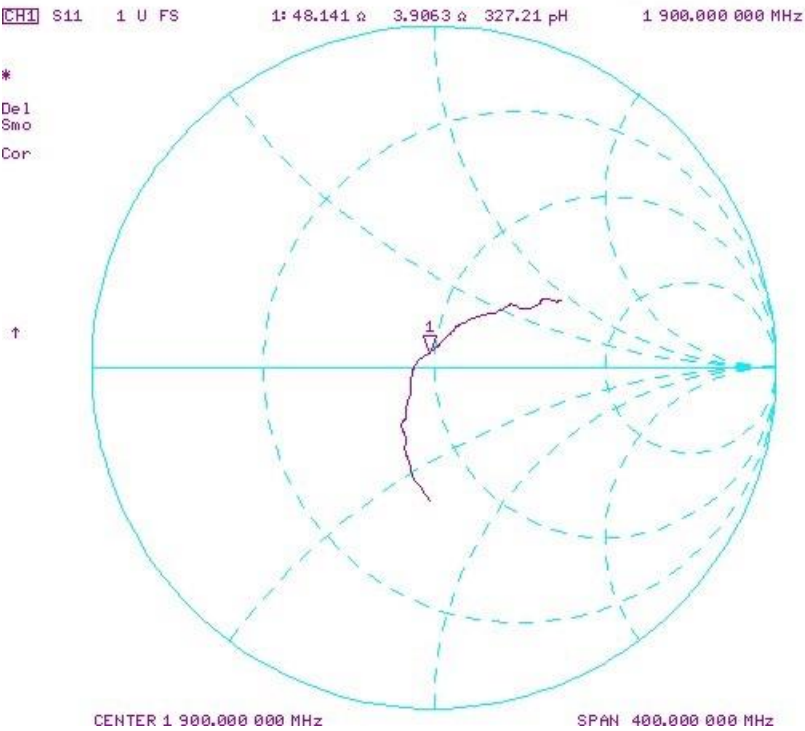
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
8/16/2017	8/1/2018	1.203	3.92	3.81	-2.81%	2.06	1.97	-4.37%	54	52.5	1.5	5.7	4.2	1.5	-23.5	-26.5	-12.80%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
8/16/2017	8/1/2018	1.203	3.95	4.29	8.61%	2.09	2.21	5.74%	49.6	48.1	1.5	6.5	3.9	2.6	-23.7	-26.7	-12.70%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 0108**

Client **PC Test**

Certificate No: **D1900V2-5d181_Sep17**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d181**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

SC ✓
10/03/2017

Calibration date: **September 07, 2017**

SC ✓
9/7/2018

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Jeton Kastrati** Name
Laboratory Technician Function

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

Signature

Issued: September 7, 2017

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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.0
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	39.0 $\pm$ 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	9.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.5 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	5.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.6 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	54.3 $\pm$ 6 %	1.47 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	9.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.5 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	5.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.7 \Omega + 4.6 j\Omega$
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.2 \Omega + 5.6 j\Omega$
Return Loss	- 24.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.200 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 23, 2013

DASY5 Validation Report for Head TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d181

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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 = 106.8 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.15 W/kg

Maximum value of SAR (measured) = 14.8 W/kg

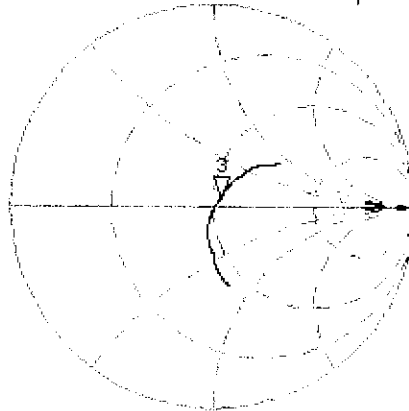


0 dB = 14.8 W/kg = 11.70 dBW/kg

Impedance Measurement Plot for Head TSL

7 Sep 2017 09:10:32
 CH1 S11 1 U FS 3: 53.668 Ω 4.5957 Ω 384.96 μH 1 900.000 000 MHz

*
 Del
 CA



Avg
 16

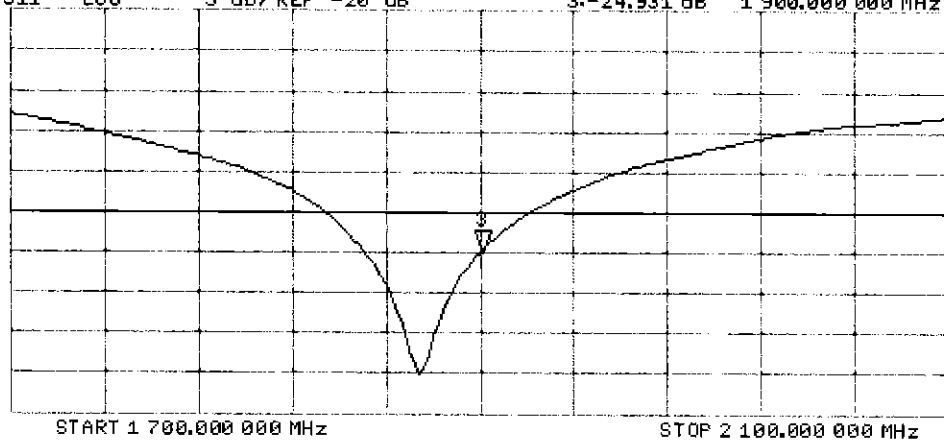
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-24.931 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d181

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.47$ S/m; $\epsilon_r = 54.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

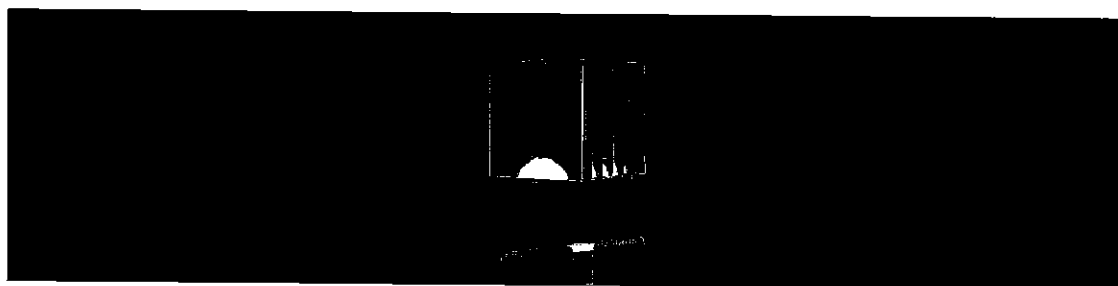
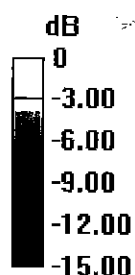
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.4 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.14 W/kg

Maximum value of SAR (measured) = 13.8 W/kg

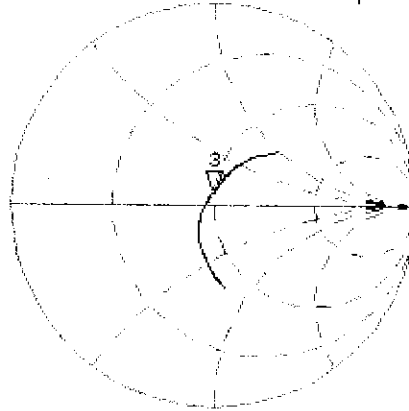


0 dB = 13.8 W/kg = 11.40 dBW/kg

Impedance Measurement Plot for Body TSL

7 Sep 2017 09:09:41
CH1 S11 1 U FS 3: 49.201 Ω 5.6484 Ω 473.15 pF 1 900.000 000 MHz

*
De1
CA



Avg
15

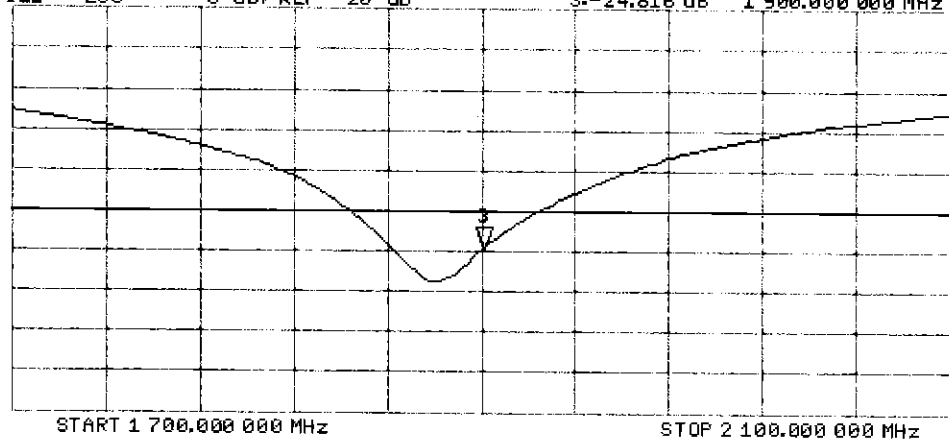
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3: -24.816 dB 1 900.000 000 MHz

CA

Avg
15

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

Certification of Calibration

Object D1900V2 – SN: 5d181

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

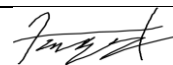
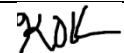
Extended Calibration date: September 07, 2018

Description: SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533
SPEAG	ES3DV3	SAR Probe	3/13/2018	Annual	3/13/2019	3131
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/7/2018	Annual	3/7/2019	604

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

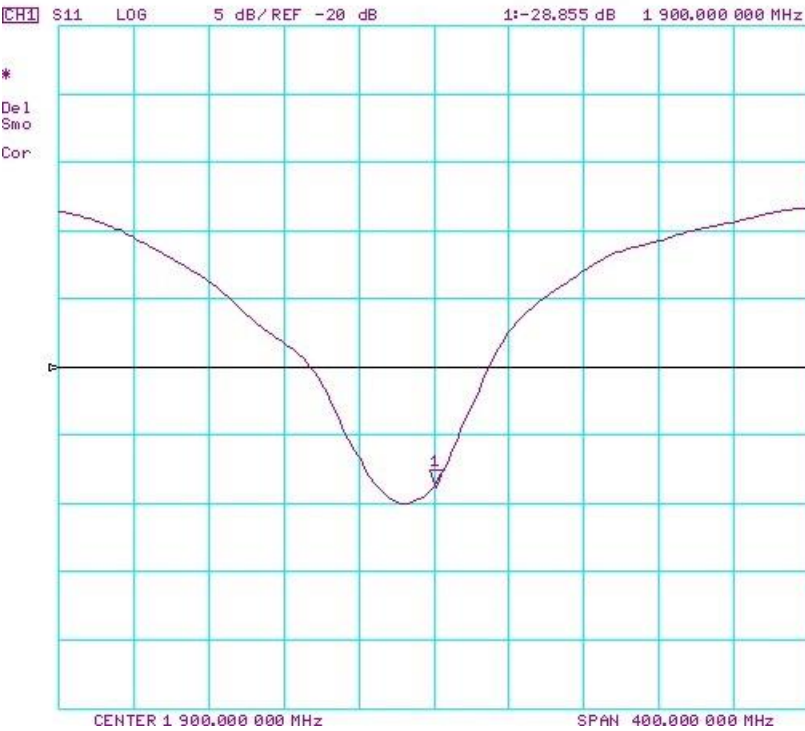
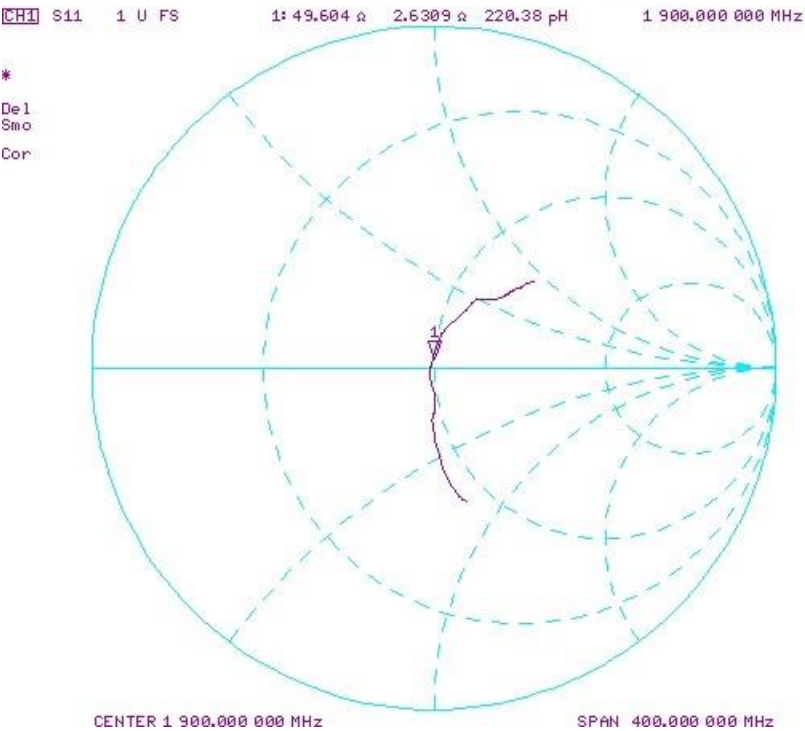
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

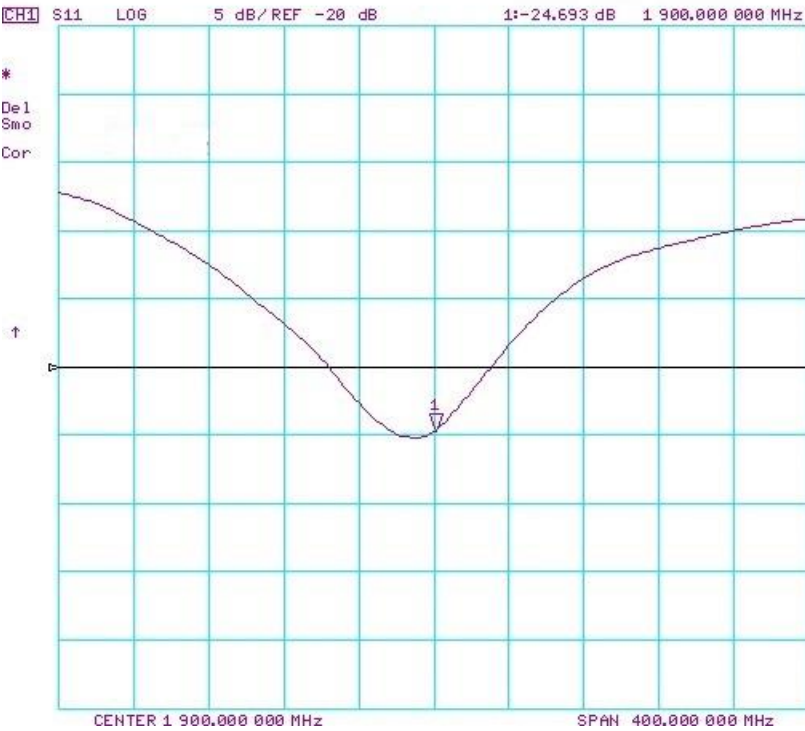
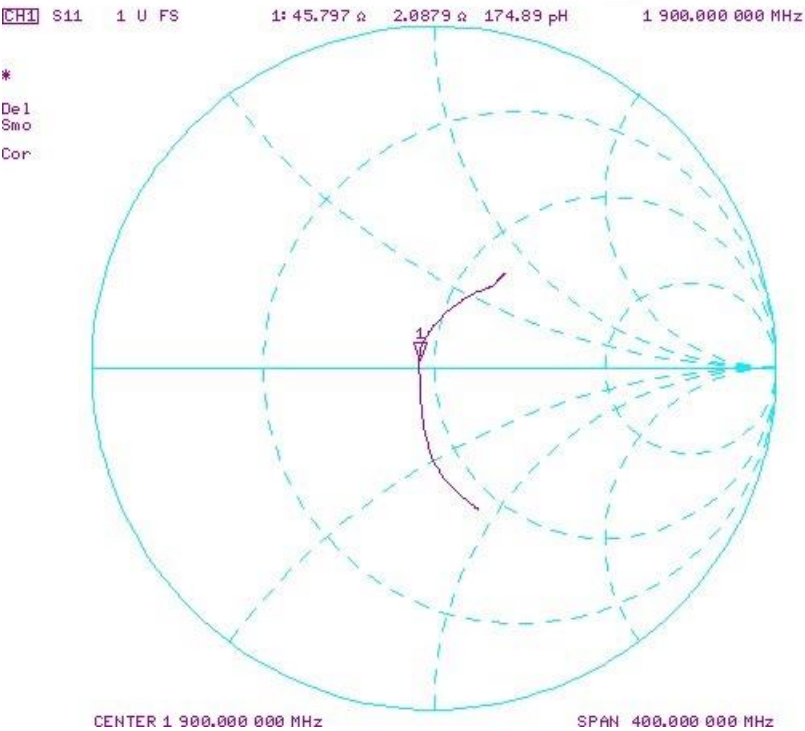
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/7/2017	9/7/2018	1.2	3.95	3.99	1.01%	2.06	2.07	0.49%	53.7	49.6	4.1	4.6	2.6	2	-24.9	-28.9	-16.10%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/7/2017	9/7/2018	1.2	3.95	4.13	4.56%	2.09	2.14	2.39%	49.2	45.8	3.4	5.6	2.1	3.5	-24.8	-24.7	0.40%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2300V2-1038_Mar18**

CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1038**

Calibration procedure(s) **QA CAL-05.v10**
Calibration procedure for dipole validation kits above 700 MHz

SC ✓
 3/21/18

Calibration date: **March 07, 2018**

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

Calibrated by: **Claudio Leubler** Name: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: March 9, 2018

This 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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2300 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.6 $\pm$ 6 %	1.70 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	12.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	49.3 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	5.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6 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	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.6 $\pm$ 6 %	1.86 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	11.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	46.7 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	5.69 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.5 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.8 Ω - 4.9 j Ω
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.9 Ω - 3.4 j Ω
Return Loss	- 25.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.170 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	July 02, 2013

DASY5 Validation Report for Head TSL

Date: 07.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1038

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used: $f = 2300$ MHz; $\sigma = 1.7$ S/m; $\epsilon_r = 38.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

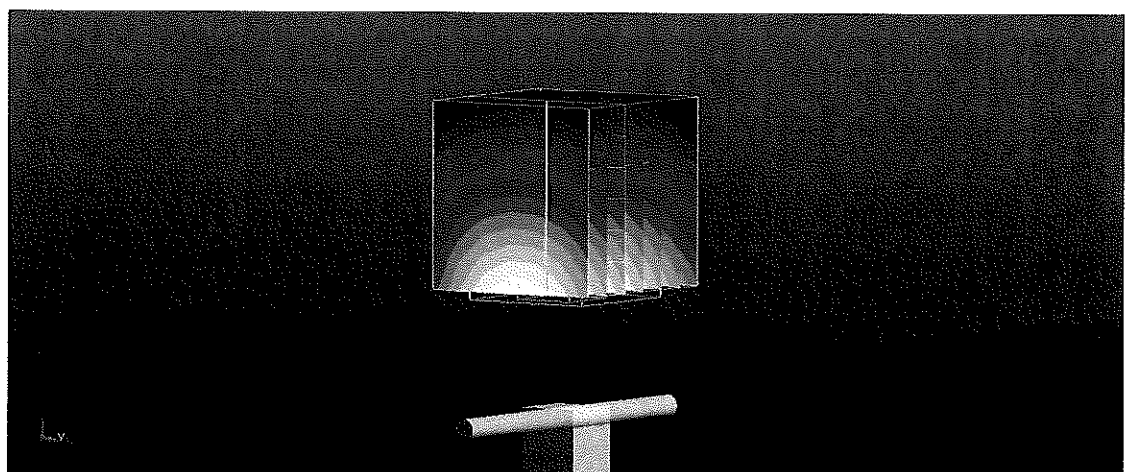
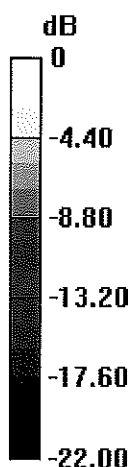
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 112.4 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 24.5 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.94 W/kg

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

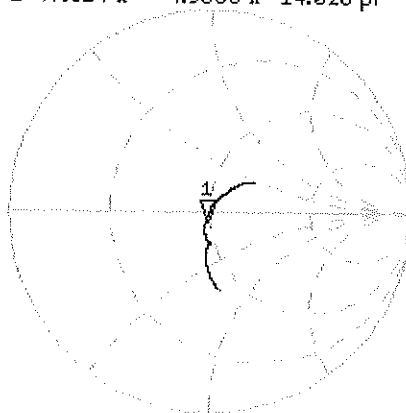


0 dB = 19.6 W/kg = 12.92 dBW/kg

Impedance Measurement Plot for Head TSL

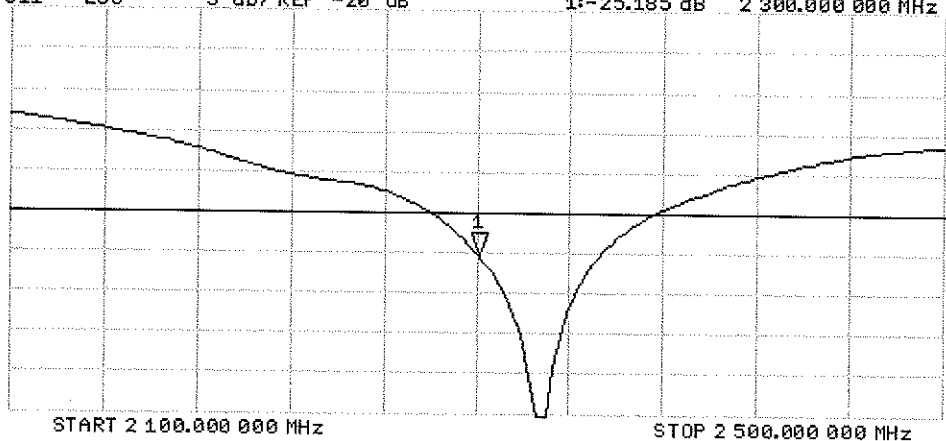
7 Mar 2018 13:16:07
 CH1 S11 1 U FS 1: 47.824 Ω -4.9336 Ω 14.026 pF 2 300.000 000 MHz

*
 Del
 Cor
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-25.185 dB 2 300.000 000 MHz

Cor
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 07.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1038

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used: $f = 2300$ MHz; $\sigma = 1.86$ S/m; $\epsilon_r = 51.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

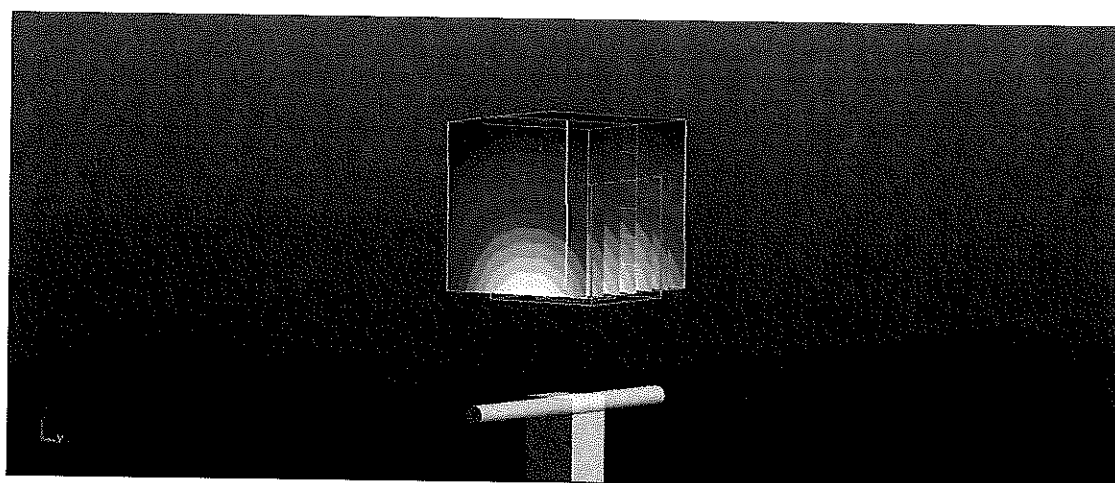
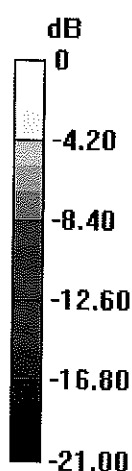
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.5 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 23.0 W/kg

SAR(1 g) = 11.9 W/kg; SAR(10 g) = 5.69 W/kg

Maximum value of SAR (measured) = 18.2 W/kg

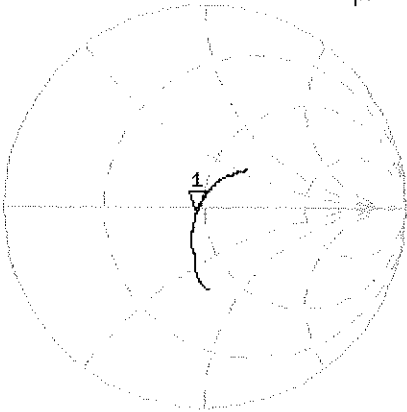


0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Body TSL

7 Mar 2018 13:11:08
CH1 S11 1 U FS 1: 45.861 Ω -3.4160 Ω 20.257 pF 2 300.000 000 MHz

*
De1
Cor



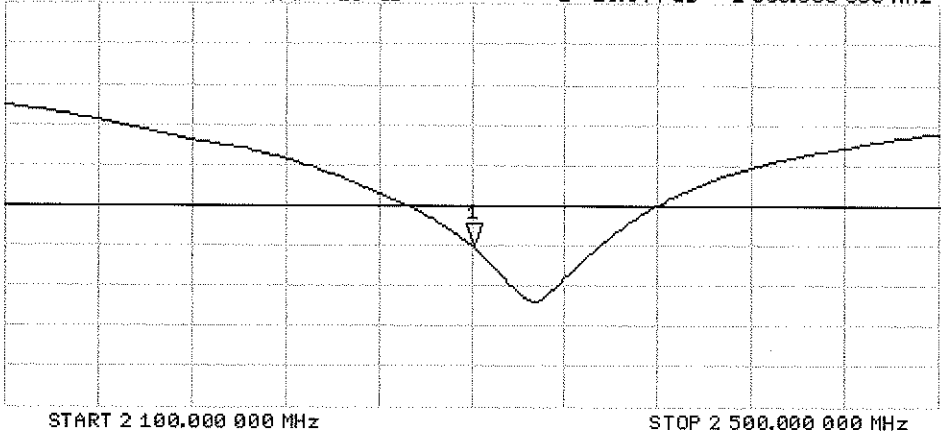
Avg
16
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.044 dB 2 300.000 000 MHz

Cor

Avg
16

H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2450V2-945_May18**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN:945**

Calibration procedure(s) **QA CAL-05.v10**
Calibration procedure for dipole validation kits above 700 MHz

SC ✓
 5/31/2018

Calibration date: **May 16, 2018**

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Manu Seltz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 17, 2018

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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.1
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 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 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	52.3 $\pm$ 6 %	1.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.5 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	49.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.83 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.2 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$56.1 \Omega + 3.7 j\Omega$
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.9 \Omega + 5.0 j\Omega$
Return Loss	- 25.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 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	March 15, 2014

DASY5 Validation Report for Head TSL

Date: 16.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 38.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

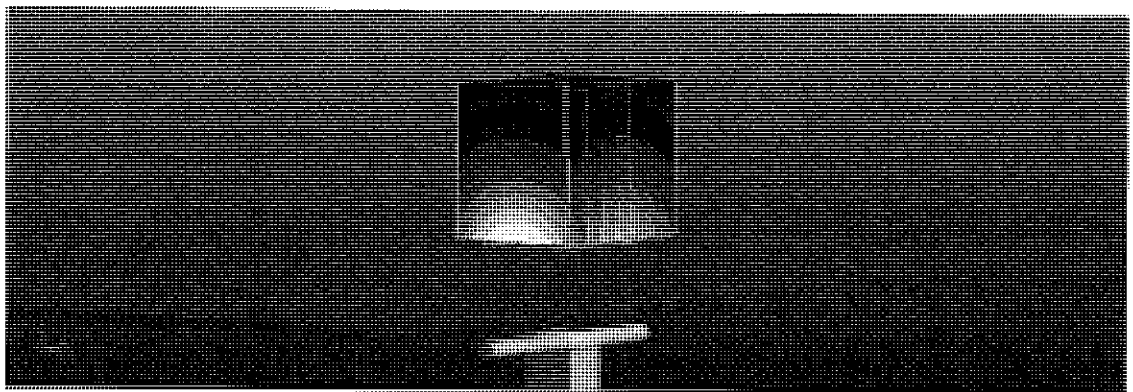
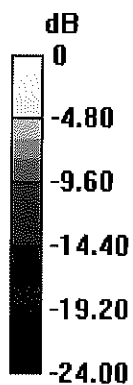
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 114.8 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.9 W/kg

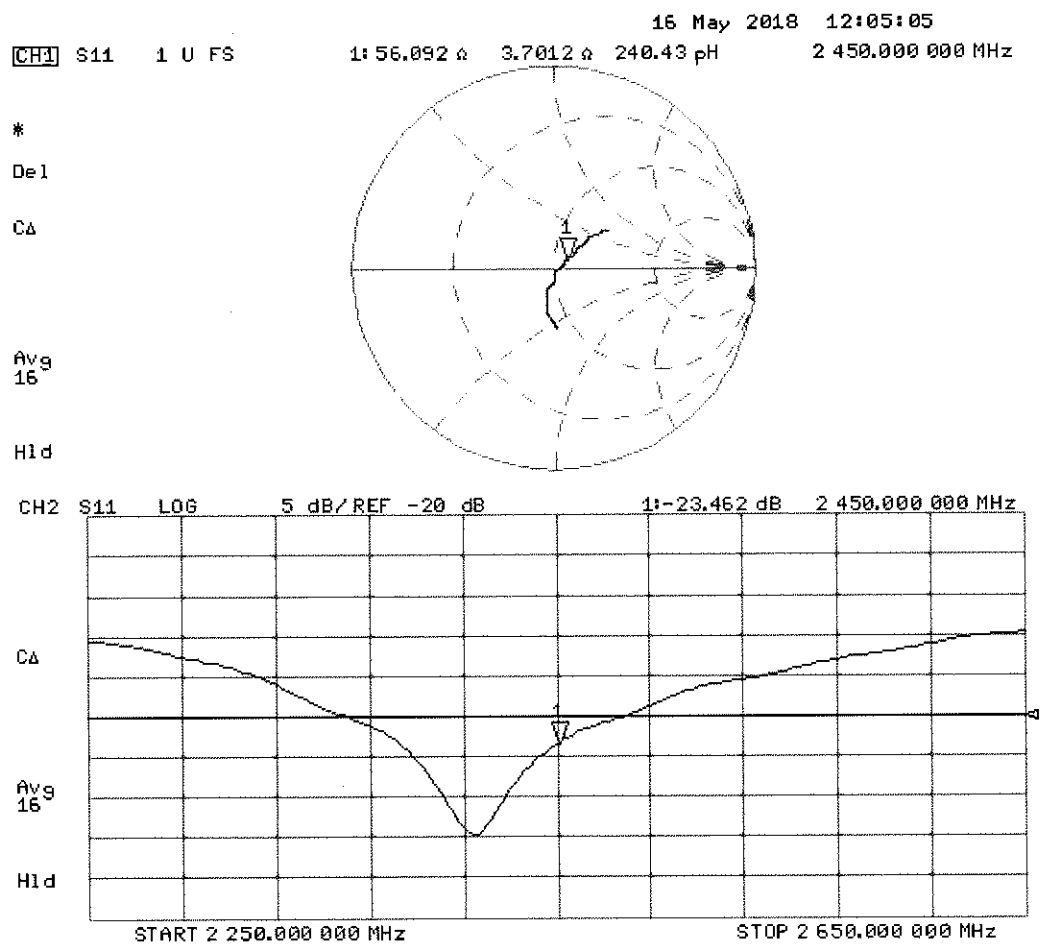
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.02 W/kg

Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ S/m; $\epsilon_r = 52.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

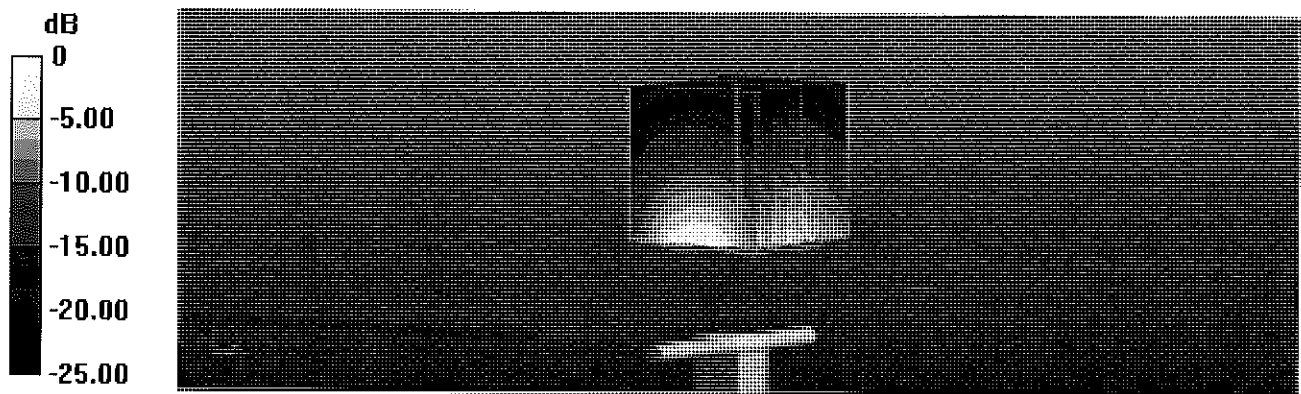
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.8 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 25.0 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.83 W/kg

Maximum value of SAR (measured) = 20.2 W/kg

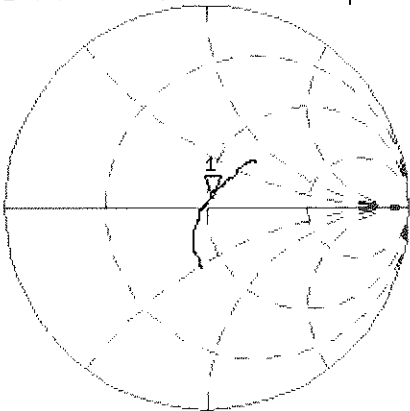


0 dB = 20.2 W/kg = 13.05 dBW/kg

Impedance Measurement Plot for Body TSL

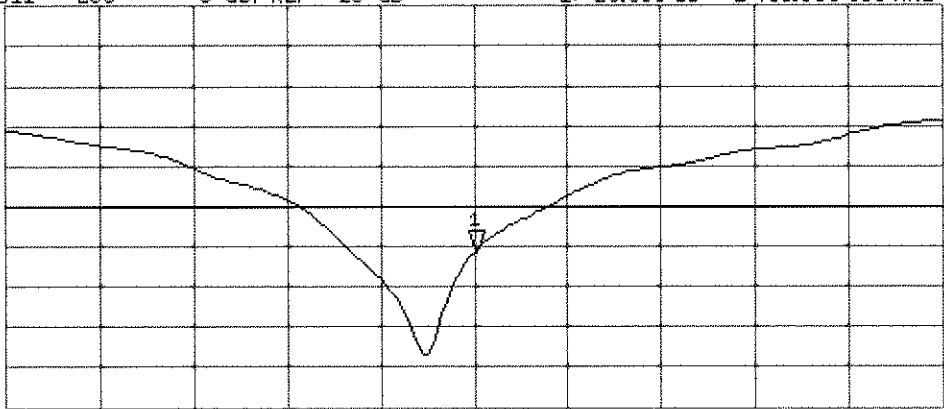
16 May 2018 12:03:43
[CH1] S11 1 U FS 1: 51.910 Ω 4.9629 Ω 322.40 μ H 2 450.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-25.659 dB 2 450.000 000 MHz

CA
Avg
16
H1d



START 2 250.000 000 MHz STOP 2 650.000 000 MHz



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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2600V2-1042_Jun17**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1042**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **June 07, 2017**

BN✓
8/3/2018
SC✓
6/1/2018

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Johannes Kurikka** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

[Signature]
[Signature]

Issued: June 8, 2017

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



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Accreditation No.: **SCS 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.0
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	37.3 $\pm$ 6 %	2.02 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	57.4 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	6.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.5 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	51.7 $\pm$ 6 %	2.22 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	14.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.1 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	6.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.5 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.0 Ω - 8.4 j Ω
Return Loss	- 21.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.5 Ω - 6.2 j Ω
Return Loss	- 22.0 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	May 24, 2011

DASY5 Validation Report for Head TSL

Date: 07.06.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1042

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 37.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

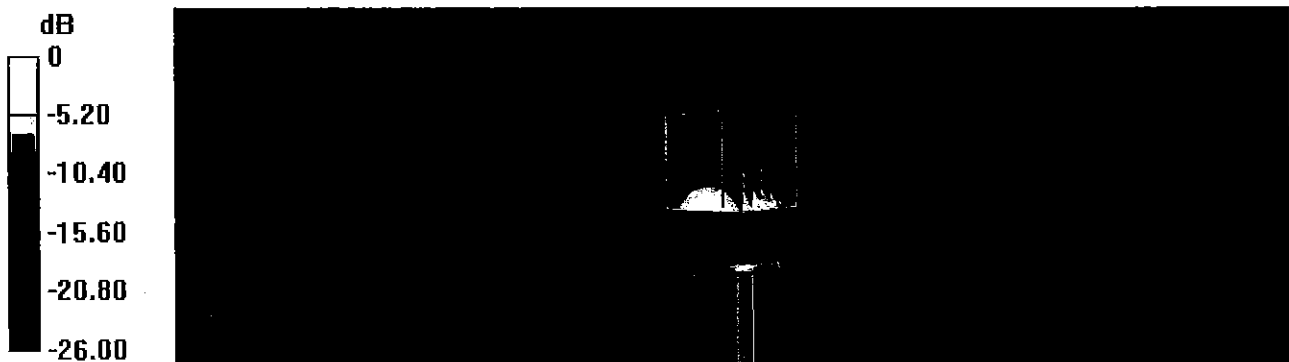
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 113.5 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 32.4 W/kg

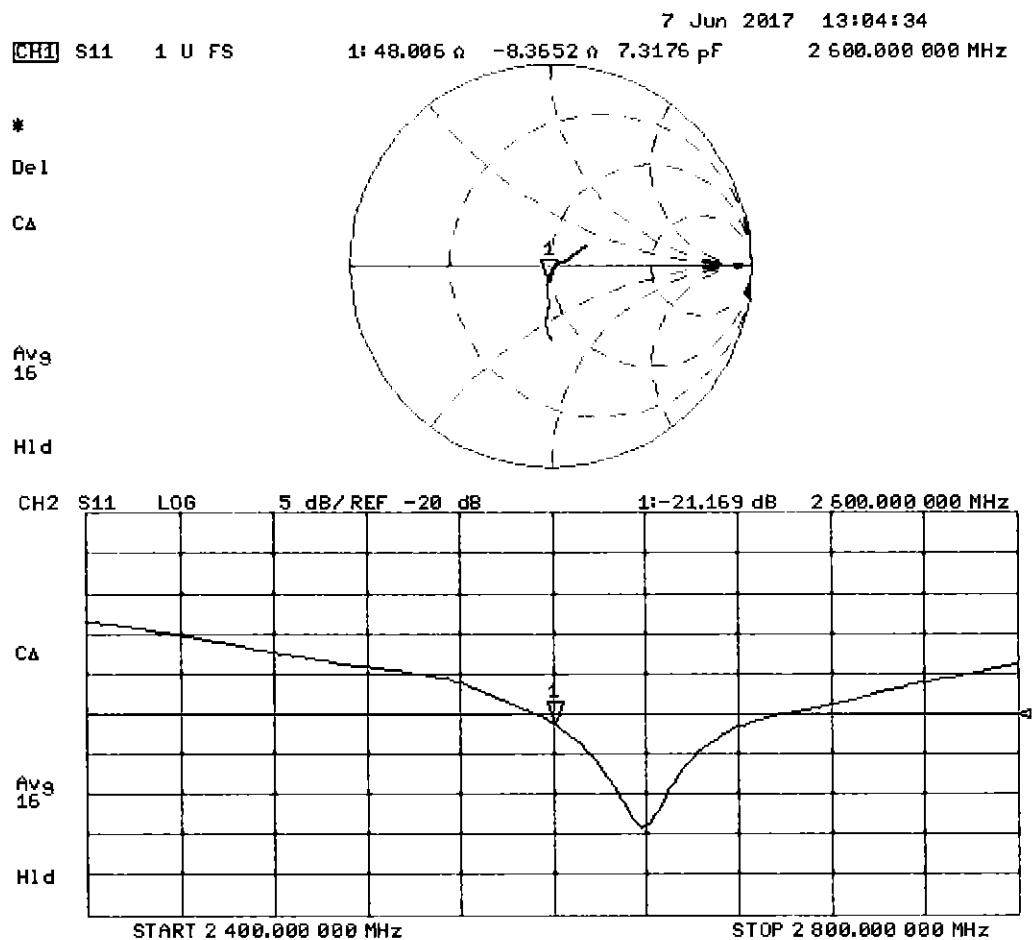
SAR(1 g) = 14.7 W/kg; SAR(10 g) = 6.46 W/kg

Maximum value of SAR (measured) = 24.8 W/kg



0 dB = 24.8 W/kg = 13.94 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.06.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1042

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.22$ S/m; $\epsilon_r = 51.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

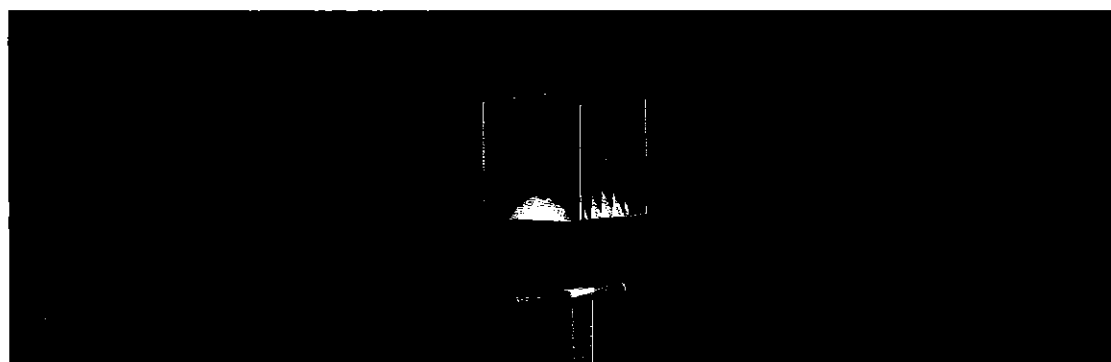
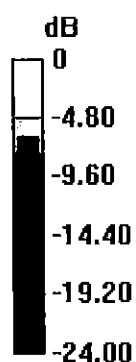
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.5 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 29.8 W/kg

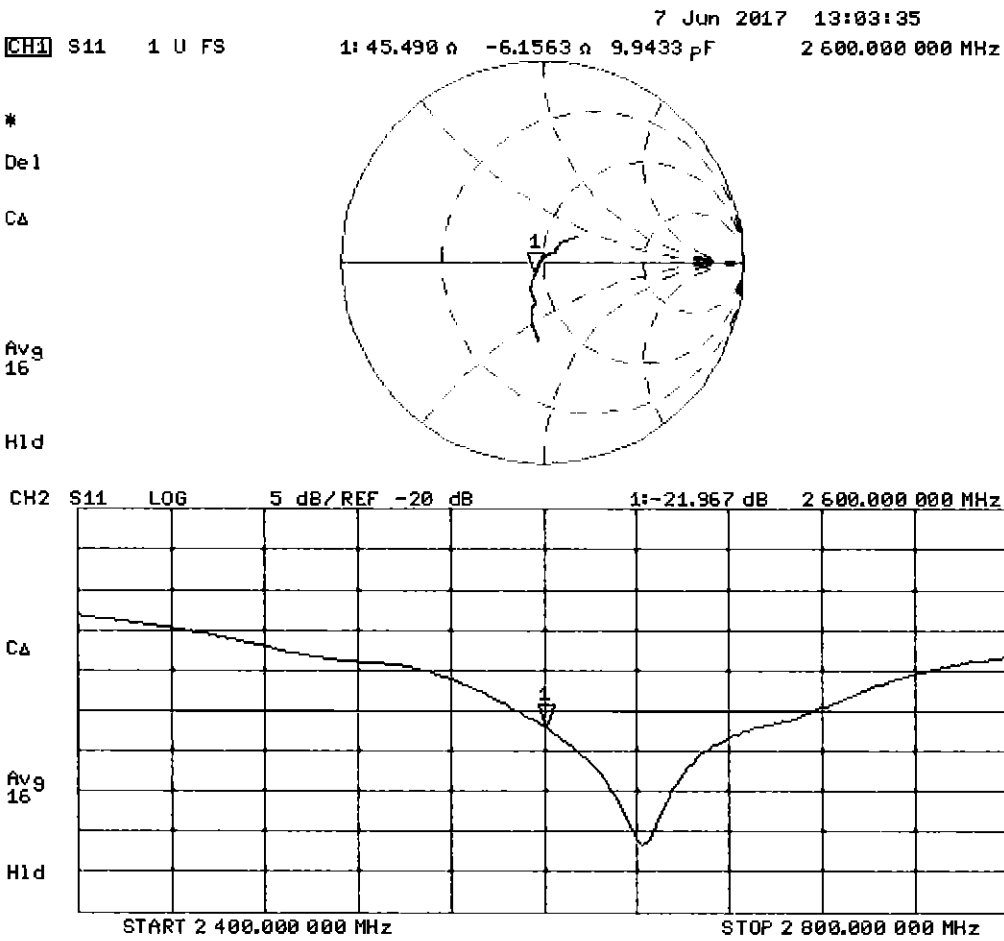
SAR(1 g) = 14 W/kg; SAR(10 g) = 6.19 W/kg

Maximum value of SAR (measured) = 22.5 W/kg



0 dB = 22.5 W/kg = 13.52 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D2600V2 – SN: 1042

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

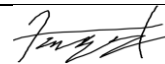
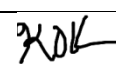
Extended Calibration date: June 01, 2018

Description: SAR Validation Dipole at 2600 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/1/2017	Annual	6/1/2018	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAKS-3.5	Portable DAK	9/5/2017	Annual	9/5/2018	1045
SPEAG	ES3DV3	SAR Probe	3/13/2018	Annual	3/13/2019	3131
SPEAG	EX3DV4	SAR Probe	1/26/2018	Annual	1/26/2019	7490
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/7/2018	Annual	3/7/2019	604
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1532

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Biomedical Engineer II	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

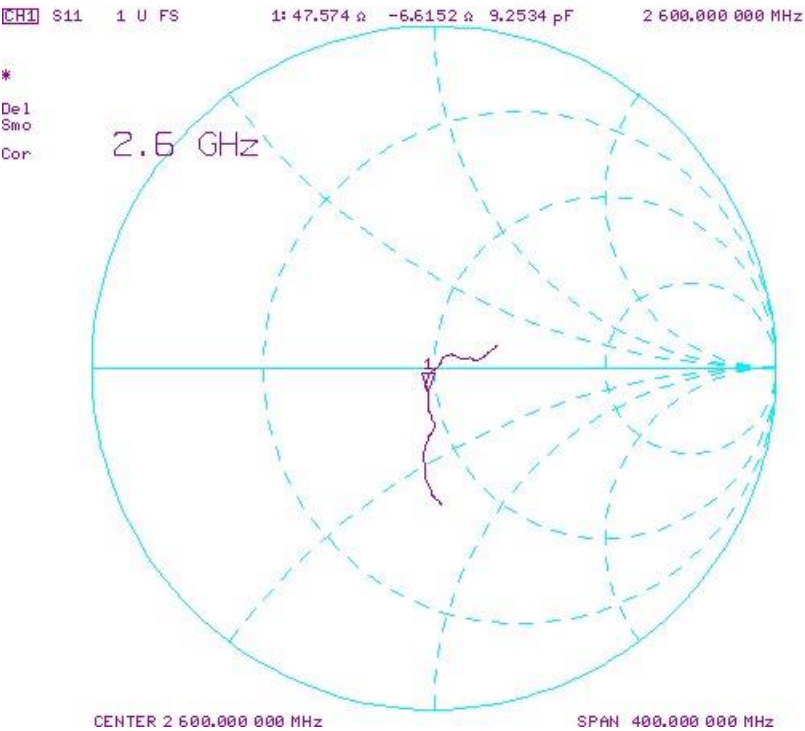
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

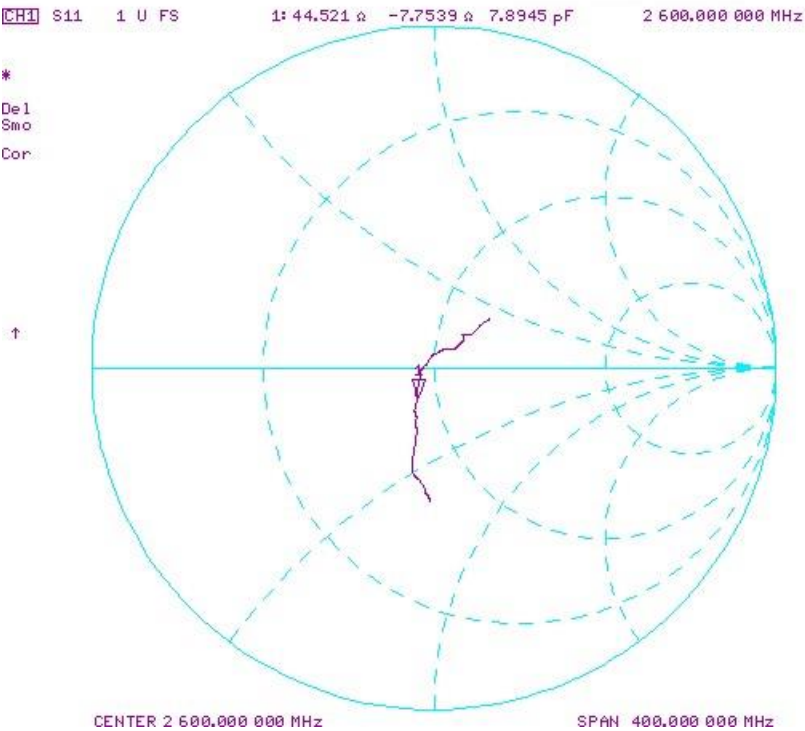
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
6/7/2017	6/1/2018	1.149	5.74	6.14	6.97%	2.55	2.64	3.53%	48	47.6	0.4	-8.4	-6.6	1.8	-21.2	-23.6	-11.30%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
6/7/2017	6/1/2018	1.149	5.51	5.3	-3.81%	2.45	2.33	-4.90%	45.5	44.5	1	-6.2	-7.8	1.6	-22	-21.1	4.10%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2600V2-1069_Sep17**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1069**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

SCV
10/03/2017

Calibration date: **September 11, 2017**

SCV
9/10/2018

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

Signature

M. Weber

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

K. Pokovic

Issued: September 11, 2017

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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.0
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	37.2 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.4 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	51.4 $\pm$ 6 %	2.23 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (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	55.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (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 (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1 Ω - 6.1 j Ω
Return Loss	- 24.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω - 4.7 j Ω
Return Loss	- 24.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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	July 17, 2013

DASY5 Validation Report for Head TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1069

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 37.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

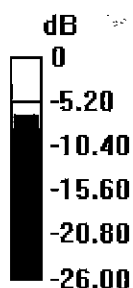
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.4 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.2 W/kg

SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.45 W/kg

Maximum value of SAR (measured) = 24.5 W/kg

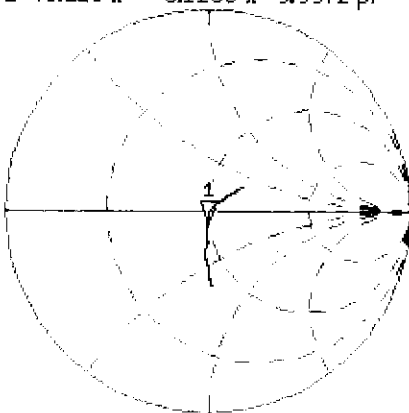


0 dB = 24.5 W/kg = 13.89 dBW/kg

Impedance Measurement Plot for Head TSL

11 Sep 2017 12:04:09
 [CH1] S11 1 U FS 1: 49.115 Ω -6.1230 Ω 9.9972 pF 2 600.000 000 MHz

*
 Del
 CA



Avg
 16

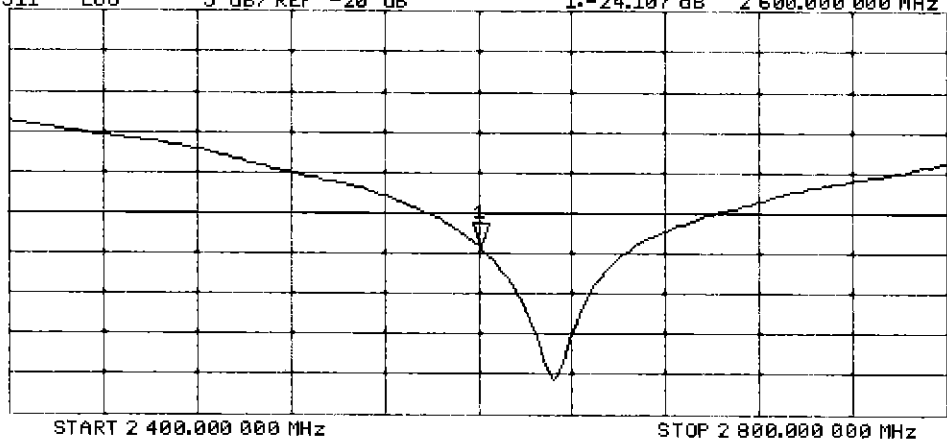
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.107 dB 2 600.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1069

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.23$ S/m; $\epsilon_r = 51.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

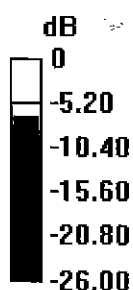
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.7 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 29.9 W/kg

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

Maximum value of SAR (measured) = 22.9 W/kg

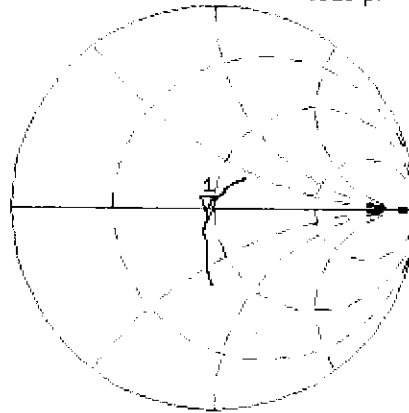


0 dB = 22.9 W/kg = 13.60 dBW/kg

Impedance Measurement Plot for Body TSL

11 Sep 2017 12:03:28
 CH1 S11 1 U FS 1: 46.244 Ω -4.7051 Ω 13.010 pF 2 600.000 000 MHz

*
 Del
 CA



Avg
 16

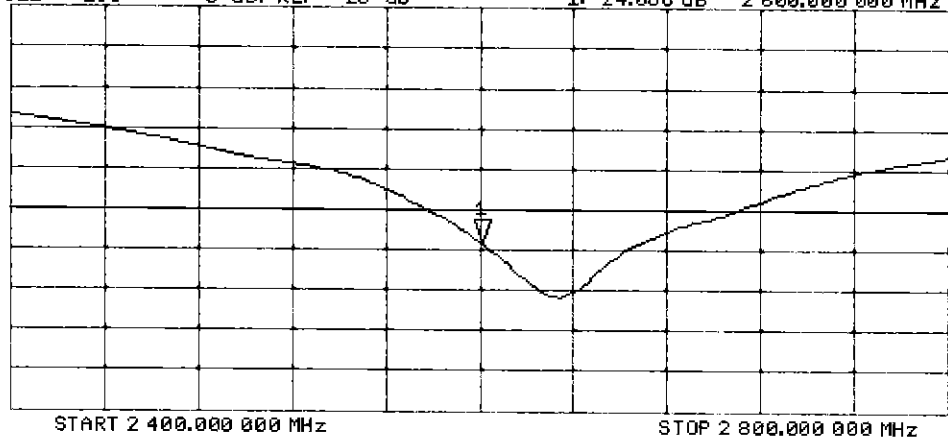
H1d

CH2 S11 L06 5 dB/REF -20 dB 1:-24.086 dB 2 600.000 000 MHz

CA

Avg
 16

H1d



START 2 400.000 000 MHz

STOP 2 800.000 000 MHz

Certification of Calibration

Object D2600V2 – SN: 1069

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

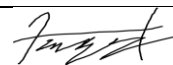
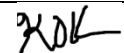
Extended Calibration date: September 10, 2018

Description: SAR Validation Dipole at 2600 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533
SPEAG	ES3DV3	SAR Probe	4/12/2018	Annual	4/12/2019	3275
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/12/2018	Annual	4/12/2019	501

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

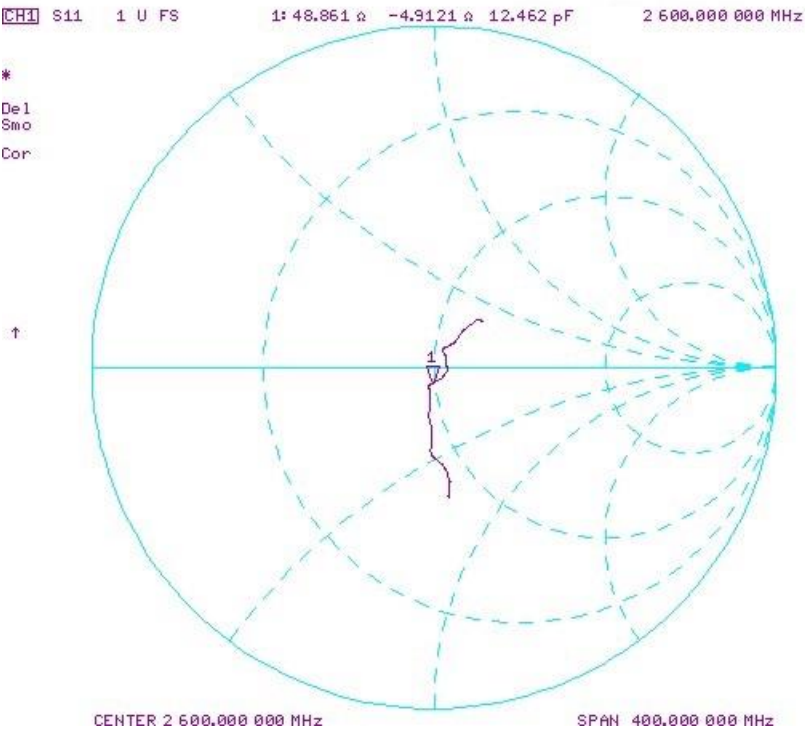
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

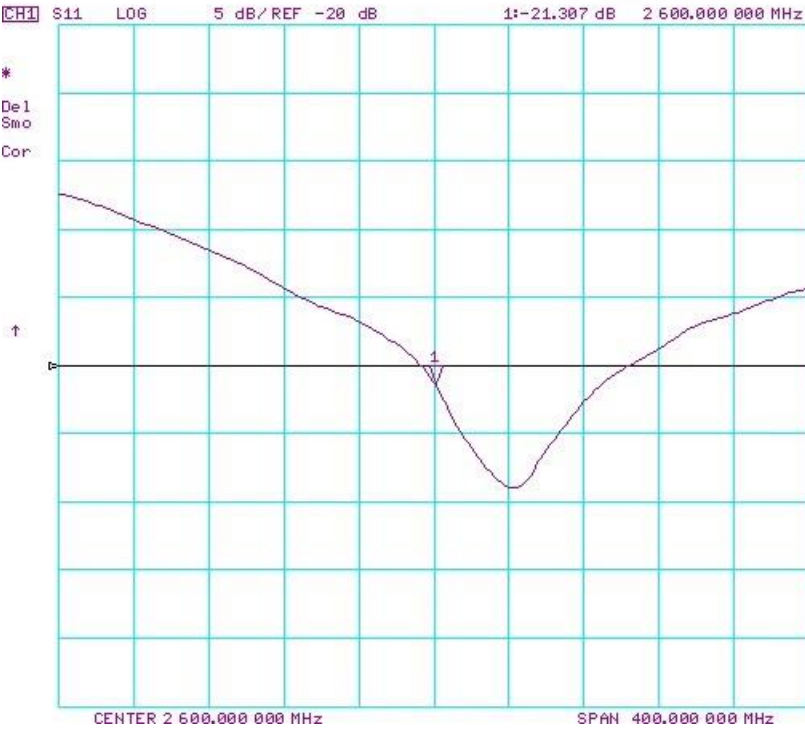
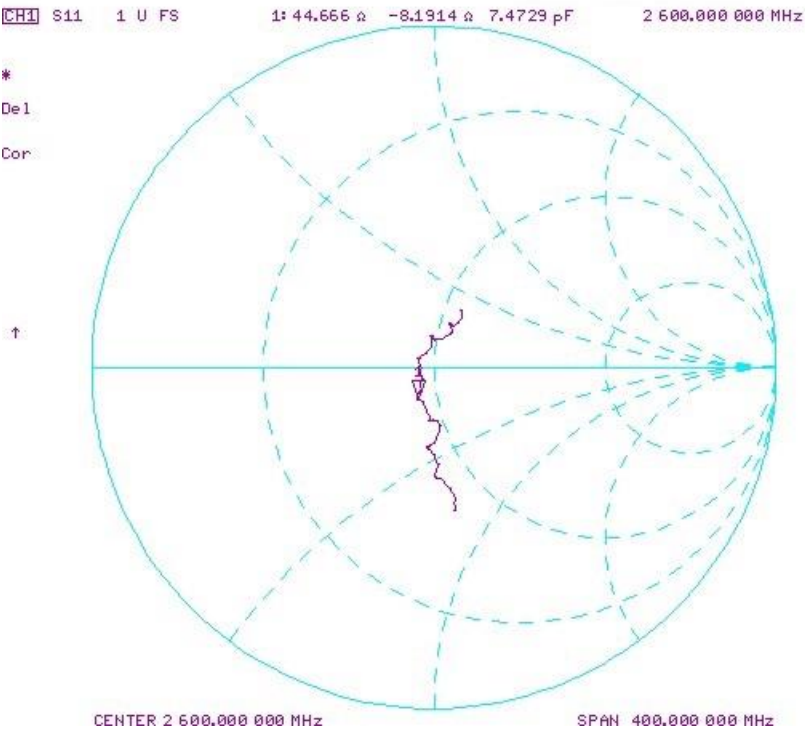
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/10/2018	1.152	5.69	5.52	-2.99%	2.54	2.51	-1.18%	49.1	48.9	0.2	-6.1	-4.9	1.2	-24.1	-25.8	-7.10%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/10/2018	1.152	5.53	5.28	-4.52%	2.48	2.35	-5.24%	46.2	44.7	1.5	-4.7	-8.2	3.5	-24.1	-21.3	11.60%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1163_Sep17**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1163**

Calibration procedure(s) **QA CAL-22.v2**
Calibration procedure for dipole validation kits between 3-6 GHz

SCV
10/03/2017

Calibration date: **September 13, 2017**

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3503	31-Dec-16 (No. EX3-3503_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Signature

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

Issued: September 13, 2017

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



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 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.10.0
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	5250 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5750 MHz $\pm$ 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	36.7 $\pm$ 6 %	4.59 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.7 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg $\pm$ 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	36.2 ± 6 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.1 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.0 ± 6 %	5.12 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 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 %	5.96 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	8.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 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 5750 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	47.6 Ω - 1.7 j Ω
Return Loss	- 30.3 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	50.0 Ω + 4.6 j Ω
Return Loss	- 26.8 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	52.6 Ω + 5.4 j Ω
Return Loss	- 24.7 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	46.6 Ω - 0.1 j Ω
Return Loss	- 29.0 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	51.3 Ω + 5.0 j Ω
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	53.2 Ω + 5.1 j Ω
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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 06, 2013

DASY5 Validation Report for Head TSL

Date: 13.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1163

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.59$ S/m; $\epsilon_r = 36.7$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.95$ S/m; $\epsilon_r = 36.2$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.12$ S/m; $\epsilon_r = 36$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.64 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 28.4 W/kg

SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.24 W/kg

Maximum value of SAR (measured) = 17.5 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 = 70.03 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.4 W/kg

SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.33 W/kg

Maximum value of SAR (measured) = 18.9 W/kg

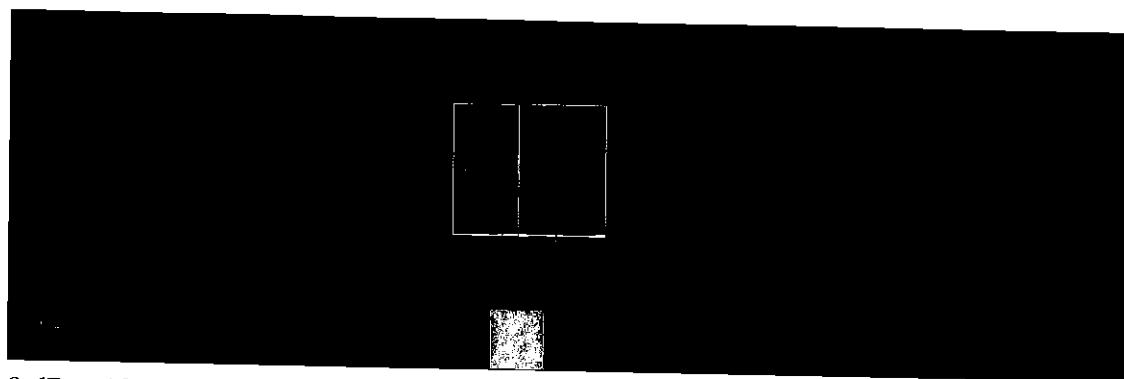
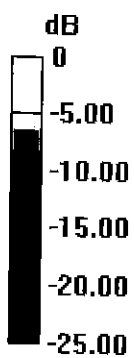
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 68.11 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 30.7 W/kg

SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 18.1 W/kg

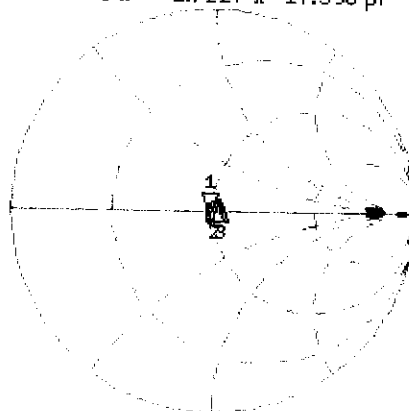


0 dB = 18.1 W/kg = 12.58 dBW/kg

Impedance Measurement Plot for Head TSL

13 Sep 2017 12:31:45
 CH1 S11 1 U FS 1: 47.576 Ω -1.7227 Ω 17.598 pF 5 250.000 000 MHz

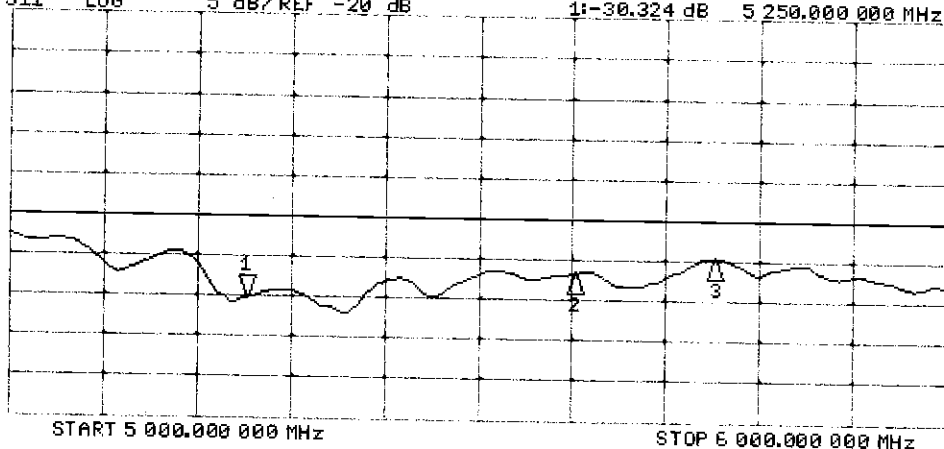
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 49.963 Ω
 4: 5586 Ω
 5.60000 GHz
 3: 52.564 Ω
 5.3887 Ω
 5.75000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -30.324 dB 5 250.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -26.824 dB
 5.60000 GHz
 3: -24.710 dB
 5.75000 GHz

DASY5 Validation Report for Body TSL

Date: 06.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1163

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 5.49$ S/m; $\epsilon_r = 47$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.96$ S/m; $\epsilon_r = 46.4$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5750$ MHz; $\sigma = 6.17$ S/m; $\epsilon_r = 46.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.51, 4.51, 4.51); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.77 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 18.5 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 = 64.00 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 33.7 W/kg

SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.24 W/kg

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

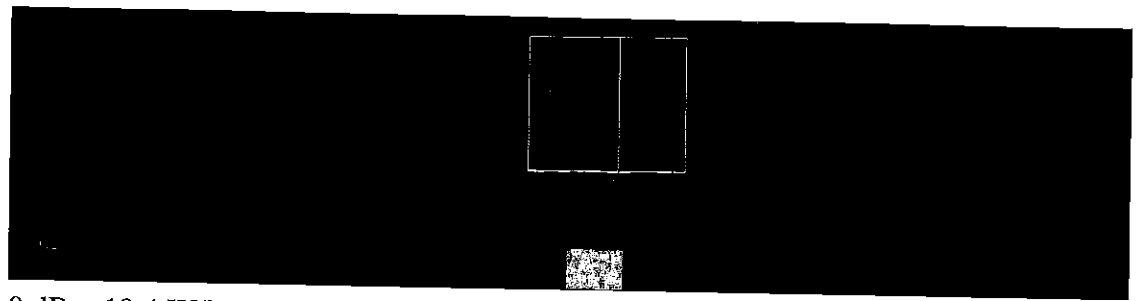
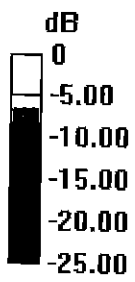
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.82 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg

Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS

6 Sep 2017 15:32:03
1: 46.590 Ω -128.91 m Ω 235.17 pF 5 250.000 000 MHz

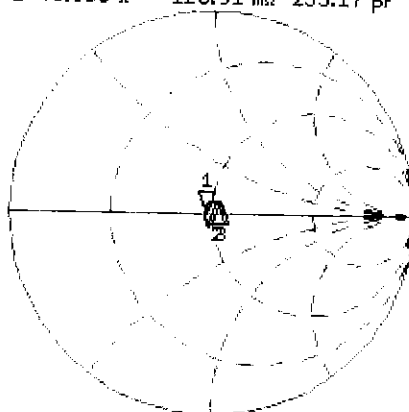
*

De1

Cor

Avg
16

H1d



CH1 Markers

2: 51.301 Ω
4.9570 Ω
5.60000 GHz
3: 53.199 Ω
5.0781 Ω
5.75000 GHz

CH2 S11 LOG

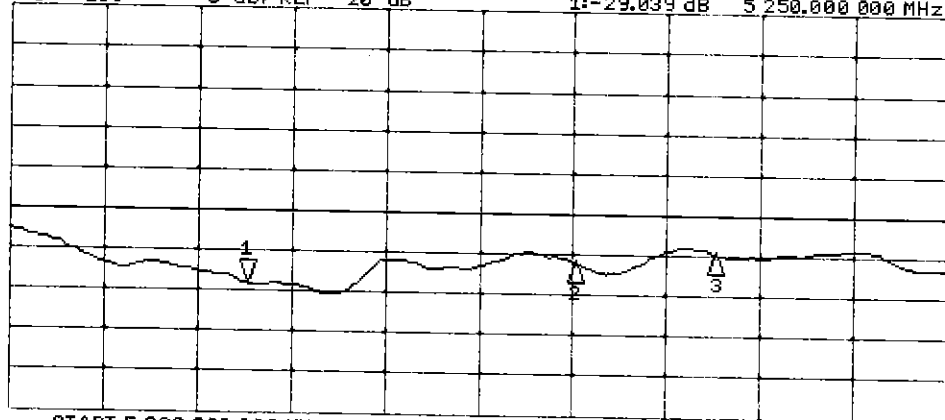
5 dB/REF -20 dB

1: -29.039 dB 5 250.000 000 MHz

Cor

Avg
16

H1d



CH2 Markers

2: -25.929 dB
5.60000 GHz
3: -24.720 dB
5.75000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **PC Test**

Certificate No: **ES3-3022_Jun18**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

Calibration date: **June 22, 2018**

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: June 23, 2018			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: **SCS 0108**

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 Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: June 22, 2018

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.97	1.01	0.96	$\pm 10.1 \%$
DCP (mV) ^B	99.7	96.5	102.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	180.7	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		185.0	
		Z	0.0	0.0	1.0		180.9	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

	C1 fF	C2 fF	α V ⁻¹	T1 ms.V ⁻²	T2 ms.V ⁻¹	T3 ms	T4 V ⁻²	T5 V ⁻¹	T6
X	56.30	408.5	36.17	29.39	2.977	5.10	0.000	0.584	1.011
Y	51.61	379.9	36.94	28.97	2.404	5.10	0.000	0.498	1.013
Z	49.66	357.5	35.61	28.42	2.517	5.10	0.193	0.469	1.009

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

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	6.54	6.54	6.54	0.50	1.39	± 12.0 %
835	41.5	0.90	6.16	6.16	6.16	0.40	1.50	± 12.0 %
1750	40.1	1.37	5.32	5.32	5.32	0.32	1.94	± 12.0 %
1900	40.0	1.40	5.07	5.07	5.07	0.53	1.39	± 12.0 %
2300	39.5	1.67	4.76	4.76	4.76	0.54	1.44	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.58	1.39	± 12.0 %
2600	39.0	1.96	4.24	4.24	4.24	0.52	1.59	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	6.12	6.12	6.12	0.48	1.36	± 12.0 %
835	55.2	0.97	5.96	5.96	5.96	0.57	1.24	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.44	1.52	± 12.0 %
1900	53.3	1.52	4.67	4.67	4.67	0.37	1.86	± 12.0 %
2300	52.9	1.81	4.36	4.36	4.36	0.72	1.30	± 12.0 %
2450	52.7	1.95	4.22	4.22	4.22	0.80	1.19	± 12.0 %
2600	52.5	2.16	4.03	4.03	4.03	0.72	1.14	± 12.0 %

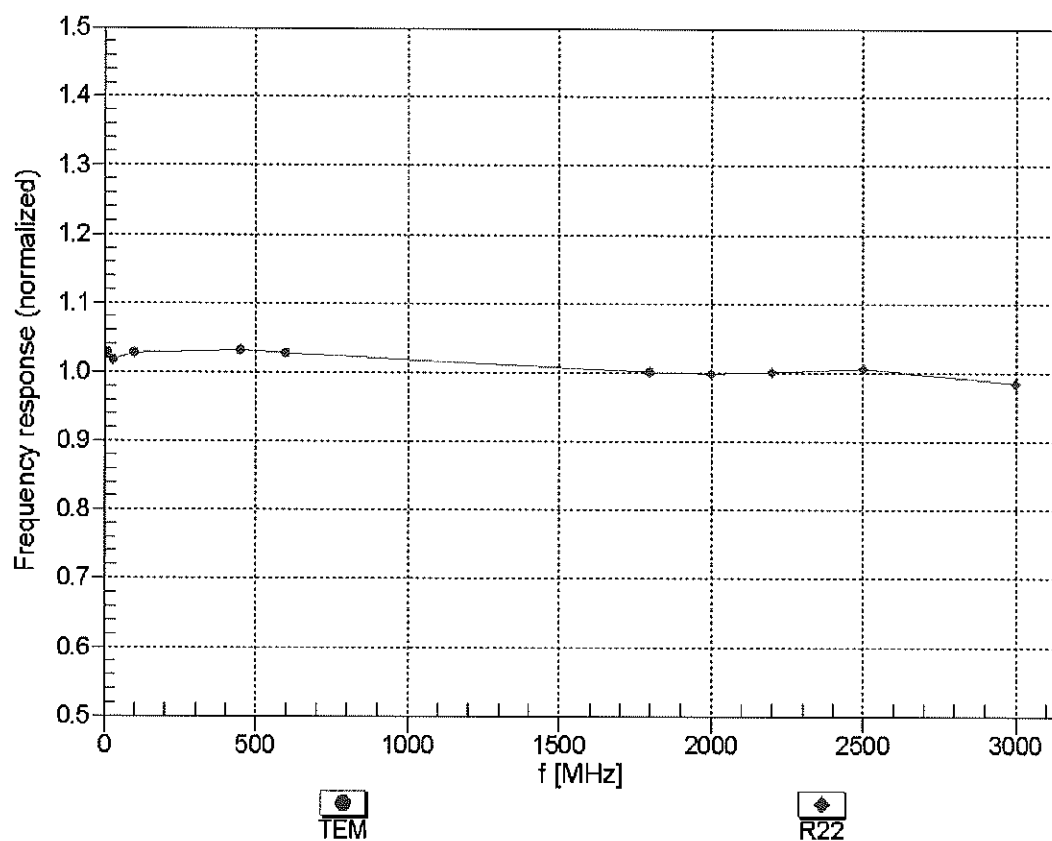
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

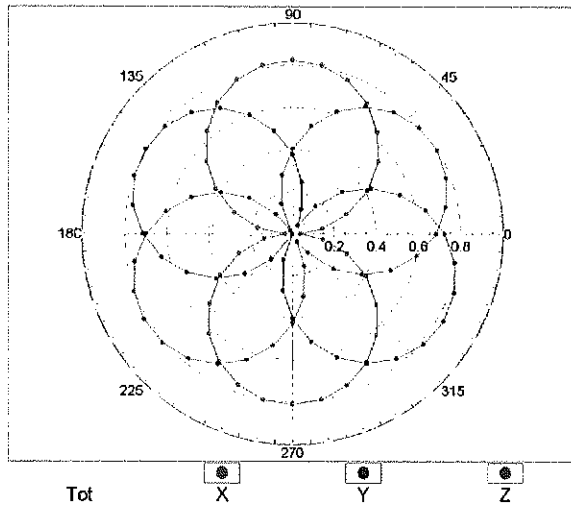
(TEM-Cell:ifi110 EXX, Waveguide: R22)



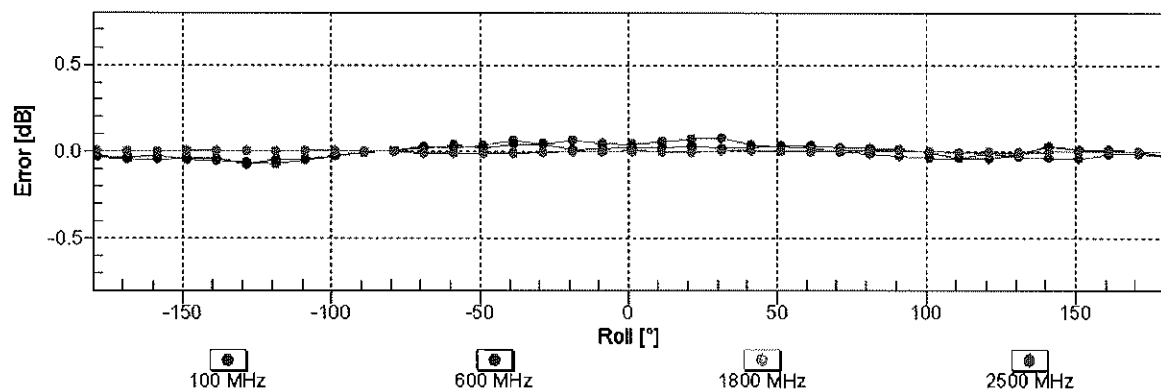
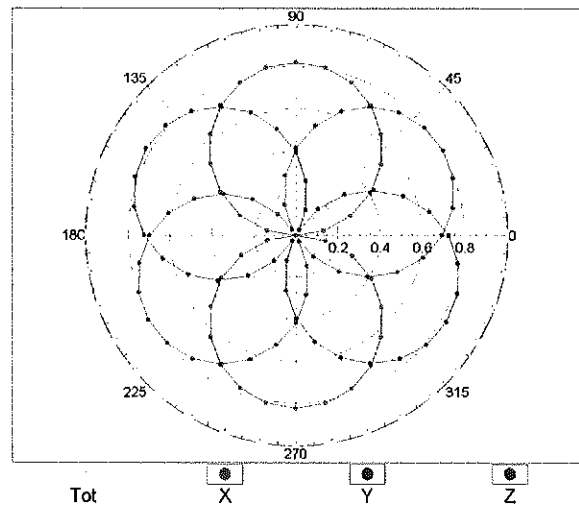
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM

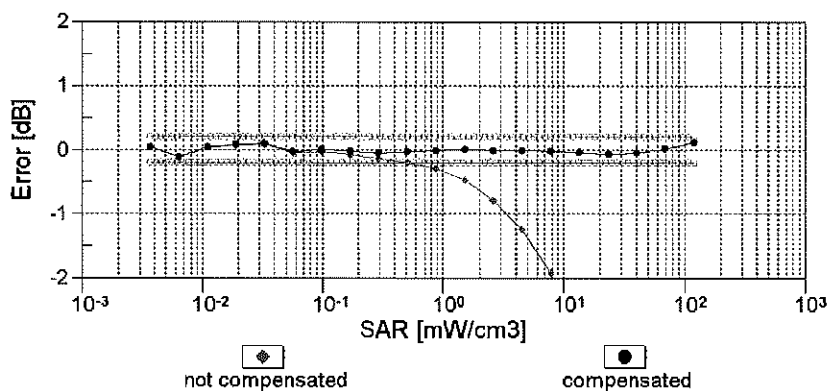
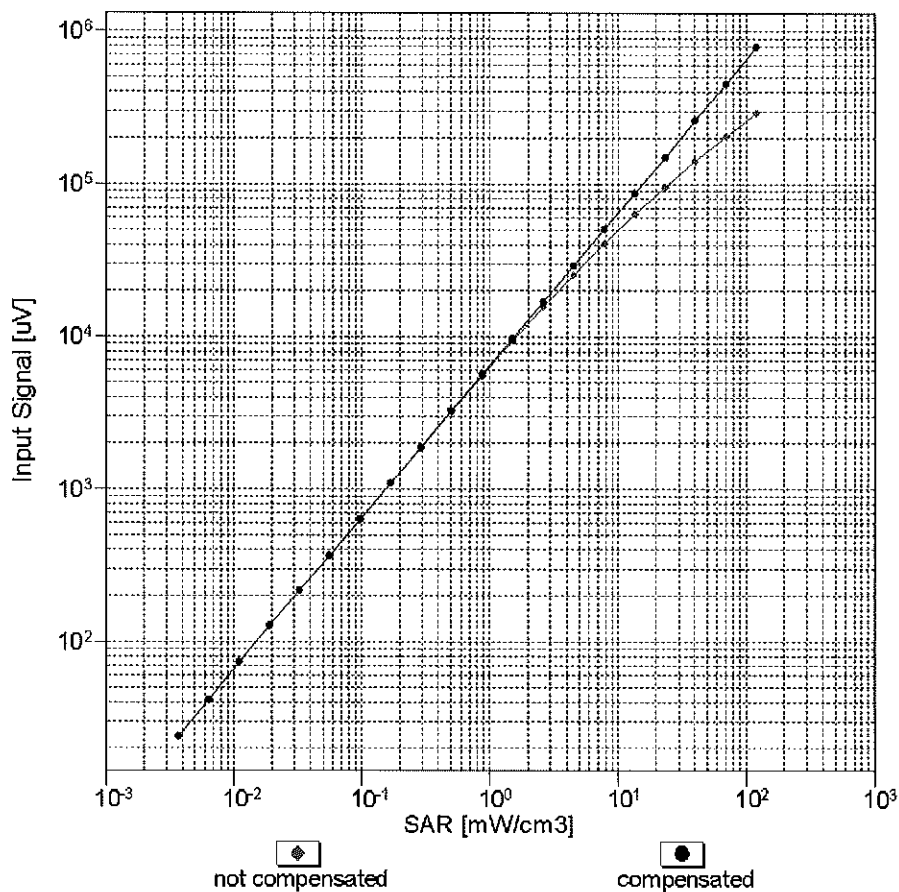


f=1800 MHz,R22



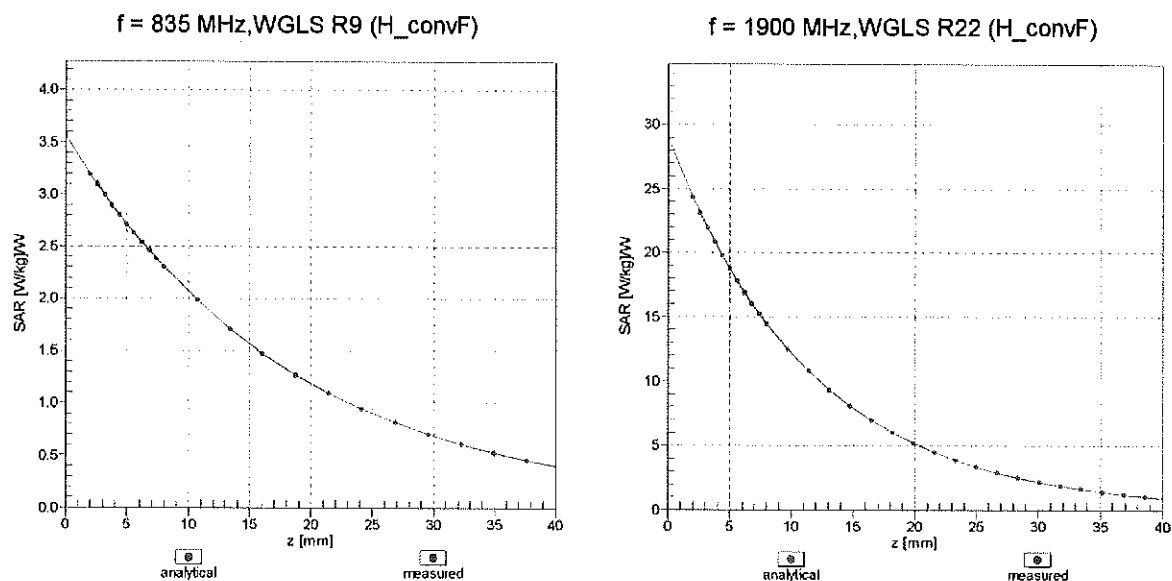
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



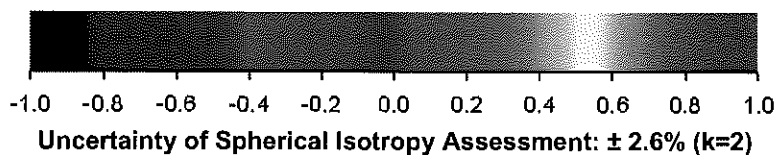
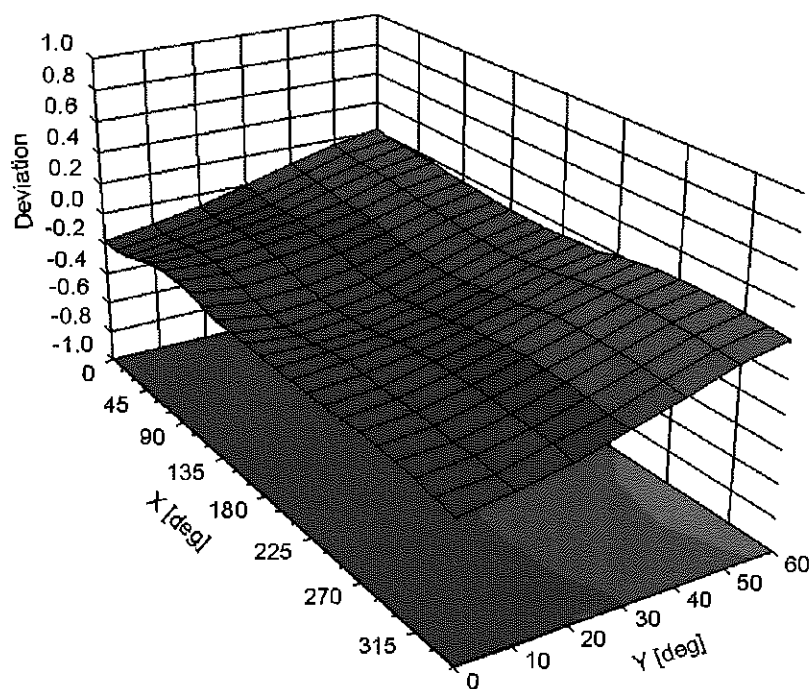
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	101.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Appendix: Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB μ V	C	D dB	VR mV	Max Unc ^E (k=2)
0	CW	X	0.00	0.00	1.00	0.00	180.7	$\pm 3.3 \%$
		Y	0.00	0.00	1.00		185.0	
		Z	0.00	0.00	1.00		180.9	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	9.12	80.72	19.72	10.00	25.0	$\pm 9.6 \%$
		Y	7.78	78.39	18.16		25.0	
		Z	8.88	80.43	19.18		25.0	
10011- CAB	UMTS-FDD (WCDMA)	X	1.13	69.14	16.23	0.00	150.0	$\pm 9.6 \%$
		Y	0.94	65.93	14.05		150.0	
		Z	1.03	67.74	15.26		150.0	
10012- CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	1.32	65.59	16.25	0.41	150.0	$\pm 9.6 \%$
		Y	1.23	64.33	15.18		150.0	
		Z	1.28	65.16	15.80		150.0	
10013- CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	5.15	67.35	17.56	1.46	150.0	$\pm 9.6 \%$
		Y	5.05	67.11	17.34		150.0	
		Z	5.06	67.35	17.45		150.0	
10021- DAC	GSM-FDD (TDMA, GMSK)	X	21.12	96.30	26.79	9.39	50.0	$\pm 9.6 \%$
		Y	34.63	103.95	28.36		50.0	
		Z	29.26	101.54	27.92		50.0	
10023- DAC	GPRS-FDD (TDMA, GMSK, TN 0)	X	18.75	94.15	26.16	9.57	50.0	$\pm 9.6 \%$
		Y	27.39	100.04	27.27		50.0	
		Z	24.24	98.32	27.00		50.0	
10024- DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	100.00	119.51	31.22	6.56	60.0	$\pm 9.6 \%$
		Y	100.00	117.40	29.84		60.0	
		Z	100.00	118.34	30.40		60.0	
10025- DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	X	19.29	106.16	40.42	12.57	50.0	$\pm 9.6 \%$
		Y	14.92	99.57	37.85		50.0	
		Z	20.66	109.51	41.75		50.0	
10026- DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	19.66	103.12	35.65	9.56	60.0	$\pm 9.6 \%$
		Y	18.05	101.73	35.07		60.0	
		Z	20.79	105.41	36.46		60.0	
10027- DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	100.00	118.25	29.66	4.80	80.0	$\pm 9.6 \%$
		Y	100.00	115.76	28.17		80.0	
		Z	100.00	117.04	28.87		80.0	
10028- DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	100.00	118.29	28.82	3.55	100.0	$\pm 9.6 \%$
		Y	100.00	115.14	27.08		100.0	
		Z	100.00	116.95	28.01		100.0	
10029- DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	13.53	94.90	31.74	7.80	80.0	$\pm 9.6 \%$
		Y	11.99	92.66	30.82		80.0	
		Z	13.36	95.33	31.90		80.0	
10030- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	100.00	117.88	29.84	5.30	70.0	$\pm 9.6 \%$
		Y	100.00	115.45	28.36		70.0	
		Z	100.00	116.58	28.99		70.0	
10031- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	100.00	118.97	27.49	1.88	100.0	$\pm 9.6 \%$
		Y	100.00	112.96	24.59		100.0	
		Z	100.00	116.57	26.27		100.0	

10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	100.00	122.85	27.97	1.17	100.0	± 9.6 %
		Y	100.00	112.87	23.49		100.0	
		Z	100.00	119.11	26.22		100.0	
10033-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	X	16.94	95.81	26.51	5.30	70.0	± 9.6 %
		Y	16.15	94.60	25.59		70.0	
		Z	17.74	96.16	26.17		70.0	
10034-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	X	8.87	89.65	22.97	1.88	100.0	± 9.6 %
		Y	5.53	82.01	19.73		100.0	
		Z	7.80	87.02	21.52		100.0	
10035-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	X	5.00	83.13	20.55	1.17	100.0	± 9.6 %
		Y	3.13	75.87	17.18		100.0	
		Z	4.27	80.34	18.96		100.0	
10036-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	X	20.34	99.02	27.54	5.30	70.0	± 9.6 %
		Y	20.03	98.23	26.74		70.0	
		Z	21.83	99.68	27.27		70.0	
10037-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	X	8.42	88.95	22.71	1.88	100.0	± 9.6 %
		Y	5.23	81.29	19.45		100.0	
		Z	7.27	86.10	21.20		100.0	
10038-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	X	5.22	84.01	20.94	1.17	100.0	± 9.6 %
		Y	3.22	76.47	17.50		100.0	
		Z	4.42	81.08	19.32		100.0	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	2.15	74.05	16.96	0.00	150.0	± 9.6 %
		Y	1.48	68.71	13.88		150.0	
		Z	1.75	71.47	15.26		150.0	
10042-CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	X	51.16	108.30	28.43	7.78	50.0	± 9.6 %
		Y	88.21	114.49	29.14		50.0	
		Z	92.16	115.96	29.82		50.0	
10044-CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	X	0.00	110.75	3.44	0.00	150.0	± 9.6 %
		Y	0.01	124.18	1.76		150.0	
		Z	0.00	108.83	6.62		150.0	
10048-CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	X	11.42	83.38	24.28	13.80	25.0	± 9.6 %
		Y	13.16	86.56	24.81		25.0	
		Z	12.43	85.46	24.63		25.0	
10049-CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	X	13.53	87.91	24.50	10.79	40.0	± 9.6 %
		Y	16.13	90.98	24.89		40.0	
		Z	15.33	90.21	24.85		40.0	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	12.94	87.44	24.76	9.03	50.0	± 9.6 %
		Y	13.62	88.57	24.69		50.0	
		Z	13.86	88.86	24.90		50.0	
10058-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	9.99	89.04	28.92	6.55	100.0	± 9.6 %
		Y	8.79	86.66	27.91		100.0	
		Z	9.58	88.70	28.79		100.0	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	1.52	67.99	17.40	0.61	110.0	± 9.6 %
		Y	1.38	66.31	16.16		110.0	
		Z	1.46	67.39	16.89		110.0	
10060-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	100.00	131.43	33.80	1.30	110.0	± 9.6 %
		Y	63.48	121.74	30.70		110.0	
		Z	100.00	130.20	33.12		110.0	

10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	12.72	100.01	28.21	2.04	110.0	± 9.6 %
		Y	8.00	91.91	25.30		110.0	
		Z	11.18	97.82	27.34		110.0	
10062-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	4.86	67.08	16.83	0.49	100.0	± 9.6 %
		Y	4.76	66.82	16.60		100.0	
		Z	4.77	67.05	16.71		100.0	
10063-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	X	4.90	67.25	16.98	0.72	100.0	± 9.6 %
		Y	4.80	66.98	16.73		100.0	
		Z	4.81	67.21	16.85		100.0	
10064-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	X	5.23	67.58	17.24	0.86	100.0	± 9.6 %
		Y	5.11	67.30	17.01		100.0	
		Z	5.11	67.52	17.11		100.0	
10065-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	X	5.14	67.63	17.42	1.21	100.0	± 9.6 %
		Y	5.02	67.34	17.18		100.0	
		Z	5.03	67.57	17.29		100.0	
10066-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	X	5.20	67.78	17.66	1.46	100.0	± 9.6 %
		Y	5.07	67.47	17.41		100.0	
		Z	5.08	67.71	17.52		100.0	
10067-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	X	5.53	67.98	18.13	2.04	100.0	± 9.6 %
		Y	5.40	67.73	17.91		100.0	
		Z	5.42	67.97	18.03		100.0	
10068-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	X	5.67	68.34	18.51	2.55	100.0	± 9.6 %
		Y	5.53	68.01	18.26		100.0	
		Z	5.54	68.25	18.37		100.0	
10069-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	X	5.75	68.32	18.71	2.67	100.0	± 9.6 %
		Y	5.61	68.01	18.46		100.0	
		Z	5.63	68.27	18.59		100.0	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	5.30	67.61	17.96	1.99	100.0	± 9.6 %
		Y	5.20	67.35	17.74		100.0	
		Z	5.21	67.60	17.85		100.0	
10072-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	5.37	68.19	18.29	2.30	100.0	± 9.6 %
		Y	5.25	67.88	18.05		100.0	
		Z	5.27	68.14	18.18		100.0	
10073-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	5.52	68.58	18.74	2.83	100.0	± 9.6 %
		Y	5.38	68.25	18.48		100.0	
		Z	5.41	68.54	18.62		100.0	
10074-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	5.57	68.68	19.00	3.30	100.0	± 9.6 %
		Y	5.43	68.33	18.73		100.0	
		Z	5.47	68.64	18.88		100.0	
10075-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	5.73	69.19	19.51	3.82	90.0	± 9.6 %
		Y	5.57	68.75	19.20		90.0	
		Z	5.61	69.08	19.36		90.0	
10076-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	5.76	69.02	19.65	4.15	90.0	± 9.6 %
		Y	5.60	68.61	19.35		90.0	
		Z	5.65	68.96	19.53		90.0	
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	5.80	69.13	19.76	4.30	90.0	± 9.6 %
		Y	5.64	68.71	19.46		90.0	
		Z	5.70	69.08	19.65		90.0	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	0.97	67.77	13.80	0.00	150.0	± 9.6 %
		Y	0.73	64.07	11.07		150.0	
		Z	0.81	65.70	12.14		150.0	
10082-CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	X	2.25	64.31	9.20	4.77	80.0	± 9.6 %
		Y	1.88	62.88	7.97		80.0	
		Z	2.02	63.56	8.52		80.0	
10090-DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	100.00	119.60	31.28	6.56	60.0	± 9.6 %
		Y	100.00	117.50	29.91		60.0	
		Z	100.00	118.43	30.47		60.0	
10097-CAB	UMTS-FDD (HSDPA)	X	1.89	68.21	16.12	0.00	150.0	± 9.6 %
		Y	1.73	66.65	14.94		150.0	
		Z	1.81	67.75	15.61		150.0	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	1.85	68.19	16.10	0.00	150.0	± 9.6 %
		Y	1.69	66.60	14.90		150.0	
		Z	1.78	67.71	15.59		150.0	
10099-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	19.56	102.95	35.59	9.56	60.0	± 9.6 %
		Y	18.00	101.62	35.03		60.0	
		Z	20.69	105.25	36.41		60.0	
10100-CAD	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	3.30	71.09	17.05	0.00	150.0	± 9.6 %
		Y	3.01	69.46	16.11		150.0	
		Z	3.13	70.42	16.66		150.0	
10101-CAD	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	3.35	67.99	16.21	0.00	150.0	± 9.6 %
		Y	3.20	67.18	15.65		150.0	
		Z	3.25	67.66	15.95		150.0	
10102-CAD	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	3.45	67.89	16.28	0.00	150.0	± 9.6 %
		Y	3.31	67.16	15.76		150.0	
		Z	3.35	67.61	16.03		150.0	
10103-CAD	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	8.68	78.34	21.41	3.98	65.0	± 9.6 %
		Y	8.39	78.12	21.24		65.0	
		Z	8.61	78.63	21.46		65.0	
10104-CAD	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	8.59	76.98	21.71	3.98	65.0	± 9.6 %
		Y	8.24	76.55	21.45		65.0	
		Z	8.42	77.02	21.66		65.0	
10105-CAD	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	8.27	76.21	21.68	3.98	65.0	± 9.6 %
		Y	7.96	75.85	21.44		65.0	
		Z	8.08	76.18	21.59		65.0	
10108-CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	2.90	70.34	16.91	0.00	150.0	± 9.6 %
		Y	2.64	68.76	15.95		150.0	
		Z	2.74	69.70	16.50		150.0	
10109-CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	3.01	67.84	16.14	0.00	150.0	± 9.6 %
		Y	2.85	66.97	15.51		150.0	
		Z	2.90	67.50	15.84		150.0	
10110-CAE	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	2.38	69.52	16.61	0.00	150.0	± 9.6 %
		Y	2.14	67.85	15.51		150.0	
		Z	2.23	68.86	16.13		150.0	
10111-CAE	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	2.71	68.52	16.43	0.00	150.0	± 9.6 %
		Y	2.53	67.49	15.63		150.0	
		Z	2.60	68.20	16.05		150.0	

10112-CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	3.13	67.76	16.17	0.00	150.0	± 9.6 %
		Y	2.98	66.98	15.59		150.0	
		Z	3.02	67.48	15.89		150.0	
10113-CAE	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	2.86	68.59	16.53	0.00	150.0	± 9.6 %
		Y	2.69	67.66	15.79		150.0	
		Z	2.75	68.32	16.17		150.0	
10114-CAC	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	5.22	67.41	16.60	0.00	150.0	± 9.6 %
		Y	5.16	67.20	16.42		150.0	
		Z	5.15	67.40	16.52		150.0	
10115-CAC	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	5.59	67.76	16.79	0.00	150.0	± 9.6 %
		Y	5.47	67.41	16.54		150.0	
		Z	5.46	67.57	16.61		150.0	
10116-CAC	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	5.35	67.70	16.67	0.00	150.0	± 9.6 %
		Y	5.27	67.44	16.47		150.0	
		Z	5.26	67.61	16.55		150.0	
10117-CAC	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	5.21	67.36	16.59	0.00	150.0	± 9.6 %
		Y	5.12	67.05	16.36		150.0	
		Z	5.11	67.24	16.46		150.0	
10118-CAC	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	5.68	67.99	16.91	0.00	150.0	± 9.6 %
		Y	5.59	67.74	16.72		150.0	
		Z	5.55	67.82	16.75		150.0	
10119-CAC	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	5.33	67.64	16.65	0.00	150.0	± 9.6 %
		Y	5.25	67.40	16.46		150.0	
		Z	5.23	67.56	16.54		150.0	
10140-CAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	3.49	67.90	16.20	0.00	150.0	± 9.6 %
		Y	3.35	67.17	15.68		150.0	
		Z	3.38	67.62	15.95		150.0	
10141-CAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	3.61	67.94	16.34	0.00	150.0	± 9.6 %
		Y	3.47	67.27	15.86		150.0	
		Z	3.51	67.70	16.12		150.0	
10142-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	2.16	69.56	16.39	0.00	150.0	± 9.6 %
		Y	1.89	67.62	15.05		150.0	
		Z	1.99	68.80	15.75		150.0	
10143-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	2.59	69.29	16.26	0.00	150.0	± 9.6 %
		Y	2.35	67.87	15.16		150.0	
		Z	2.44	68.82	15.68		150.0	
10144-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	2.39	67.25	14.80	0.00	150.0	± 9.6 %
		Y	2.18	65.99	13.75		150.0	
		Z	2.24	66.71	14.17		150.0	
10145-CAE	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	1.43	66.95	13.27	0.00	150.0	± 9.6 %
		Y	1.14	64.01	11.00		150.0	
		Z	1.19	64.93	11.55		150.0	
10146-CAE	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	2.88	71.44	15.09	0.00	150.0	± 9.6 %
		Y	2.19	68.05	12.99		150.0	
		Z	2.00	66.89	12.10		150.0	
10147-CAE	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	3.73	75.07	16.77	0.00	150.0	± 9.6 %
		Y	2.71	70.86	14.41		150.0	
		Z	2.36	69.01	13.24		150.0	

10149-CAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	3.02	67.89	16.19	0.00	150.0	± 9.6 %
		Y	2.86	67.02	15.55		150.0	
		Z	2.91	67.56	15.88		150.0	
10150-CAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	3.14	67.81	16.21	0.00	150.0	± 9.6 %
		Y	2.99	67.03	15.62		150.0	
		Z	3.03	67.53	15.93		150.0	
10151-CAD	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.24	80.70	22.42	3.98	65.0	± 9.6 %
		Y	8.94	80.53	22.24		65.0	
		Z	9.27	81.24	22.54		65.0	
10152-CAD	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	8.24	77.24	21.58	3.98	65.0	± 9.6 %
		Y	7.84	76.70	21.22		65.0	
		Z	8.05	77.25	21.46		65.0	
10153-CAD	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	8.60	77.96	22.20	3.98	65.0	± 9.6 %
		Y	8.27	77.61	21.94		65.0	
		Z	8.46	78.10	22.14		65.0	
10154-CAE	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	2.43	69.95	16.88	0.00	150.0	± 9.6 %
		Y	2.18	68.21	15.75		150.0	
		Z	2.27	69.24	16.37		150.0	
10155-CAE	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	2.71	68.53	16.44	0.00	150.0	± 9.6 %
		Y	2.53	67.50	15.65		150.0	
		Z	2.60	68.21	16.06		150.0	
10156-CAE	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	2.02	69.83	16.32	0.00	150.0	± 9.6 %
		Y	1.73	67.53	14.74		150.0	
		Z	1.84	68.84	15.51		150.0	
10157-CAE	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	2.24	67.95	14.94	0.00	150.0	± 9.6 %
		Y	1.99	66.32	13.65		150.0	
		Z	2.07	67.20	14.15		150.0	
10158-CAE	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	2.87	68.64	16.57	0.00	150.0	± 9.6 %
		Y	2.69	67.71	15.83		150.0	
		Z	2.75	68.38	16.22		150.0	
10159-CAE	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	2.35	68.36	15.21	0.00	150.0	± 9.6 %
		Y	2.09	66.69	13.90		150.0	
		Z	2.17	67.60	14.40		150.0	
10160-CAD	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	2.90	69.35	16.70	0.00	150.0	± 9.6 %
		Y	2.71	68.24	15.94		150.0	
		Z	2.77	68.92	16.36		150.0	
10161-CAD	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	3.03	67.73	16.15	0.00	150.0	± 9.6 %
		Y	2.88	66.94	15.54		150.0	
		Z	2.92	67.46	15.85		150.0	
10162-CAD	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	3.14	67.82	16.23	0.00	150.0	± 9.6 %
		Y	2.99	67.08	15.65		150.0	
		Z	3.03	67.60	15.96		150.0	
10166-CAE	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	3.79	70.15	19.63	3.01	150.0	± 9.6 %
		Y	3.61	69.64	19.37		150.0	
		Z	3.59	69.77	19.29		150.0	
10167-CAE	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	4.70	73.05	20.10	3.01	150.0	± 9.6 %
		Y	4.36	72.33	19.76		150.0	
		Z	4.38	72.59	19.72		150.0	

10168-CAE	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	5.13	74.98	21.26	3.01	150.0	± 9.6 %
		Y	4.81	74.54	21.08		150.0	
		Z	4.81	74.66	20.96		150.0	
10169-CAD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	3.24	70.32	19.77	3.01	150.0	± 9.6 %
		Y	2.95	68.97	19.14		150.0	
		Z	2.96	69.16	19.07		150.0	
10170-CAD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	4.47	76.14	21.98	3.01	150.0	± 9.6 %
		Y	3.92	74.50	21.37		150.0	
		Z	3.95	74.66	21.22		150.0	
10171-AAD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	3.75	72.35	19.45	3.01	150.0	± 9.6 %
		Y	3.27	70.62	18.68		150.0	
		Z	3.32	71.00	18.68		150.0	
10172-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	25.61	107.79	33.43	6.02	65.0	± 9.6 %
		Y	22.14	106.45	33.18		65.0	
		Z	23.36	107.08	33.16		65.0	
10173-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	28.53	105.12	30.95	6.02	65.0	± 9.6 %
		Y	32.15	108.79	32.08		65.0	
		Z	30.18	106.96	31.30		65.0	
10174-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	22.70	99.68	28.85	6.02	65.0	± 9.6 %
		Y	24.46	102.42	29.70		65.0	
		Z	22.92	100.73	28.97		65.0	
10175-CAE	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	3.21	70.03	19.54	3.01	150.0	± 9.6 %
		Y	2.92	68.68	18.89		150.0	
		Z	2.93	68.89	18.85		150.0	
10176-CAE	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	4.48	76.16	21.99	3.01	150.0	± 9.6 %
		Y	3.92	74.53	21.39		150.0	
		Z	3.95	74.68	21.24		150.0	
10177-CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	3.23	70.18	19.63	3.01	150.0	± 9.6 %
		Y	2.94	68.82	18.99		150.0	
		Z	2.95	69.02	18.93		150.0	
10178-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	4.43	75.93	21.86	3.01	150.0	± 9.6 %
		Y	3.88	74.30	21.26		150.0	
		Z	3.92	74.49	21.13		150.0	
10179-CAE	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	4.09	74.17	20.60	3.01	150.0	± 9.6 %
		Y	3.57	72.47	19.91		150.0	
		Z	3.61	72.76	19.84		150.0	
10180-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	3.74	72.28	19.40	3.01	150.0	± 9.6 %
		Y	3.26	70.55	18.63		150.0	
		Z	3.31	70.94	18.64		150.0	
10181-CAD	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	3.23	70.16	19.62	3.01	150.0	± 9.6 %
		Y	2.94	68.81	18.98		150.0	
		Z	2.94	69.01	18.92		150.0	
10182-CAD	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	4.42	75.91	21.85	3.01	150.0	± 9.6 %
		Y	3.87	74.28	21.25		150.0	
		Z	3.91	74.47	21.12		150.0	
10183-AAC	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	3.73	72.25	19.39	3.01	150.0	± 9.6 %
		Y	3.25	70.53	18.62		150.0	
		Z	3.31	70.92	18.63		150.0	

10184-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	3.24	70.20	19.64	3.01	150.0	± 9.6 %
		Y	2.95	68.85	19.00		150.0	
		Z	2.95	69.05	18.94		150.0	
10185-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	4.44	75.97	21.89	3.01	150.0	± 9.6 %
		Y	3.89	74.35	21.29		150.0	
		Z	3.93	74.54	21.15		150.0	
10186-AAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	3.75	72.32	19.42	3.01	150.0	± 9.6 %
		Y	3.27	70.59	18.65		150.0	
		Z	3.32	70.99	18.66		150.0	
10187-CAE	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	3.25	70.25	19.70	3.01	150.0	± 9.6 %
		Y	2.96	68.90	19.06		150.0	
		Z	2.96	69.09	19.00		150.0	
10188-CAE	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	4.58	76.60	22.24	3.01	150.0	± 9.6 %
		Y	4.01	74.99	21.66		150.0	
		Z	4.04	75.11	21.49		150.0	
10189-AAE	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	3.83	72.73	19.68	3.01	150.0	± 9.6 %
		Y	3.34	71.00	18.93		150.0	
		Z	3.39	71.37	18.92		150.0	
10193-CAC	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	4.62	66.80	16.33	0.00	150.0	± 9.6 %
		Y	4.53	66.52	16.07		150.0	
		Z	4.53	66.76	16.19		150.0	
10194-CAC	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	4.81	67.15	16.45	0.00	150.0	± 9.6 %
		Y	4.70	66.84	16.20		150.0	
		Z	4.71	67.08	16.32		150.0	
10195-CAC	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	4.85	67.17	16.46	0.00	150.0	± 9.6 %
		Y	4.75	66.88	16.22		150.0	
		Z	4.75	67.11	16.34		150.0	
10196-CAC	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	4.64	66.89	16.36	0.00	150.0	± 9.6 %
		Y	4.53	66.59	16.09		150.0	
		Z	4.54	66.82	16.21		150.0	
10197-CAC	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	4.83	67.17	16.47	0.00	150.0	± 9.6 %
		Y	4.72	66.87	16.21		150.0	
		Z	4.72	67.10	16.33		150.0	
10198-CAC	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	4.86	67.19	16.48	0.00	150.0	± 9.6 %
		Y	4.75	66.90	16.23		150.0	
		Z	4.75	67.13	16.35		150.0	
10219-CAC	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	4.58	66.90	16.32	0.00	150.0	± 9.6 %
		Y	4.48	66.59	16.05		150.0	
		Z	4.49	66.83	16.17		150.0	
10220-CAC	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	4.82	67.15	16.46	0.00	150.0	± 9.6 %
		Y	4.71	66.84	16.21		150.0	
		Z	4.71	67.07	16.32		150.0	
10221-CAC	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	4.86	67.12	16.46	0.00	150.0	± 9.6 %
		Y	4.76	66.83	16.22		150.0	
		Z	4.76	67.06	16.33		150.0	
10222-CAC	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	5.19	67.37	16.59	0.00	150.0	± 9.6 %
		Y	5.09	67.05	16.35		150.0	
		Z	5.09	67.25	16.45		150.0	

10223-CAC	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	5.52	67.63	16.74	0.00	150.0	± 9.6 %
		Y	5.42	67.33	16.53		150.0	
		Z	5.40	67.49	16.60		150.0	
10224-CAC	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	5.23	67.46	16.56	0.00	150.0	± 9.6 %
		Y	5.14	67.16	16.34		150.0	
		Z	5.13	67.36	16.43		150.0	
10225-CAB	UMTS-FDD (HSPA+)	X	2.89	66.40	15.64	0.00	150.0	± 9.6 %
		Y	2.77	65.79	15.06		150.0	
		Z	2.80	66.23	15.32		150.0	
10226-CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	30.12	106.23	31.36	6.02	65.0	± 9.6 %
		Y	34.82	110.42	32.62		65.0	
		Z	32.27	108.32	31.77		65.0	
10227-CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	24.97	101.48	29.46	6.02	65.0	± 9.6 %
		Y	29.42	105.79	30.75		65.0	
		Z	27.01	103.63	29.87		65.0	
10228-CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	29.67	111.13	34.49	6.02	65.0	± 9.6 %
		Y	27.16	110.89	34.56		65.0	
		Z	28.51	111.32	34.46		65.0	
10229-CAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	28.56	105.12	30.96	6.02	65.0	± 9.6 %
		Y	32.23	108.82	32.10		65.0	
		Z	30.23	106.98	31.31		65.0	
10230-CAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	23.87	100.59	29.13	6.02	65.0	± 9.6 %
		Y	27.48	104.47	30.31		65.0	
		Z	25.51	102.53	29.49		65.0	
10231-CAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	28.15	109.97	34.08	6.02	65.0	± 9.6 %
		Y	25.42	109.44	34.06		65.0	
		Z	26.84	110.01	34.01		65.0	
10232-CAD	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	28.55	105.12	30.96	6.02	65.0	± 9.6 %
		Y	32.22	108.83	32.10		65.0	
		Z	30.23	106.99	31.32		65.0	
10233-CAD	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	23.88	100.61	29.14	6.02	65.0	± 9.6 %
		Y	27.47	104.47	30.31		65.0	
		Z	25.50	102.54	29.49		65.0	
10234-CAD	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	26.72	108.74	33.63	6.02	65.0	± 9.6 %
		Y	23.94	108.04	33.55		65.0	
		Z	25.35	108.68	33.52		65.0	
10235-CAD	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	28.64	105.19	30.98	6.02	65.0	± 9.6 %
		Y	32.35	108.91	32.12		65.0	
		Z	30.34	107.07	31.34		65.0	
10236-CAD	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	24.09	100.74	29.17	6.02	65.0	± 9.6 %
		Y	27.77	104.64	30.35		65.0	
		Z	25.76	102.69	29.53		65.0	
10237-CAD	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	28.42	110.18	34.15	6.02	65.0	± 9.6 %
		Y	25.64	109.64	34.12		65.0	
		Z	27.09	110.23	34.07		65.0	
10238-CAD	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	28.55	105.14	30.97	6.02	65.0	± 9.6 %
		Y	32.21	108.84	32.10		65.0	
		Z	30.22	107.00	31.32		65.0	

10239-CAD	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	23.87	100.62	29.14	6.02	65.0	± 9.6 %
		Y	27.45	104.48	30.31		65.0	
		Z	25.49	102.55	29.50		65.0	
10240-CAD	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	28.32	110.12	34.13	6.02	65.0	± 9.6 %
		Y	25.54	109.58	34.10		65.0	
		Z	27.00	110.17	34.06		65.0	
10241-CAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	12.01	86.44	27.50	6.98	65.0	± 9.6 %
		Y	11.32	86.10	27.36		65.0	
		Z	11.85	87.07	27.59		65.0	
10242-CAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	11.22	84.92	26.83	6.98	65.0	± 9.6 %
		Y	10.54	84.52	26.66		65.0	
		Z	10.96	85.36	26.86		65.0	
10243-CAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	9.36	82.71	26.86	6.98	65.0	± 9.6 %
		Y	8.68	81.81	26.47		65.0	
		Z	9.04	82.81	26.78		65.0	
10244-CAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	9.20	80.16	20.97	3.98	65.0	± 9.6 %
		Y	8.90	79.99	20.57		65.0	
		Z	8.43	78.77	19.85		65.0	
10245-CAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	X	9.05	79.64	20.72	3.98	65.0	± 9.6 %
		Y	8.67	79.32	20.26		65.0	
		Z	8.23	78.16	19.56		65.0	
10246-CAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	9.25	82.90	21.89	3.98	65.0	± 9.6 %
		Y	8.35	81.34	20.87		65.0	
		Z	8.83	82.25	21.22		65.0	
10247-CAD	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	7.67	77.68	20.47	3.98	65.0	± 9.6 %
		Y	7.14	76.72	19.73		65.0	
		Z	7.35	77.20	19.90		65.0	
10248-CAD	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	7.65	77.19	20.27	3.98	65.0	± 9.6 %
		Y	7.09	76.18	19.49		65.0	
		Z	7.28	76.65	19.67		65.0	
10249-CAD	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	10.28	84.91	23.29	3.98	65.0	± 9.6 %
		Y	9.73	84.22	22.70		65.0	
		Z	10.33	85.25	23.10		65.0	
10250-CAD	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	8.56	79.63	22.54	3.98	65.0	± 9.6 %
		Y	8.21	79.30	22.21		65.0	
		Z	8.43	79.79	22.40		65.0	
10251-CAD	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	8.13	77.62	21.46	3.98	65.0	± 9.6 %
		Y	7.72	77.06	21.01		65.0	
		Z	7.94	77.62	21.25		65.0	
10252-CAD	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	10.04	83.94	23.64	3.98	65.0	± 9.6 %
		Y	9.73	83.79	23.39		65.0	
		Z	10.22	84.72	23.77		65.0	
10253-CAD	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	8.03	76.66	21.37	3.98	65.0	± 9.6 %
		Y	7.66	76.16	21.00		65.0	
		Z	7.86	76.71	21.24		65.0	
10254-CAD	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	8.40	77.39	21.95	3.98	65.0	± 9.6 %
		Y	8.07	77.03	21.65		65.0	
		Z	8.26	77.52	21.85		65.0	

10255-CAD	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	8.96	80.36	22.51	3.98	65.0	± 9.6 %
		Y	8.65	80.17	22.31		65.0	
		Z	8.98	80.90	22.62		65.0	
10256-CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	8.08	77.70	19.21	3.98	65.0	± 9.6 %
		Y	7.41	76.61	18.34		65.0	
		Z	6.97	75.37	17.59		65.0	
10257-CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	7.88	76.96	18.83	3.98	65.0	± 9.6 %
		Y	7.14	75.71	17.88		65.0	
		Z	6.75	74.57	17.17		65.0	
10258-CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	7.78	79.64	20.06	3.98	65.0	± 9.6 %
		Y	6.62	77.19	18.57		65.0	
		Z	6.94	77.88	18.85		65.0	
10259-CAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	8.02	78.38	21.20	3.98	65.0	± 9.6 %
		Y	7.56	77.67	20.62		65.0	
		Z	7.78	78.17	20.80		65.0	
10260-CAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	8.03	78.09	21.10	3.98	65.0	± 9.6 %
		Y	7.56	77.37	20.51		65.0	
		Z	7.76	77.83	20.68		65.0	
10261-CAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	9.78	83.86	23.23	3.98	65.0	± 9.6 %
		Y	9.31	83.32	22.75		65.0	
		Z	9.82	84.29	23.13		65.0	
10262-CAD	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	8.55	79.59	22.50	3.98	65.0	± 9.6 %
		Y	8.20	79.24	22.17		65.0	
		Z	8.42	79.74	22.36		65.0	
10263-CAD	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	8.12	77.61	21.45	3.98	65.0	± 9.6 %
		Y	7.71	77.05	21.01		65.0	
		Z	7.93	77.61	21.24		65.0	
10264-CAD	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	9.97	83.80	23.57	3.98	65.0	± 9.6 %
		Y	9.64	83.61	23.31		65.0	
		Z	10.14	84.55	23.69		65.0	
10265-CAD	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	8.24	77.24	21.58	3.98	65.0	± 9.6 %
		Y	7.84	76.71	21.22		65.0	
		Z	8.05	77.25	21.47		65.0	
10266-CAD	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	8.60	77.95	22.20	3.98	65.0	± 9.6 %
		Y	8.26	77.60	21.93		65.0	
		Z	8.45	78.09	22.14		65.0	
10267-CAD	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.23	80.67	22.41	3.98	65.0	± 9.6 %
		Y	8.93	80.49	22.22		65.0	
		Z	9.26	81.21	22.53		65.0	
10268-CAD	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	8.68	76.70	21.72	3.98	65.0	± 9.6 %
		Y	8.35	76.33	21.48		65.0	
		Z	8.51	76.76	21.67		65.0	
10269-CAD	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	8.61	76.29	21.63	3.98	65.0	± 9.6 %
		Y	8.29	75.93	21.38		65.0	
		Z	8.44	76.36	21.57		65.0	
10270-CAD	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	8.72	77.95	21.49	3.98	65.0	± 9.6 %
		Y	8.44	77.75	21.34		65.0	
		Z	8.65	78.26	21.56		65.0	

10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	2.65	66.73	15.53	0.00	150.0	± 9.6 %
		Y	2.53	66.00	14.87		150.0	
		Z	2.58	66.59	15.22		150.0	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	1.72	68.93	16.16	0.00	150.0	± 9.6 %
		Y	1.51	66.78	14.69		150.0	
		Z	1.61	68.10	15.52		150.0	
10277-CAA	PHS (QPSK)	X	5.72	69.80	14.27	9.03	50.0	± 9.6 %
		Y	4.91	67.88	12.66		50.0	
		Z	5.15	68.54	13.15		50.0	
10278-CAA	PHS (QPSK, BW 884MHz, Rolloff 0.5)	X	8.85	78.92	20.42	9.03	50.0	± 9.6 %
		Y	7.98	77.31	19.14		50.0	
		Z	8.11	77.47	19.29		50.0	
10279-CAA	PHS (QPSK, BW 884MHz, Rolloff 0.38)	X	8.99	79.11	20.50	9.03	50.0	± 9.6 %
		Y	8.10	77.48	19.23		50.0	
		Z	8.23	77.64	19.38		50.0	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	1.69	70.53	15.18	0.00	150.0	± 9.6 %
		Y	1.25	66.50	12.56		150.0	
		Z	1.40	68.36	13.59		150.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	0.95	67.48	13.64	0.00	150.0	± 9.6 %
		Y	0.72	63.92	10.97		150.0	
		Z	0.79	65.48	12.01		150.0	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	1.29	72.80	16.48	0.00	150.0	± 9.6 %
		Y	0.83	66.41	12.61		150.0	
		Z	1.02	69.60	14.38		150.0	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	2.10	80.21	19.93	0.00	150.0	± 9.6 %
		Y	1.10	70.20	14.87		150.0	
		Z	1.60	75.99	17.57		150.0	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	11.30	84.68	24.49	9.03	50.0	± 9.6 %
		Y	11.80	85.70	24.41		50.0	
		Z	11.89	85.73	24.46		50.0	
10297-AAC	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	2.91	70.44	16.97	0.00	150.0	± 9.6 %
		Y	2.65	68.85	16.01		150.0	
		Z	2.75	69.79	16.57		150.0	
10298-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	1.77	69.10	15.14	0.00	150.0	± 9.6 %
		Y	1.44	66.22	13.11		150.0	
		Z	1.53	67.54	13.87		150.0	
10299-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	3.44	73.52	16.85	0.00	150.0	± 9.6 %
		Y	2.88	71.29	15.45		150.0	
		Z	2.69	70.29	14.69		150.0	
10300-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	X	2.46	67.83	13.54	0.00	150.0	± 9.6 %
		Y	2.09	66.06	12.24		150.0	
		Z	1.99	65.57	11.71		150.0	
10301-AAA	IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC)	X	5.88	68.88	19.16	4.17	80.0	± 9.6 %
		Y	5.51	67.81	18.47		80.0	
		Z	5.71	68.72	18.91		80.0	
10302-AAA	IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL symbols)	X	6.37	69.56	19.96	4.96	80.0	± 9.6 %
		Y	5.98	68.32	19.14		80.0	
		Z	6.20	69.38	19.70		80.0	

10303-AAA	IEEE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)	X	6.25	69.73	20.05	4.96	80.0	± 9.6 %
		Y	5.81	68.31	19.13		80.0	
		Z	6.05	69.46	19.73		80.0	
10304-AAA	IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)	X	5.83	68.83	19.14	4.17	80.0	± 9.6 %
		Y	5.47	67.66	18.36		80.0	
		Z	5.67	68.66	18.87		80.0	
10305-AAA	IEEE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 symbols)	X	11.59	87.86	28.59	6.02	50.0	± 9.6 %
		Y	8.30	80.20	25.07		50.0	
		Z	10.73	86.12	27.50		50.0	
10306-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 symbols)	X	6.95	73.41	22.40	6.02	50.0	± 9.6 %
		Y	6.70	73.81	22.62		50.0	
		Z	6.66	72.86	21.87		50.0	
10307-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 symbols)	X	7.11	74.28	22.59	6.02	50.0	± 9.6 %
		Y	6.93	74.97	22.97		50.0	
		Z	6.77	73.56	22.00		50.0	
10308-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)	X	7.22	74.85	22.86	6.02	50.0	± 9.6 %
		Y	7.08	75.70	23.30		50.0	
		Z	8.15	79.17	24.90		50.0	
10309-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 symbols)	X	7.08	73.79	22.60	6.02	50.0	± 9.6 %
		Y	6.82	74.15	22.80		50.0	
		Z	6.77	73.19	22.06		50.0	
10310-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 symbols)	X	7.00	73.73	22.45	6.02	50.0	± 9.6 %
		Y	6.79	74.28	22.75		50.0	
		Z	6.70	73.15	21.91		50.0	
10311-AAC	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	3.27	69.63	16.57	0.00	150.0	± 9.6 %
		Y	2.99	68.15	15.70		150.0	
		Z	3.10	69.03	16.20		150.0	
10313-AAA	iDEN 1:3	X	7.67	78.82	19.03	6.99	70.0	± 9.6 %
		Y	6.82	77.24	18.08		70.0	
		Z	7.52	78.71	18.78		70.0	
10314-AAA	iDEN 1:6	X	9.54	84.04	23.30	10.00	30.0	± 9.6 %
		Y	9.16	83.89	22.95		30.0	
		Z	9.80	84.95	23.44		30.0	
10315-AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	1.17	65.05	15.97	0.17	150.0	± 9.6 %
		Y	1.09	63.78	14.85		150.0	
		Z	1.13	64.61	15.50		150.0	
10316-AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	4.73	67.02	16.56	0.17	150.0	± 9.6 %
		Y	4.63	66.73	16.31		150.0	
		Z	4.64	66.97	16.43		150.0	
10317-AAC	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	4.73	67.02	16.56	0.17	150.0	± 9.6 %
		Y	4.63	66.73	16.31		150.0	
		Z	4.64	66.97	16.43		150.0	
10400-AAD	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	4.82	67.23	16.46	0.00	150.0	± 9.6 %
		Y	4.70	66.92	16.20		150.0	
		Z	4.70	67.16	16.33		150.0	
10401-AAD	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	5.50	67.42	16.62	0.00	150.0	± 9.6 %
		Y	5.45	67.29	16.49		150.0	
		Z	5.44	67.46	16.57		150.0	

10402-AAD	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	5.77	67.80	16.65	0.00	150.0	± 9.6 %
		Y	5.67	67.48	16.43		150.0	
		Z	5.66	67.64	16.50		150.0	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	1.69	70.53	15.18	0.00	115.0	± 9.6 %
		Y	1.25	66.50	12.56		115.0	
		Z	1.40	68.36	13.59		115.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	1.69	70.53	15.18	0.00	115.0	± 9.6 %
		Y	1.25	66.50	12.56		115.0	
		Z	1.40	68.36	13.59		115.0	
10406-AAB	CDMA2000, RC3, SO32, SCH0, Full Rate	X	58.29	119.52	31.57	0.00	100.0	± 9.6 %
		Y	82.81	124.83	32.44		100.0	
		Z	53.04	115.96	29.70		100.0	
10410-AAD	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9, Subframe Conf=4)	X	100.00	122.33	31.60	3.23	80.0	± 9.6 %
		Y	100.00	122.90	31.55		80.0	
		Z	100.00	121.45	30.83		80.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	1.01	63.41	15.03	0.00	150.0	± 9.6 %
		Y	0.96	62.37	13.98		150.0	
		Z	0.99	63.08	14.59		150.0	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	4.63	66.84	16.39	0.00	150.0	± 9.6 %
		Y	4.53	66.56	16.14		150.0	
		Z	4.54	66.80	16.26		150.0	
10417-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	4.63	66.84	16.39	0.00	150.0	± 9.6 %
		Y	4.53	66.56	16.14		150.0	
		Z	4.54	66.80	16.26		150.0	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preamble)	X	4.61	66.99	16.40	0.00	150.0	± 9.6 %
		Y	4.52	66.70	16.14		150.0	
		Z	4.53	66.96	16.28		150.0	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preamble)	X	4.64	66.94	16.40	0.00	150.0	± 9.6 %
		Y	4.54	66.66	16.15		150.0	
		Z	4.55	66.91	16.28		150.0	
10422-AAB	IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)	X	4.76	66.95	16.42	0.00	150.0	± 9.6 %
		Y	4.66	66.68	16.18		150.0	
		Z	4.67	66.91	16.30		150.0	
10423-AAB	IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM)	X	4.95	67.31	16.55	0.00	150.0	± 9.6 %
		Y	4.83	67.01	16.30		150.0	
		Z	4.83	67.23	16.42		150.0	
10424-AAB	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM)	X	4.86	67.25	16.52	0.00	150.0	± 9.6 %
		Y	4.75	66.95	16.27		150.0	
		Z	4.75	67.18	16.39		150.0	
10425-AAB	IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)	X	5.48	67.66	16.74	0.00	150.0	± 9.6 %
		Y	5.40	67.43	16.55		150.0	
		Z	5.38	67.57	16.61		150.0	
10426-AAB	IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM)	X	5.48	67.68	16.74	0.00	150.0	± 9.6 %
		Y	5.41	67.49	16.57		150.0	
		Z	5.39	67.62	16.64		150.0	

10427-AAB	IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)	X	5.49	67.63	16.71	0.00	150.0	± 9.6 %
		Y	5.41	67.41	16.53		150.0	
		Z	5.39	67.56	16.60		150.0	
10430-AAB	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	X	4.28	70.45	18.15	0.00	150.0	± 9.6 %
		Y	4.15	70.21	17.82		150.0	
		Z	4.17	70.53	17.95		150.0	
10431-AAB	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	X	4.34	67.42	16.43	0.00	150.0	± 9.6 %
		Y	4.21	67.05	16.09		150.0	
		Z	4.21	67.35	16.24		150.0	
10432-AAB	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	X	4.63	67.29	16.48	0.00	150.0	± 9.6 %
		Y	4.51	66.97	16.19		150.0	
		Z	4.52	67.23	16.33		150.0	
10433-AAB	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	X	4.88	67.28	16.54	0.00	150.0	± 9.6 %
		Y	4.77	66.98	16.29		150.0	
		Z	4.77	67.21	16.41		150.0	
10434-AAA	W-CDMA (BS Test Model 1, 64 DPCH)	X	4.37	71.21	18.12	0.00	150.0	± 9.6 %
		Y	4.21	70.88	17.70		150.0	
		Z	4.25	71.29	17.86		150.0	
10435-AAC	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	100.00	122.16	31.53	3.23	80.0	± 9.6 %
		Y	100.00	122.71	31.47		80.0	
		Z	100.00	121.26	30.74		80.0	
10447-AAB	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)	X	3.64	67.48	15.86	0.00	150.0	± 9.6 %
		Y	3.47	66.90	15.30		150.0	
		Z	3.50	67.31	15.51		150.0	
10448-AAB	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)	X	4.17	67.19	16.29	0.00	150.0	± 9.6 %
		Y	4.04	66.82	15.93		150.0	
		Z	4.05	67.12	16.10		150.0	
10449-AAB	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)	X	4.43	67.11	16.37	0.00	150.0	± 9.6 %
		Y	4.32	66.77	16.08		150.0	
		Z	4.33	67.04	16.22		150.0	
10450-AAB	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)	X	4.62	67.04	16.39	0.00	150.0	± 9.6 %
		Y	4.52	66.72	16.12		150.0	
		Z	4.52	66.97	16.25		150.0	
10451-AAA	W-CDMA (BS Test Model 1, 64 DPCH, Clipping 44%)	X	3.56	67.73	15.55	0.00	150.0	± 9.6 %
		Y	3.35	67.01	14.87		150.0	
		Z	3.38	67.45	15.09		150.0	
10456-AAB	IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle)	X	6.34	68.21	16.88	0.00	150.0	± 9.6 %
		Y	6.27	67.98	16.71		150.0	
		Z	6.25	68.10	16.76		150.0	
10457-AAA	UMTS-FDD (DC-HSDPA)	X	3.84	65.46	16.11	0.00	150.0	± 9.6 %
		Y	3.77	65.19	15.83		150.0	
		Z	3.79	65.43	15.97		150.0	
10458-AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	X	4.00	70.46	17.58	0.00	150.0	± 9.6 %
		Y	3.84	70.06	17.04		150.0	
		Z	3.90	70.60	17.26		150.0	
10459-AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	X	5.11	67.94	18.07	0.00	150.0	± 9.6 %
		Y	5.02	68.02	17.94		150.0	
		Z	5.00	68.15	17.94		150.0	

10460-AAA	UMTS-FDD (WCDMA, AMR)	X	0.99	70.19	17.21	0.00	150.0	± 9.6 %
		Y	0.79	66.24	14.56		150.0	
		Z	0.89	68.50	16.06		150.0	
10461-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	100.00	125.48	33.13	3.29	80.0	± 9.6 %
		Y	100.00	126.71	33.38		80.0	
		Z	100.00	124.78	32.43		80.0	
10462-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	111.35	26.37	3.23	80.0	± 9.6 %
		Y	100.00	110.68	25.72		80.0	
		Z	99.96	108.86	24.85		80.0	
10463-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	108.43	24.96	3.23	80.0	± 9.6 %
		Y	100.00	107.27	24.09		80.0	
		Z	11.86	83.93	17.98		80.0	
10464-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	100.00	123.68	32.14	3.23	80.0	± 9.6 %
		Y	100.00	124.66	32.27		80.0	
		Z	100.00	122.71	31.32		80.0	
10465-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	110.89	26.14	3.23	80.0	± 9.6 %
		Y	100.00	110.13	25.45		80.0	
		Z	38.00	97.98	22.23		80.0	
10466-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	66.21	103.47	23.73	3.23	80.0	± 9.6 %
		Y	29.96	94.21	20.95		80.0	
		Z	7.74	79.35	16.55		80.0	
10467-AAC	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	100.00	123.89	32.23	3.23	80.0	± 9.6 %
		Y	100.00	124.90	32.38		80.0	
		Z	100.00	122.94	31.42		80.0	
10468-AAC	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	111.04	26.21	3.23	80.0	± 9.6 %
		Y	100.00	110.31	25.54		80.0	
		Z	48.22	100.68	22.91		80.0	
10469-AAC	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	70.15	104.12	23.88	3.23	80.0	± 9.6 %
		Y	31.63	94.80	21.09		80.0	
		Z	7.88	79.54	16.61		80.0	
10470-AAC	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	100.00	123.92	32.24	3.23	80.0	± 9.6 %
		Y	100.00	124.94	32.38		80.0	
		Z	100.00	122.97	31.42		80.0	
10471-AAC	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	111.00	26.18	3.23	80.0	± 9.6 %
		Y	100.00	110.26	25.51		80.0	
		Z	47.97	100.58	22.87		80.0	
10472-AAC	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	70.92	104.20	23.88	3.23	80.0	± 9.6 %
		Y	31.52	94.72	21.06		80.0	
		Z	7.84	79.47	16.58		80.0	
10473-AAC	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	100.00	123.89	32.23	3.23	80.0	± 9.6 %
		Y	100.00	124.91	32.37		80.0	
		Z	100.00	122.94	31.41		80.0	
10474-AAC	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	111.01	26.19	3.23	80.0	± 9.6 %
		Y	100.00	110.27	25.51		80.0	
		Z	47.00	100.37	22.82		80.0	
10475-AAC	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	68.93	103.90	23.81	3.23	80.0	± 9.6 %
		Y	30.64	94.44	20.99		80.0	
		Z	7.75	79.37	16.55		80.0	

10477-AAC	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	100.00	110.85	26.11	3.23	80.0	± 9.6 %
		Y	100.00	110.08	25.42		80.0	
		Z	39.81	98.45	22.33		80.0	
10478-AAC	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	66.88	103.53	23.72	3.23	80.0	± 9.6 %
		Y	29.54	94.01	20.87		80.0	
		Z	7.64	79.20	16.49		80.0	
10479-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	18.61	98.48	27.45	3.23	80.0	± 9.6 %
		Y	25.62	103.89	28.72		80.0	
		Z	19.02	98.49	26.87		80.0	
10480-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	17.74	92.23	23.95	3.23	80.0	± 9.6 %
		Y	23.09	96.00	24.65		80.0	
		Z	15.42	89.78	22.53		80.0	
10481-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	14.70	88.73	22.56	3.23	80.0	± 9.6 %
		Y	17.07	90.84	22.79		80.0	
		Z	11.82	85.36	20.81		80.0	
10482-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.42	80.34	20.27	2.23	80.0	± 9.6 %
		Y	4.54	75.37	17.94		80.0	
		Z	5.57	78.35	19.09		80.0	
10483-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.52	83.05	21.15	2.23	80.0	± 9.6 %
		Y	9.34	82.78	20.64		80.0	
		Z	7.40	79.15	19.09		80.0	
10484-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	8.60	81.38	20.58	2.23	80.0	± 9.6 %
		Y	8.20	80.76	19.96		80.0	
		Z	6.69	77.58	18.54		80.0	
10485-AAC	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.55	80.98	21.28	2.23	80.0	± 9.6 %
		Y	5.07	77.22	19.53		80.0	
		Z	6.01	79.95	20.60		80.0	
10486-AAC	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	5.00	73.93	18.31	2.23	80.0	± 9.6 %
		Y	4.24	71.65	16.98		80.0	
		Z	4.64	73.10	17.58		80.0	
10487-AAC	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	4.92	73.36	18.08	2.23	80.0	± 9.6 %
		Y	4.20	71.18	16.78		80.0	
		Z	4.56	72.51	17.34		80.0	
10488-AAC	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.10	78.52	20.97	2.23	80.0	± 9.6 %
		Y	5.11	75.97	19.78		80.0	
		Z	5.69	77.85	20.57		80.0	
10489-AAC	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	4.95	72.75	18.88	2.23	80.0	± 9.6 %
		Y	4.48	71.40	18.08		80.0	
		Z	4.72	72.41	18.54		80.0	
10490-AAC	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	5.00	72.39	18.75	2.23	80.0	± 9.6 %
		Y	4.55	71.14	18.00		80.0	
		Z	4.78	72.09	18.43		80.0	
10491-AAC	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.71	75.50	19.96	2.23	80.0	± 9.6 %
		Y	5.04	73.73	19.09		80.0	
		Z	5.40	75.03	19.67		80.0	
10492-AAC	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	5.12	71.43	18.61	2.23	80.0	± 9.6 %
		Y	4.74	70.41	18.01		80.0	
		Z	4.91	71.17	18.36		80.0	

10493-AAC	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	5.16	71.20	18.53	2.23	80.0	± 9.6 %
		Y	4.79	70.23	17.95		80.0	
		Z	4.96	70.96	18.29		80.0	
10494-AAC	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.40	77.43	20.51	2.23	80.0	± 9.6 %
		Y	5.52	75.29	19.53		80.0	
		Z	6.00	76.80	20.18		80.0	
10495-AAC	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	5.21	71.98	18.84	2.23	80.0	± 9.6 %
		Y	4.80	70.86	18.21		80.0	
		Z	4.99	71.64	18.58		80.0	
10496-AAC	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	5.24	71.52	18.69	2.23	80.0	± 9.6 %
		Y	4.85	70.51	18.11		80.0	
		Z	5.02	71.23	18.45		80.0	
10497-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	4.89	76.14	17.97	2.23	80.0	± 9.6 %
		Y	3.19	70.40	15.09		80.0	
		Z	3.85	72.91	16.12		80.0	
10498-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	3.27	68.15	13.86	2.23	80.0	± 9.6 %
		Y	2.33	64.21	11.42		80.0	
		Z	2.49	65.10	11.84		80.0	
10499-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	3.14	67.39	13.40	2.23	80.0	± 9.6 %
		Y	2.26	63.62	11.00		80.0	
		Z	2.39	64.37	11.36		80.0	
10500-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.12	79.35	20.96	2.23	80.0	± 9.6 %
		Y	4.97	76.32	19.51		80.0	
		Z	5.70	78.62	20.44		80.0	
10501-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	4.96	73.36	18.48	2.23	80.0	± 9.6 %
		Y	4.36	71.58	17.41		80.0	
		Z	4.68	72.83	17.95		80.0	
10502-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	4.98	73.06	18.32	2.23	80.0	± 9.6 %
		Y	4.39	71.34	17.27		80.0	
		Z	4.70	72.53	17.78		80.0	
10503-AAC	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.02	78.31	20.87	2.23	80.0	± 9.6 %
		Y	5.05	75.75	19.68		80.0	
		Z	5.61	77.63	20.47		80.0	
10504-AAC	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	4.93	72.67	18.83	2.23	80.0	± 9.6 %
		Y	4.45	71.30	18.03		80.0	
		Z	4.70	72.32	18.48		80.0	
10505-AAC	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	4.97	72.30	18.70	2.23	80.0	± 9.6 %
		Y	4.52	71.04	17.95		80.0	
		Z	4.75	71.99	18.37		80.0	
10506-AAC	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.35	77.28	20.44	2.23	80.0	± 9.6 %
		Y	5.48	75.14	19.46		80.0	
		Z	5.95	76.64	20.11		80.0	
10507-AAC	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	5.19	71.92	18.80	2.23	80.0	± 9.6 %
		Y	4.78	70.80	18.18		80.0	
		Z	4.97	71.58	18.54		80.0	

10508-AAC	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	5.22	71.46	18.65	2.23	80.0	± 9.6 %
		Y	4.84	70.44	18.07		80.0	
		Z	5.01	71.16	18.41		80.0	
10509-AAC	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.16	74.73	19.49	2.23	80.0	± 9.6 %
		Y	5.55	73.22	18.76		80.0	
		Z	5.87	74.29	19.25		80.0	
10510-AAC	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	5.58	71.18	18.59	2.23	80.0	± 9.6 %
		Y	5.22	70.26	18.08		80.0	
		Z	5.37	70.88	18.37		80.0	
10511-AAC	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	5.59	70.81	18.48	2.23	80.0	± 9.6 %
		Y	5.25	69.96	18.01		80.0	
		Z	5.39	70.55	18.28		80.0	
10512-AAC	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.77	76.89	20.15	2.23	80.0	± 9.6 %
		Y	5.92	74.92	19.26		80.0	
		Z	6.37	76.26	19.84		80.0	
10513-AAC	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	5.53	71.68	18.77	2.23	80.0	± 9.6 %
		Y	5.14	70.63	18.21		80.0	
		Z	5.30	71.30	18.53		80.0	
10514-AAC	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	5.48	71.10	18.60	2.23	80.0	± 9.6 %
		Y	5.12	70.15	18.08		80.0	
		Z	5.27	70.77	18.37		80.0	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	0.97	63.65	15.12	0.00	150.0	± 9.6 %
		Y	0.92	62.50	14.00		150.0	
		Z	0.95	63.27	14.65		150.0	
10516-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 99pc duty cycle)	X	0.79	75.90	19.78	0.00	150.0	± 9.6 %
		Y	0.49	67.25	14.66		150.0	
		Z	0.62	71.59	17.42		150.0	
10517-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 99pc duty cycle)	X	0.85	66.16	16.04	0.00	150.0	± 9.6 %
		Y	0.75	63.97	14.23		150.0	
		Z	0.80	65.28	15.27		150.0	
10518-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	X	4.62	66.92	16.37	0.00	150.0	± 9.6 %
		Y	4.52	66.63	16.11		150.0	
		Z	4.53	66.88	16.24		150.0	
10519-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 99pc duty cycle)	X	4.83	67.19	16.50	0.00	150.0	± 9.6 %
		Y	4.71	66.89	16.25		150.0	
		Z	4.71	67.12	16.36		150.0	
10520-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 99pc duty cycle)	X	4.68	67.16	16.43	0.00	150.0	± 9.6 %
		Y	4.56	66.83	16.16		150.0	
		Z	4.57	67.07	16.28		150.0	
10521-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 99pc duty cycle)	X	4.61	67.16	16.41	0.00	150.0	± 9.6 %
		Y	4.49	66.82	16.13		150.0	
		Z	4.50	67.06	16.26		150.0	
10522-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 99pc duty cycle)	X	4.66	67.20	16.48	0.00	150.0	± 9.6 %
		Y	4.55	66.91	16.22		150.0	
		Z	4.56	67.16	16.35		150.0	

10523-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 99pc duty cycle)	X	4.53	67.06	16.32	0.00	150.0	± 9.6 %
		Y	4.43	66.75	16.05		150.0	
		Z	4.44	67.02	16.19		150.0	
10524-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 99pc duty cycle)	X	4.61	67.14	16.45	0.00	150.0	± 9.6 %
		Y	4.50	66.83	16.19		150.0	
		Z	4.50	67.08	16.32		150.0	
10525-AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	X	4.58	66.16	16.03	0.00	150.0	± 9.6 %
		Y	4.48	65.85	15.77		150.0	
		Z	4.49	66.11	15.90		150.0	
10526-AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	X	4.77	66.55	16.18	0.00	150.0	± 9.6 %
		Y	4.65	66.23	15.92		150.0	
		Z	4.66	66.48	16.05		150.0	
10527-AAB	IEEE 802.11ac WiFi (20MHz, MCS2, 99pc duty cycle)	X	4.69	66.52	16.13	0.00	150.0	± 9.6 %
		Y	4.57	66.18	15.85		150.0	
		Z	4.58	66.44	15.99		150.0	
10528-AAB	IEEE 802.11ac WiFi (20MHz, MCS3, 99pc duty cycle)	X	4.70	66.54	16.16	0.00	150.0	± 9.6 %
		Y	4.59	66.20	15.89		150.0	
		Z	4.59	66.46	16.02		150.0	
10529-AAB	IEEE 802.11ac WiFi (20MHz, MCS4, 99pc duty cycle)	X	4.70	66.54	16.16	0.00	150.0	± 9.6 %
		Y	4.59	66.20	15.89		150.0	
		Z	4.59	66.46	16.02		150.0	
10531-AAB	IEEE 802.11ac WiFi (20MHz, MCS6, 99pc duty cycle)	X	4.71	66.67	16.19	0.00	150.0	± 9.6 %
		Y	4.58	66.30	15.90		150.0	
		Z	4.59	66.56	16.03		150.0	
10532-AAB	IEEE 802.11ac WiFi (20MHz, MCS7, 99pc duty cycle)	X	4.56	66.53	16.12	0.00	150.0	± 9.6 %
		Y	4.44	66.14	15.82		150.0	
		Z	4.45	66.41	15.96		150.0	
10533-AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 99pc duty cycle)	X	4.71	66.57	16.14	0.00	150.0	± 9.6 %
		Y	4.60	66.24	15.87		150.0	
		Z	4.60	66.51	16.01		150.0	
10534-AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	X	5.23	66.67	16.22	0.00	150.0	± 9.6 %
		Y	5.14	66.38	16.00		150.0	
		Z	5.14	66.58	16.10		150.0	
10535-AAB	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	X	5.31	66.84	16.29	0.00	150.0	± 9.6 %
		Y	5.22	66.58	16.09		150.0	
		Z	5.21	66.78	16.19		150.0	
10536-AAB	IEEE 802.11ac WiFi (40MHz, MCS2, 99pc duty cycle)	X	5.17	66.80	16.25	0.00	150.0	± 9.6 %
		Y	5.07	66.49	16.02		150.0	
		Z	5.07	66.71	16.13		150.0	
10537-AAB	IEEE 802.11ac WiFi (40MHz, MCS3, 99pc duty cycle)	X	5.24	66.78	16.25	0.00	150.0	± 9.6 %
		Y	5.13	66.47	16.02		150.0	
		Z	5.13	66.67	16.12		150.0	
10538-AAB	IEEE 802.11ac WiFi (40MHz, MCS4, 99pc duty cycle)	X	5.34	66.83	16.31	0.00	150.0	± 9.6 %
		Y	5.23	66.51	16.08		150.0	
		Z	5.22	66.70	16.17		150.0	
10540-AAB	IEEE 802.11ac WiFi (40MHz, MCS6, 99pc duty cycle)	X	5.25	66.81	16.32	0.00	150.0	± 9.6 %
		Y	5.16	66.53	16.10		150.0	
		Z	5.16	66.73	16.20		150.0	

10541-AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 99pc duty cycle)	X	5.22	66.67	16.24	0.00	150.0	± 9.6 %
		Y	5.13	66.37	16.02		150.0	
		Z	5.13	66.58	16.12		150.0	
10542-AAB	IEEE 802.11ac WiFi (40MHz, MCS8, 99pc duty cycle)	X	5.38	66.75	16.30	0.00	150.0	± 9.6 %
		Y	5.29	66.46	16.08		150.0	
		Z	5.28	66.65	16.17		150.0	
10543-AAB	IEEE 802.11ac WiFi (40MHz, MCS9, 99pc duty cycle)	X	5.47	66.79	16.33	0.00	150.0	± 9.6 %
		Y	5.38	66.54	16.14		150.0	
		Z	5.36	66.70	16.22		150.0	
10544-AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	X	5.53	66.76	16.20	0.00	150.0	± 9.6 %
		Y	5.45	66.49	16.00		150.0	
		Z	5.45	66.68	16.09		150.0	
10545-AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	X	5.75	67.24	16.38	0.00	150.0	± 9.6 %
		Y	5.67	66.99	16.20		150.0	
		Z	5.66	67.15	16.27		150.0	
10546-AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 99pc duty cycle)	X	5.62	67.04	16.30	0.00	150.0	± 9.6 %
		Y	5.52	66.72	16.08		150.0	
		Z	5.52	66.90	16.16		150.0	
10547-AAB	IEEE 802.11ac WiFi (80MHz, MCS3, 99pc duty cycle)	X	5.71	67.13	16.33	0.00	150.0	± 9.6 %
		Y	5.60	66.78	16.10		150.0	
		Z	5.59	66.94	16.17		150.0	
10548-AAB	IEEE 802.11ac WiFi (80MHz, MCS4, 99pc duty cycle)	X	6.09	68.45	16.97	0.00	150.0	± 9.6 %
		Y	5.98	68.09	16.72		150.0	
		Z	5.90	68.06	16.71		150.0	
10550-AAB	IEEE 802.11ac WiFi (80MHz, MCS6, 99pc duty cycle)	X	5.64	67.01	16.29	0.00	150.0	± 9.6 %
		Y	5.56	66.76	16.11		150.0	
		Z	5.55	66.94	16.19		150.0	
10551-AAB	IEEE 802.11ac WiFi (80MHz, MCS7, 99pc duty cycle)	X	5.64	67.06	16.28	0.00	150.0	± 9.6 %
		Y	5.55	66.75	16.06		150.0	
		Z	5.55	66.95	16.16		150.0	
10552-AAB	IEEE 802.11ac WiFi (80MHz, MCS8, 99pc duty cycle)	X	5.55	66.82	16.17	0.00	150.0	± 9.6 %
		Y	5.46	66.53	15.96		150.0	
		Z	5.46	66.74	16.06		150.0	
10553-AAB	IEEE 802.11ac WiFi (80MHz, MCS9, 99pc duty cycle)	X	5.64	66.88	16.23	0.00	150.0	± 9.6 %
		Y	5.54	66.58	16.02		150.0	
		Z	5.54	66.77	16.11		150.0	
10554-AAC	IEEE 802.11ac WiFi (160MHz, MCS0, 99pc duty cycle)	X	5.94	67.15	16.30	0.00	150.0	± 9.6 %
		Y	5.87	66.87	16.10		150.0	
		Z	5.86	67.05	16.18		150.0	
10555-AAC	IEEE 802.11ac WiFi (160MHz, MCS1, 99pc duty cycle)	X	6.09	67.49	16.44	0.00	150.0	± 9.6 %
		Y	6.01	67.23	16.26		150.0	
		Z	6.00	67.38	16.32		150.0	
10556-AAC	IEEE 802.11ac WiFi (160MHz, MCS2, 99pc duty cycle)	X	6.10	67.52	16.45	0.00	150.0	± 9.6 %
		Y	6.02	67.25	16.26		150.0	
		Z	6.02	67.42	16.34		150.0	
10557-AAC	IEEE 802.11ac WiFi (160MHz, MCS3, 99pc duty cycle)	X	6.08	67.44	16.43	0.00	150.0	± 9.6 %
		Y	5.99	67.15	16.23		150.0	
		Z	5.98	67.31	16.30		150.0	

10558-AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 99pc duty cycle)	X	6.14	67.64	16.55	0.00	150.0	± 9.6 %
		Y	6.04	67.32	16.33		150.0	
		Z	6.03	67.48	16.40		150.0	
10560-AAC	IEEE 802.11ac WiFi (160MHz, MCS6, 99pc duty cycle)	X	6.12	67.44	16.49	0.00	150.0	± 9.6 %
		Y	6.03	67.14	16.28		150.0	
		Z	6.02	67.31	16.36		150.0	
10561-AAC	IEEE 802.11ac WiFi (160MHz, MCS7, 99pc duty cycle)	X	6.04	67.43	16.52	0.00	150.0	± 9.6 %
		Y	5.96	67.14	16.32		150.0	
		Z	5.95	67.31	16.39		150.0	
10562-AAC	IEEE 802.11ac WiFi (160MHz, MCS8, 99pc duty cycle)	X	6.21	67.94	16.77	0.00	150.0	± 9.6 %
		Y	6.10	67.58	16.54		150.0	
		Z	6.08	67.71	16.59		150.0	
10563-AAC	IEEE 802.11ac WiFi (160MHz, MCS9, 99pc duty cycle)	X	6.62	68.71	17.11	0.00	150.0	± 9.6 %
		Y	6.41	68.12	16.77		150.0	
		Z	6.30	68.01	16.70		150.0	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	4.97	67.05	16.56	0.46	150.0	± 9.6 %
		Y	4.87	66.78	16.32		150.0	
		Z	4.87	67.01	16.43		150.0	
10565-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 99pc duty cycle)	X	5.21	67.51	16.88	0.46	150.0	± 9.6 %
		Y	5.10	67.22	16.64		150.0	
		Z	5.10	67.43	16.74		150.0	
10566-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 99pc duty cycle)	X	5.05	67.38	16.71	0.46	150.0	± 9.6 %
		Y	4.93	67.07	16.45		150.0	
		Z	4.93	67.29	16.57		150.0	
10567-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 99pc duty cycle)	X	5.07	67.74	17.03	0.46	150.0	± 9.6 %
		Y	4.96	67.43	16.79		150.0	
		Z	4.96	67.65	16.90		150.0	
10568-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 99pc duty cycle)	X	4.97	67.18	16.50	0.46	150.0	± 9.6 %
		Y	4.86	66.88	16.25		150.0	
		Z	4.86	67.13	16.38		150.0	
10569-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 99pc duty cycle)	X	5.02	67.78	17.06	0.46	150.0	± 9.6 %
		Y	4.91	67.51	16.84		150.0	
		Z	4.92	67.74	16.95		150.0	
10570-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 99pc duty cycle)	X	5.06	67.64	17.01	0.46	150.0	± 9.6 %
		Y	4.95	67.38	16.79		150.0	
		Z	4.95	67.60	16.90		150.0	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	1.37	66.59	16.71	0.46	130.0	± 9.6 %
		Y	1.26	65.12	15.54		130.0	
		Z	1.32	66.08	16.22		130.0	
10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	1.39	67.31	17.11	0.46	130.0	± 9.6 %
		Y	1.28	65.71	15.88		130.0	
		Z	1.34	66.74	16.60		130.0	
10573-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 90pc duty cycle)	X	17.13	116.23	31.59	0.46	130.0	± 9.6 %
		Y	2.44	84.17	21.35		130.0	
		Z	6.44	100.05	26.86		130.0	
10574-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc duty cycle)	X	1.76	75.21	20.71	0.46	130.0	± 9.6 %
		Y	1.45	71.43	18.52		130.0	
		Z	1.62	73.67	19.79		130.0	

10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	4.79	66.95	16.68	0.46	130.0	± 9.6 %
		Y	4.69	66.67	16.43		130.0	
		Z	4.69	66.91	16.55		130.0	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	4.81	67.10	16.73	0.46	130.0	± 9.6 %
		Y	4.71	66.83	16.49		130.0	
		Z	4.72	67.06	16.60		130.0	
10577-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc duty cycle)	X	5.03	67.41	16.91	0.46	130.0	± 9.6 %
		Y	4.92	67.12	16.66		130.0	
		Z	4.92	67.34	16.77		130.0	
10578-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc duty cycle)	X	4.93	67.56	17.00	0.46	130.0	± 9.6 %
		Y	4.81	67.27	16.75		130.0	
		Z	4.82	67.49	16.86		130.0	
10579-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)	X	4.71	66.96	16.38	0.46	130.0	± 9.6 %
		Y	4.59	66.61	16.09		130.0	
		Z	4.60	66.86	16.22		130.0	
10580-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)	X	4.76	66.97	16.40	0.46	130.0	± 9.6 %
		Y	4.64	66.65	16.11		130.0	
		Z	4.64	66.90	16.25		130.0	
10581-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)	X	4.83	67.64	16.95	0.46	130.0	± 9.6 %
		Y	4.71	67.32	16.69		130.0	
		Z	4.72	67.56	16.81		130.0	
10582-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)	X	4.66	66.74	16.19	0.46	130.0	± 9.6 %
		Y	4.54	66.39	15.89		130.0	
		Z	4.54	66.64	16.03		130.0	
10583-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	X	4.79	66.95	16.68	0.46	130.0	± 9.6 %
		Y	4.69	66.67	16.43		130.0	
		Z	4.69	66.91	16.55		130.0	
10584-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	X	4.81	67.10	16.73	0.46	130.0	± 9.6 %
		Y	4.71	66.83	16.49		130.0	
		Z	4.72	67.06	16.60		130.0	
10585-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 90pc duty cycle)	X	5.03	67.41	16.91	0.46	130.0	± 9.6 %
		Y	4.92	67.12	16.66		130.0	
		Z	4.92	67.34	16.77		130.0	
10586-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 90pc duty cycle)	X	4.93	67.56	17.00	0.46	130.0	± 9.6 %
		Y	4.81	67.27	16.75		130.0	
		Z	4.82	67.49	16.86		130.0	
10587-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 90pc duty cycle)	X	4.71	66.96	16.38	0.46	130.0	± 9.6 %
		Y	4.59	66.61	16.09		130.0	
		Z	4.60	66.86	16.22		130.0	
10588-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 90pc duty cycle)	X	4.76	66.97	16.40	0.46	130.0	± 9.6 %
		Y	4.64	66.65	16.11		130.0	
		Z	4.64	66.90	16.25		130.0	
10589-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 90pc duty cycle)	X	4.83	67.64	16.95	0.46	130.0	± 9.6 %
		Y	4.71	67.32	16.69		130.0	
		Z	4.72	67.56	16.81		130.0	
10590-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 90pc duty cycle)	X	4.66	66.74	16.19	0.46	130.0	± 9.6 %
		Y	4.54	66.39	15.89		130.0	
		Z	4.54	66.64	16.03		130.0	

10591-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	4.93	66.98	16.76	0.46	130.0	± 9.6 %
		Y	4.84	66.73	16.53		130.0	
		Z	4.84	66.95	16.64		130.0	
10592-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	5.10	67.33	16.89	0.46	130.0	± 9.6 %
		Y	4.99	67.06	16.66		130.0	
		Z	4.99	67.28	16.77		130.0	
10593-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS2, 90pc duty cycle)	X	5.03	67.27	16.79	0.46	130.0	± 9.6 %
		Y	4.92	66.98	16.54		130.0	
		Z	4.92	67.20	16.65		130.0	
10594-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS3, 90pc duty cycle)	X	5.08	67.42	16.93	0.46	130.0	± 9.6 %
		Y	4.97	67.14	16.70		130.0	
		Z	4.97	67.36	16.80		130.0	
10595-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS4, 90pc duty cycle)	X	5.05	67.38	16.83	0.46	130.0	± 9.6 %
		Y	4.94	67.10	16.59		130.0	
		Z	4.94	67.32	16.70		130.0	
10596-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS5, 90pc duty cycle)	X	4.99	67.40	16.85	0.46	130.0	± 9.6 %
		Y	4.88	67.10	16.60		130.0	
		Z	4.88	67.34	16.72		130.0	
10597-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS6, 90pc duty cycle)	X	4.94	67.32	16.74	0.46	130.0	± 9.6 %
		Y	4.83	67.01	16.48		130.0	
		Z	4.83	67.24	16.60		130.0	
10598-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS7, 90pc duty cycle)	X	4.92	67.54	16.99	0.46	130.0	± 9.6 %
		Y	4.81	67.23	16.73		130.0	
		Z	4.81	67.45	16.84		130.0	
10599-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	5.61	67.56	16.97	0.46	130.0	± 9.6 %
		Y	5.52	67.33	16.78		130.0	
		Z	5.52	67.51	16.86		130.0	
10600-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	5.83	68.25	17.29	0.46	130.0	± 9.6 %
		Y	5.73	67.98	17.09		130.0	
		Z	5.68	68.03	17.10		130.0	
10601-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS2, 90pc duty cycle)	X	5.67	67.85	17.10	0.46	130.0	± 9.6 %
		Y	5.58	67.60	16.91		130.0	
		Z	5.55	67.72	16.96		130.0	
10602-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS3, 90pc duty cycle)	X	5.75	67.84	17.02	0.46	130.0	± 9.6 %
		Y	5.68	67.65	16.85		130.0	
		Z	5.66	67.78	16.92		130.0	
10603-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS4, 90pc duty cycle)	X	5.83	68.10	17.27	0.46	130.0	± 9.6 %
		Y	5.74	67.87	17.09		130.0	
		Z	5.72	68.02	17.16		130.0	
10604-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS5, 90pc duty cycle)	X	5.61	67.53	16.97	0.46	130.0	± 9.6 %
		Y	5.53	67.28	16.78		130.0	
		Z	5.52	67.47	16.87		130.0	
10605-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS6, 90pc duty cycle)	X	5.75	67.94	17.19	0.46	130.0	± 9.6 %
		Y	5.68	67.77	17.03		130.0	
		Z	5.66	67.89	17.09		130.0	
10606-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS7, 90pc duty cycle)	X	5.49	67.29	16.73	0.46	130.0	± 9.6 %
		Y	5.41	67.06	16.53		130.0	
		Z	5.38	67.16	16.58		130.0	

10607-AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	X	4.77	66.28	16.37	0.46	130.0	± 9.6 %
		Y	4.67	66.00	16.12		130.0	
		Z	4.67	66.24	16.25		130.0	
10608-AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	X	4.97	66.70	16.53	0.46	130.0	± 9.6 %
		Y	4.85	66.40	16.29		130.0	
		Z	4.86	66.65	16.41		130.0	
10609-AAB	IEEE 802.11ac WiFi (20MHz, MCS2, 90pc duty cycle)	X	4.86	66.58	16.39	0.46	130.0	± 9.6 %
		Y	4.74	66.26	16.13		130.0	
		Z	4.75	66.51	16.26		130.0	
10610-AAB	IEEE 802.11ac WiFi (20MHz, MCS3, 90pc duty cycle)	X	4.91	66.72	16.54	0.46	130.0	± 9.6 %
		Y	4.79	66.41	16.29		130.0	
		Z	4.80	66.66	16.41		130.0	
10611-AAB	IEEE 802.11ac WiFi (20MHz, MCS4, 90pc duty cycle)	X	4.83	66.55	16.41	0.46	130.0	± 9.6 %
		Y	4.71	66.23	16.14		130.0	
		Z	4.72	66.48	16.27		130.0	
10612-AAB	IEEE 802.11ac WiFi (20MHz, MCS5, 90pc duty cycle)	X	4.85	66.73	16.46	0.46	130.0	± 9.6 %
		Y	4.72	66.39	16.19		130.0	
		Z	4.73	66.65	16.32		130.0	
10613-AAB	IEEE 802.11ac WiFi (20MHz, MCS6, 90pc duty cycle)	X	4.86	66.64	16.36	0.46	130.0	± 9.6 %
		Y	4.73	66.28	16.08		130.0	
		Z	4.74	66.53	16.21		130.0	
10614-AAB	IEEE 802.11ac WiFi (20MHz, MCS7, 90pc duty cycle)	X	4.79	66.79	16.56	0.46	130.0	± 9.6 %
		Y	4.67	66.44	16.29		130.0	
		Z	4.67	66.69	16.42		130.0	
10615-AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 90pc duty cycle)	X	4.84	66.40	16.20	0.46	130.0	± 9.6 %
		Y	4.72	66.07	15.93		130.0	
		Z	4.72	66.33	16.07		130.0	
10616-AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	X	5.42	66.80	16.56	0.46	130.0	± 9.6 %
		Y	5.33	66.52	16.36		130.0	
		Z	5.32	66.71	16.44		130.0	
10617-AAB	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	X	5.49	66.95	16.61	0.46	130.0	± 9.6 %
		Y	5.41	66.76	16.45		130.0	
		Z	5.40	66.93	16.53		130.0	
10618-AAB	IEEE 802.11ac WiFi (40MHz, MCS2, 90pc duty cycle)	X	5.38	66.99	16.64	0.46	130.0	± 9.6 %
		Y	5.28	66.71	16.44		130.0	
		Z	5.28	66.90	16.53		130.0	
10619-AAB	IEEE 802.11ac WiFi (40MHz, MCS3, 90pc duty cycle)	X	5.41	66.83	16.51	0.46	130.0	± 9.6 %
		Y	5.32	66.57	16.30		130.0	
		Z	5.31	66.75	16.39		130.0	
10620-AAB	IEEE 802.11ac WiFi (40MHz, MCS4, 90pc duty cycle)	X	5.51	66.90	16.59	0.46	130.0	± 9.6 %
		Y	5.40	66.60	16.37		130.0	
		Z	5.39	66.77	16.45		130.0	
10621-AAB	IEEE 802.11ac WiFi (40MHz, MCS5, 90pc duty cycle)	X	5.48	66.93	16.71	0.46	130.0	± 9.6 %
		Y	5.39	66.68	16.52		130.0	
		Z	5.38	66.86	16.61		130.0	
10622-AAB	IEEE 802.11ac WiFi (40MHz, MCS6, 90pc duty cycle)	X	5.50	67.12	16.80	0.46	130.0	± 9.6 %
		Y	5.42	66.91	16.63		130.0	
		Z	5.40	67.05	16.70		130.0	

10623-AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 90pc duty cycle)	X	5.37	66.65	16.45	0.46	130.0	± 9.6 %
		Y	5.28	66.39	16.25		130.0	
		Z	5.28	66.58	16.34		130.0	
10624-AAB	IEEE 802.11ac WiFi (40MHz, MCS8, 90pc duty cycle)	X	5.57	66.87	16.62	0.46	130.0	± 9.6 %
		Y	5.48	66.61	16.42		130.0	
		Z	5.47	66.77	16.50		130.0	
10625-AAB	IEEE 802.11ac WiFi (40MHz, MCS9, 90pc duty cycle)	X	6.04	68.14	17.31	0.46	130.0	± 9.6 %
		Y	5.92	67.83	17.08		130.0	
		Z	5.86	67.85	17.09		130.0	
10626-AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	X	5.69	66.81	16.49	0.46	130.0	± 9.6 %
		Y	5.62	66.57	16.31		130.0	
		Z	5.62	66.75	16.39		130.0	
10627-AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)	X	5.97	67.48	16.78	0.46	130.0	± 9.6 %
		Y	5.90	67.27	16.62		130.0	
		Z	5.88	67.40	16.68		130.0	
10628-AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 90pc duty cycle)	X	5.76	67.00	16.48	0.46	130.0	± 9.6 %
		Y	5.67	66.72	16.28		130.0	
		Z	5.66	66.88	16.36		130.0	
10629-AAB	IEEE 802.11ac WiFi (80MHz, MCS3, 90pc duty cycle)	X	5.84	67.06	16.50	0.46	130.0	± 9.6 %
		Y	5.77	66.85	16.34		130.0	
		Z	5.74	66.97	16.39		130.0	
10630-AAB	IEEE 802.11ac WiFi (80MHz, MCS4, 90pc duty cycle)	X	6.51	69.24	17.59	0.46	130.0	± 9.6 %
		Y	6.40	68.89	17.35		130.0	
		Z	6.28	68.76	17.29		130.0	
10631-AAB	IEEE 802.11ac WiFi (80MHz, MCS5, 90pc duty cycle)	X	6.25	68.57	17.44	0.46	130.0	± 9.6 %
		Y	6.12	68.19	17.19		130.0	
		Z	6.08	68.24	17.21		130.0	
10632-AAB	IEEE 802.11ac WiFi (80MHz, MCS6, 90pc duty cycle)	X	5.92	67.46	16.90	0.46	130.0	± 9.6 %
		Y	5.86	67.28	16.76		130.0	
		Z	5.84	67.41	16.81		130.0	
10633-AAB	IEEE 802.11ac WiFi (80MHz, MCS7, 90pc duty cycle)	X	5.82	67.14	16.58	0.46	130.0	± 9.6 %
		Y	5.71	66.81	16.36		130.0	
		Z	5.71	66.98	16.44		130.0	
10634-AAB	IEEE 802.11ac WiFi (80MHz, MCS8, 90pc duty cycle)	X	5.79	67.13	16.63	0.46	130.0	± 9.6 %
		Y	5.70	66.83	16.42		130.0	
		Z	5.69	67.01	16.50		130.0	
10635-AAB	IEEE 802.11ac WiFi (80MHz, MCS9, 90pc duty cycle)	X	5.70	66.55	16.10	0.46	130.0	± 9.6 %
		Y	5.59	66.22	15.86		130.0	
		Z	5.59	66.41	15.96		130.0	
10636-AAC	IEEE 802.11ac WiFi (160MHz, MCS0, 90pc duty cycle)	X	6.11	67.22	16.60	0.46	130.0	± 9.6 %
		Y	6.05	66.97	16.42		130.0	
		Z	6.04	67.12	16.48		130.0	
10637-AAC	IEEE 802.11ac WiFi (160MHz, MCS1, 90pc duty cycle)	X	6.29	67.65	16.79	0.46	130.0	± 9.6 %
		Y	6.23	67.43	16.63		130.0	
		Z	6.20	67.55	16.68		130.0	
10638-AAC	IEEE 802.11ac WiFi (160MHz, MCS2, 90pc duty cycle)	X	6.29	67.62	16.76	0.46	130.0	± 9.6 %
		Y	6.23	67.40	16.60		130.0	
		Z	6.20	67.52	16.64		130.0	

10639-AAC	IEEE 802.11ac WiFi (160MHz, MCS3, 90pc duty cycle)	X	6.27	67.57	16.77	0.46	130.0	± 9.6 %
		Y	6.19	67.29	16.58		130.0	
		Z	6.17	67.43	16.64		130.0	
10640-AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 90pc duty cycle)	X	6.30	67.66	16.77	0.46	130.0	± 9.6 %
		Y	6.20	67.34	16.55		130.0	
		Z	6.18	67.47	16.61		130.0	
10641-AAC	IEEE 802.11ac WiFi (160MHz, MCS5, 90pc duty cycle)	X	6.30	67.43	16.67	0.46	130.0	± 9.6 %
		Y	6.24	67.21	16.51		130.0	
		Z	6.23	67.38	16.58		130.0	
10642-AAC	IEEE 802.11ac WiFi (160MHz, MCS6, 90pc duty cycle)	X	6.35	67.69	16.96	0.46	130.0	± 9.6 %
		Y	6.27	67.44	16.78		130.0	
		Z	6.25	67.57	16.84		130.0	
10643-AAC	IEEE 802.11ac WiFi (160MHz, MCS7, 90pc duty cycle)	X	6.19	67.43	16.74	0.46	130.0	± 9.6 %
		Y	6.12	67.17	16.55		130.0	
		Z	6.10	67.32	16.62		130.0	
10644-AAC	IEEE 802.11ac WiFi (160MHz, MCS8, 90pc duty cycle)	X	6.42	68.12	17.10	0.46	130.0	± 9.6 %
		Y	6.30	67.73	16.85		130.0	
		Z	6.27	67.83	16.89		130.0	
10645-AAC	IEEE 802.11ac WiFi (160MHz, MCS9, 90pc duty cycle)	X	6.96	69.23	17.61	0.46	130.0	± 9.6 %
		Y	6.81	68.82	17.36		130.0	
		Z	6.64	68.54	17.21		130.0	
10646-AAD	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,7)	X	36.14	117.31	38.90	9.30	60.0	± 9.6 %
		Y	37.41	119.79	39.76		60.0	
		Z	44.85	123.68	40.74		60.0	
10647-AAC	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,7)	X	38.37	119.57	39.70	9.30	60.0	± 9.6 %
		Y	37.81	120.93	40.24		60.0	
		Z	46.89	125.67	41.46		60.0	
10648-AAA	CDMA2000 (1x Advanced)	X	0.76	64.71	11.69	0.00	150.0	± 9.6 %
		Y	0.62	62.37	9.59		150.0	
		Z	0.65	63.27	10.28		150.0	
10652-AAB	LTE-TDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)	X	4.49	69.07	17.63	2.23	80.0	± 9.6 %
		Y	4.22	68.27	17.06		80.0	
		Z	4.35	68.92	17.36		80.0	
10653-AAB	LTE-TDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)	X	4.93	68.17	17.64	2.23	80.0	± 9.6 %
		Y	4.72	67.56	17.22		80.0	
		Z	4.80	68.03	17.44		80.0	
10654-AAB	LTE-TDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)	X	4.87	67.81	17.63	2.23	80.0	± 9.6 %
		Y	4.67	67.22	17.23		80.0	
		Z	4.76	67.67	17.45		80.0	
10655-AAB	LTE-TDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)	X	4.93	67.83	17.67	2.23	80.0	± 9.6 %
		Y	4.74	67.21	17.27		80.0	
		Z	4.82	67.65	17.48		80.0	
10658-AAA	Pulse Waveform (200Hz, 10%)	X	13.17	86.89	23.60	10.00	50.0	± 9.6 %
		Y	14.69	88.65	23.55		50.0	
		Z	14.49	88.55	23.74		50.0	
10659-AAA	Pulse Waveform (200Hz, 20%)	X	50.09	107.91	28.24	6.99	60.0	± 9.6 %
		Y	74.63	111.90	28.40		60.0	
		Z	82.42	114.14	29.27		60.0	

10660-AAA	Pulse Waveform (200Hz, 40%)	X	100.00	115.90	28.07	3.98	80.0	± 9.6 %
		Y	100.00	112.84	26.35		80.0	
		Z	100.00	114.41	27.18		80.0	
10661-AAA	Pulse Waveform (200Hz, 60%)	X	100.00	116.78	26.96	2.22	100.0	± 9.6 %
		Y	100.00	111.69	24.44		100.0	
		Z	100.00	114.68	25.86		100.0	
10662-AAA	Pulse Waveform (200Hz, 80%)	X	100.00	120.91	26.72	0.97	120.0	± 9.6 %
		Y	100.00	108.87	21.46		120.0	
		Z	100.00	116.35	24.67		120.0	

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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 0108**

Client **PC Test**

Certificate No: **ES3-3131_Mar18**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3131**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

SC✓
3/21/18

Calibration date: **March 13, 2018**

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: March 13, 2018			
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 0108**

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
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3131

Manufactured: February 6, 2007
Calibrated: March 13, 2018

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3131

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.27	1.26	1.21	$\pm 10.1 \%$
DCP (mV) ^B	104.8	101.0	102.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	190.2	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		209.7	
		Z	0.0	0.0	1.0		205.3	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $\text{ms}\cdot\text{V}^{-2}$	T2 $\text{ms}\cdot\text{V}^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	59.71	424.3	34.95	29.43	2.926	5.10	0.529	0.536	1.010
Y	55.55	399.2	35.49	28.93	2.461	5.10	0.546	0.521	1.009
Z	63.86	454.3	34.89	29.70	3.365	5.10	0.736	0.556	1.011

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

^A The uncertainties of Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.