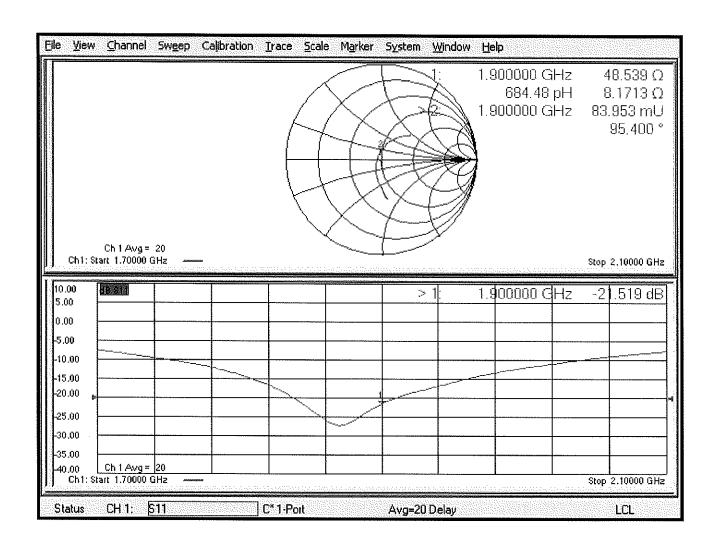
## Impedance Measurement Plot for Body TSL



## PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D1900V2 – SN:5d149

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor		Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	3914
SPEAG	EX3DV4	SAR Probe	5/16/2019	Annual	5/16/2020	7406
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/8/2019	Annual	5/8/2020	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/14/2019	Annual	2/14/2020	1272

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

### Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	304

Object:	Date Issued:	Page 1 of 4
D1900V2 - SN: 5d149	10/18/2019	Page 1 of 4

### **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:

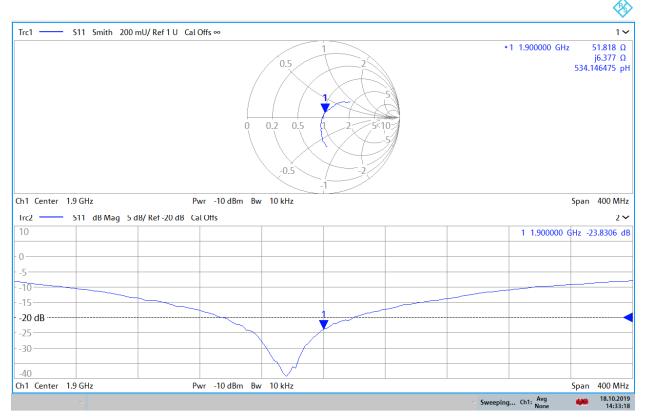
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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	Head SAR (1g)		Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(10a) W/ka @	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
10/23/2018	10/18/2019	1.193	3.93	4.24	7.89%	2.05	2.18	6.34%	52.9	51.8	1.1	6.3	6.4	0.1	-23.4	-23.8	-1.80%	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	(40-) M(4 ©	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
10/23/2018	10/18/2019	1.193	3.94	4.2	6.60%	2.07	2.15	3.86%	48.5	48.4	0.1	8.2	7.6	0.6	-21.5	-22.1	-2.60%	PASS

Object:	Date Issued:	Page 2 of 4
D1900V2 - SN: 5d149	10/18/2019	Fage 2 01 4

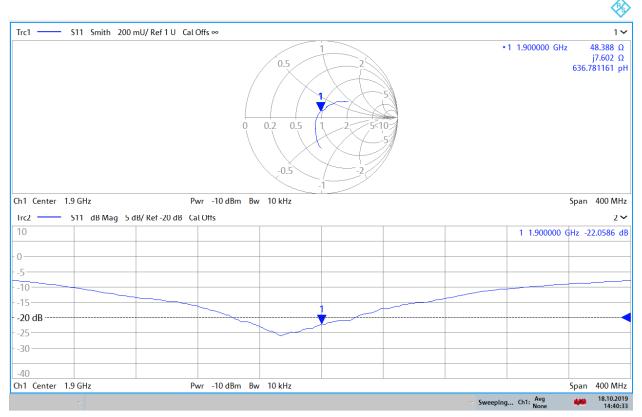
#### Impedance & Return-Loss Measurement Plot for Head TSL



14:33:19 18.10.2019

Object:	Date Issued:	Page 3 of 4
D1900V2 - SN: 5d149	10/18/2019	Page 3 of 4

### Impedance & Return-Loss Measurement Plot for Body TSL



14:40:34 18.10.2019

Object:	Date Issued:	Page 4 of 4
D1900V2 - SN: 5d149	10/18/2019	Page 4 of 4

### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client

**PC Test** 

Certificate No: D1900V2-5d148 Feb19

## **CALIBRATION CERTIFICATE**

Object

D1900V2 - SN:5d148

Calibration procedure(s)

QA CAL-05.v11

Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

1300

Calibration date:

February 21, 2019

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)°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	31-Dec-18 (No. EX3-7349_Dec18)	Dec-19
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	07-Oct-15 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Manu Seltz	Laboratory Technician	- Pi
			770
Approved by:	Katja Pokovic	Technical Manager	AUG

Issued: February 21, 2019

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

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Swiss Calibration Service

Accreditation No.: SCS 0108

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#### Glossary:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z

not applicable or not measured

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

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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%.

Certificate No: D1900V2-5d148\_Feb19

Page 2 of 8

### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	1900 MHz ± 1 MHz	

## **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.65 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.4 W/kg ± 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 ± 0.2) °C	53.6 ± 6 %	1.47 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.56 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 16.5 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω + 6.8 jΩ
Return Loss	- 23.2 dB

## **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	48.4 Ω + 7.8 jΩ
Return Loss	- 21.9 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	
Liectrical Delay (one direction)	1.170 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

#### **DASY5 Validation Report for Head TSL**

Date: 21.02,2019

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

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

Medium parameters used: f = 1900 MHz;  $\sigma = 1.38 \text{ S/m}$ ;  $\varepsilon_r = 40.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### **DASY52 Configuration:**

Probe: EX3DV4 - SN7349; ConvF(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 31.12.2018

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 04.10.2018

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

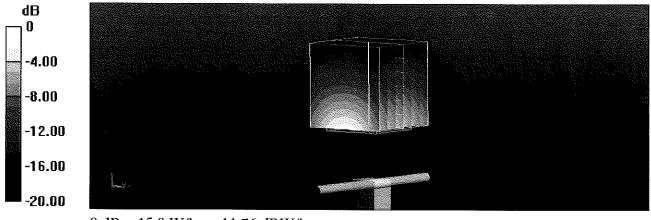
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.4 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.8 W/kg

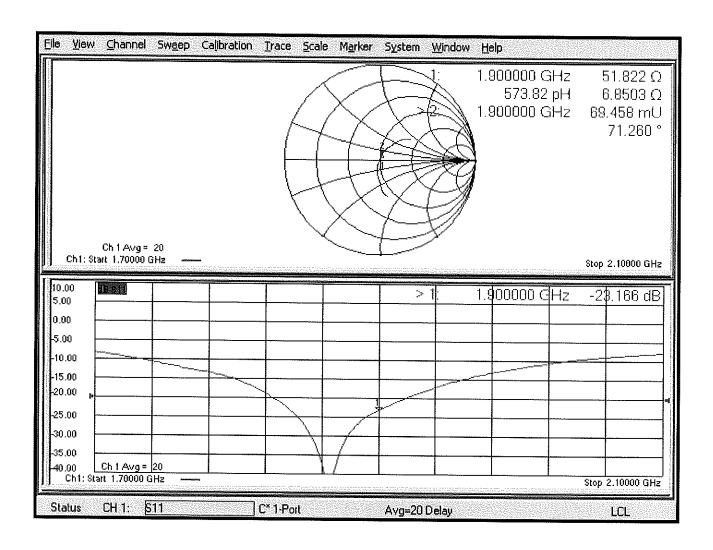
SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.05 W/kg

Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

## Impedance Measurement Plot for Head TSL



### **DASY5 Validation Report for Body TSL**

Date: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

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

Medium parameters used: f = 1900 MHz;  $\sigma = 1.47 \text{ S/m}$ ;  $\varepsilon_r = 53.6$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.23, 8.23, 8.23) @ 1900 MHz; Calibrated: 31.12.2018

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 04.10,2018

Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

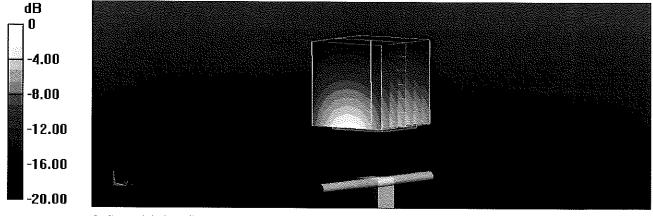
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.7 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.0 W/kg

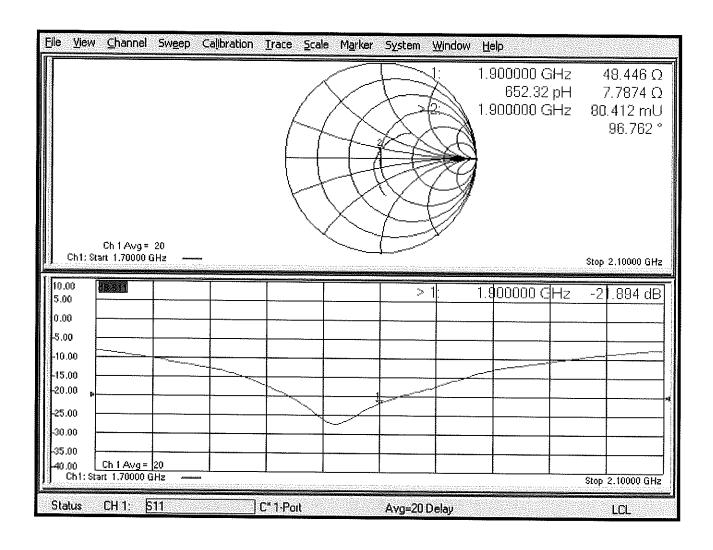
SAR(1 g) = 9.56 W/kg; SAR(10 g) = 5.05 W/kg

Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

## Impedance Measurement Plot for Body TSL



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Swiss Calibration Service

Accreditation No.: SCS 0108

Issued: November 8, 2017

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Client

PC Test

Certificate No: D2300V2-1064 Nov17

#### CALIBRATION CERTIFICATE Object QA CAL-05.v9 Calibration procedure(s) Calibration procedure for dipole validation kits above 700 MHz Calibration date: November 08, 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-791 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 26-Oct-17 (No. DAE4-601\_Oct17) Oct-18 Secondary Standards Check Date (in house) Scheduled Check Power meter EPM-442A SN: GB37480704 07-Oct-15 (în 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 SN: MY41092317 Power sensor HP 8481A 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 SN: US37390585 Network Analyzer HP 8753E 18-Oct-01 (in house check Oct-17) In house check: Oct-18 Name Function Signature Jeton Kastrati Calibrated by: Laboratory Technician Katja Pokovic Technical Manager Approved by:

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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:

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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%.

Certificate No: D2300V2-1064\_Nov17 Page 2 of 8

#### **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 ± 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 ± 0.2) °C	38.3 ± 6 %	1.70 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	- W	

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	47.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 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 ± 0.2) °C	51.9 ± 6 %	1.85 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	11.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	46.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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	22.6 W/kg ± 16.5 % (k=2)

Certificate No: D2300V2-1064\_Nov17 Page 3 of 8

## Appendix (Additional assessments outside the scope of SCS 0108)

## **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	48.4 Ω - 5.2 jΩ
Return Loss	- 25.1 dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.1 Ω - 4.1 jΩ
Return Loss	- 23.5 dB

## **General Antenna Parameters and Design**

г		
- 1	Floatrical Delevidence discussion	
- 1	Electrical Delay (one direction)	1.168 ns
L	, , , , , , , , , , , , , , , , , , ,	1.100 (15

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 20, 2015

Certificate No: D2300V2-1064\_Nov17

#### **DASY5 Validation Report for Head TSL**

Date: 08.11.2017

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1064

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

Medium parameters used: f = 2300 MHz;  $\sigma = 1.7 \text{ S/m}$ ;  $\varepsilon_r = 38.3$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.31, 8.31, 8.31); Calibrated: 31.05.2017;

• 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:

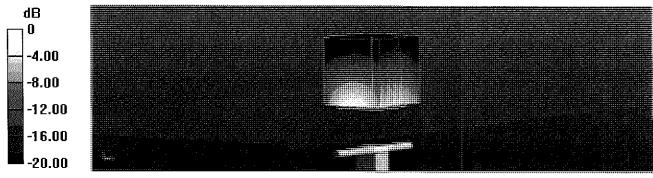
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 112.6 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 23.8 W/kg

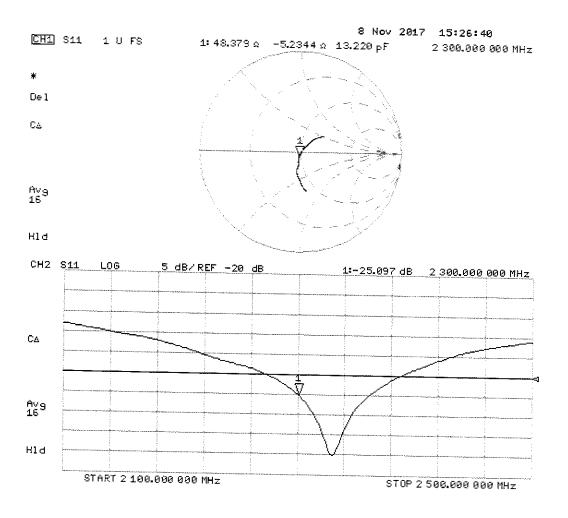
SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.84 W/kg

Maximum value of SAR (measured) = 19.5 W/kg



0 dB = 19.5 W/kg = 12.90 dBW/kg

# Impedance Measurement Plot for Head TSL



## **DASY5 Validation Report for Body TSL**

Date: 08.11.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1064

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

Medium parameters used: f = 2300 MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.22, 8.22, 8.22); Calibrated: 31.05.2017;

• 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:

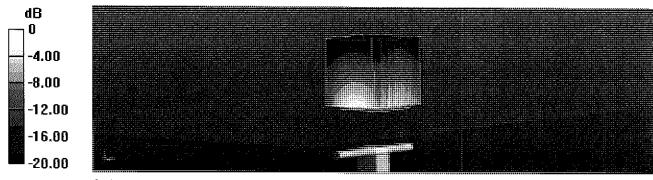
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.6 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 22.6 W/kg

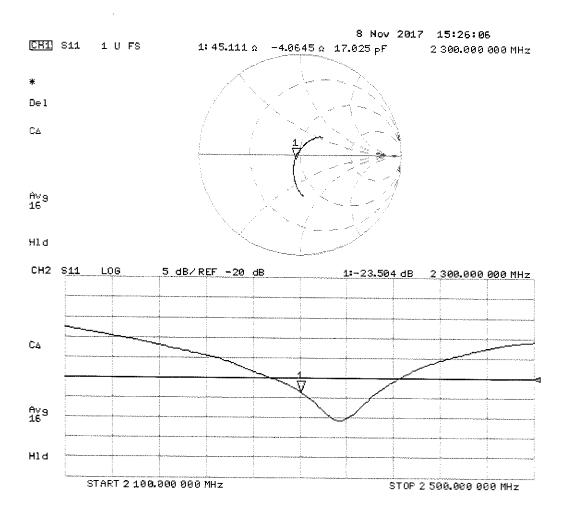
SAR(1 g) = 11.8 W/kg; SAR(10 g) = 5.69 W/kg

Maximum value of SAR (measured) = 18.4 W/kg



0 dB = 18.4 W/kg = 12.65 dBW/kg

## Impedance Measurement Plot for Body TSL



### PCTEST ENGINEERING LABORATORY, INC.



18855 Adams Ct, Morgan Hill, CA 95037 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



# **Certification of Calibration**

Object D2300V2 – SN: 1064

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

Extended Calibration date: November 20, 2018

Description: SAR Validation Dipole at 2300 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Vector Network Analyzer	8/30/2018	Annual	8/30/2019	MY40003841
Agilent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/22/2017	Annual	10/22/2018	1328004
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Biennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330156
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
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2018	Annual	7/11/2019	1322
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	EX3DV4	SAR Probe	6/25/2018	Annual	6/25/2019	7409
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7410

## Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	SAR Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K

Object:	Date Issued:	Page 1 of 4
D2300V2 - SN: 1064	11/20/2018	Page 1 of 4

### **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:

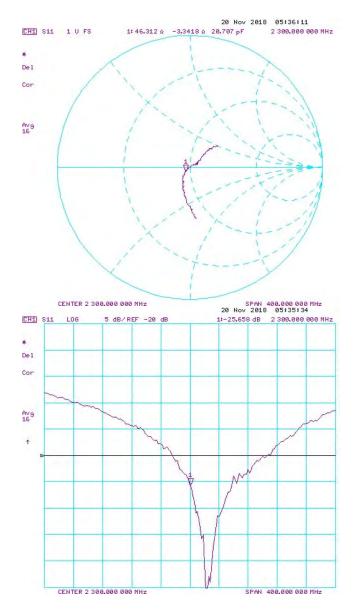
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance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

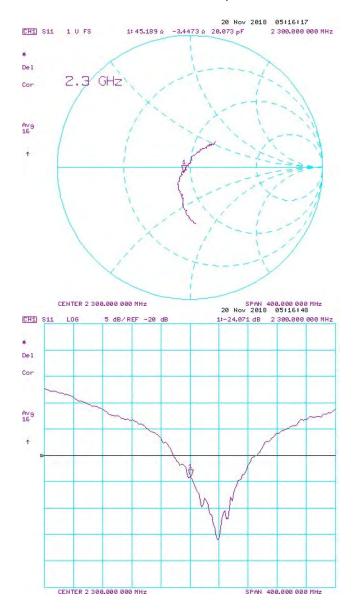
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	(0/)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(40-) 14//	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) 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
11/8/2017	11/20/2018	1.168	4.76	4.69	-1.47%	2.31	2.24	-3.03%	48.4	46.3	2.1	-5.2	-3.3	1.9	-25.1	-25.7	-2.20%	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
11/8/2017	11/20/2018	1.168	4.65	4.83	3.87%	2.26	2.29	1.33%	45.1	45.2	0.1	-4.1	-3.4	0.7	-23.5	-24.1	-2.40%	PASS

Object:	Date Issued:	Page 2 of 4
D2300V2 - SN: 1064	11/20/2018	Faye 2 01 4

### Impedance & Return-Loss Measurement Plot for Head TSL



### Impedance & Return-Loss Measurement Plot for Body TSL



#### Calibration Laboratory of Schmid & Partner Engineering AG

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kallbrierdienst
C Service sulsse d'étalonnage
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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client

**PC Test** 

Certificate No: D2450V2-797\_Sep17

	CERTIFICATI		•
Object	D2450V2 - SN:7	97	
Callbration procedure(s)	QA CAL-05.v9 Calibration proce	edure for dipole validation kits abo	(o)o)
Callbration date:	September 11, 2	017	Extended PMV 9/20/2
The measurements and the unce	rtainties with confidence p	ional standards, which realize the physical un probability are given on the following pages ar	ilts of measurements (SI). BNV ad are part of the certificate.
All Caudrations have been conduc	cted in the closed laborato	ry facility: environment temperature (22 $\pm$ 3)°(	C and humidity < 70%.
Calibration Equipment used (M&	TE critical for calibration)		
	FE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards Power meler NRP		Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18
Primary Standards Power meler NRP	1D #		Apr-18
Primary Standards Power meler NRP Power sensor NRP-Z91	ID # SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	ID # SN: 104778 SN: 103244	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	Apr-18 Apr-18 . î. Apr-18
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	ID # SN: 104778 SN: 103244 SN: 103245	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	Apr-18 Apr-18 a
Primary Standards Power meler NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Apr-18 Apr-18 : Apr-16 Apr-18
Primary Standards Power meler NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529)	Apr-18 Apr-18 : a Apr-18 Apr-18 Apr-18
Primary Standards Power meier NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529) 31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)	Apr-18 Apr-18 Apr-16 Apr-16 Apr-18 Apr-18 Apr-18 May-18 May-18
Primary Standards Power meler NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)	Apr-18 Apr-18 Apr-16 Apr-16 Apr-18 Apr-18 May-18 May-18 Mar-18
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529) 31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house)	Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Mar-18 Scheduled Check In house check: Oct-18
Primary Standards Power meler NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	ID # SN: 104779 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529) 31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)  Check Date (in house) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529) 31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)  Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Primary Standards Power meler NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529) 31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)  Check Date (in house) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08 Network Analyzer HP 8753E	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529) 31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)  Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Mar-18 Scheduled Check In house check: Oct-18

Issued: September 11, 2017

Certificate No: D2450V2-797\_Sep17

Katja Pokovic

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

Approved by:

Technical Manager

### Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossarv:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,v,z

N/A

not applicable or not measured

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

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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	2450 MHz ± 1 MHz	

## **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity	
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m	
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.86 mho/m ± 6 %	
Head TSL temperature change during test	< 0.5 °C	-	Mhana	

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg ± 16.5 % (k=2)

## **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.9 ± 6 %	2.04 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	N.S. o. o.	

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 W/kg ± 16.5 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 7.4 jΩ
Return Loss	- 21.9 dB

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	49.7 Ω + 9.1 jΩ
Return Loss	- 20,9 dB

#### General Antenna Parameters and Design

	<u>,</u>
I Floatrical Delay (one direction)	l 1.152 ns l
Electrical Delay (one direction)	I 1.152 ns I
	*******

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

#### **Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	January 24, 2006

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#### **DASY5 Validation Report for Head TSL**

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

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

Medium parameters used: f = 2450 MHz;  $\sigma = 1.86$  S/m;  $\varepsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12); 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) = 26.9 W/kg

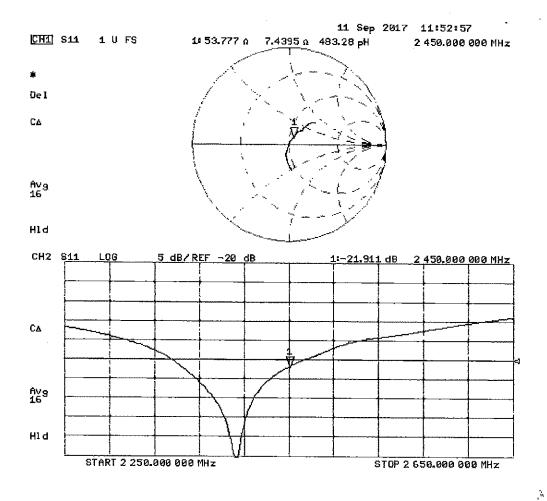
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.28 W/kg

Maximum value of SAR (measured) = 21.6 W/kg



0 dB = 21.6 W/kg = 13.34 dBW/kg

# Impedance Measurement Plot for Head TSL



### **DASY5 Validation Report for Body TSL**

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

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

Medium parameters used: f = 2450 MHz;  $\sigma = 2.04$  S/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.1, 8.1, 8.1); 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:

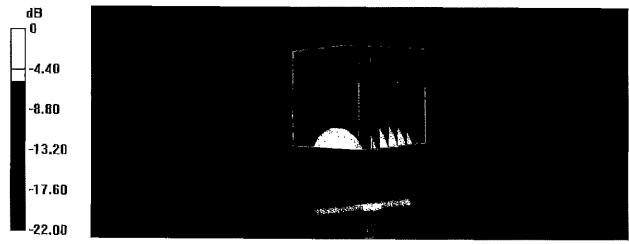
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.4 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 25.6 W/kg

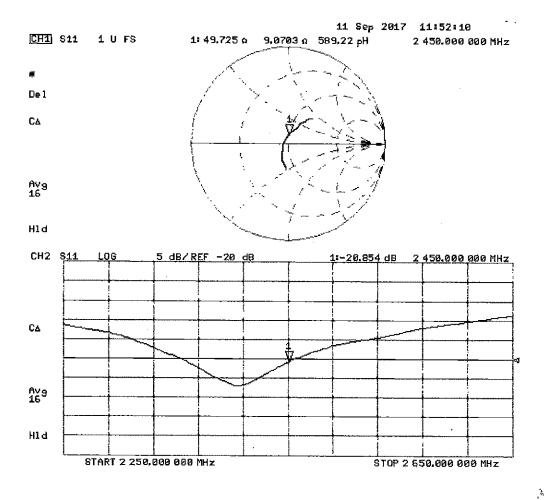
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.14 W/kg

Maximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg = 13.07 dBW/kg

## Impedance Measurement Plot for Body TSL



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# PCTEST ENGINEERING LABORATORY, INC. 7185 Oakland Mills Road, Columbia, MD



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## **Certification of Calibration**

Object

D2450V2 - SN: 797

Calibration procedure(s)

Procedure for Calibration Extension for SAR Dipoles.

**Extended Calibration date:** 

September 11, 2018

Description:

SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Blennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	8iennial	5/2/2019	170330156
Amplifler Research	15S1G6	Amplifler	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight	7720	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
Agilent	8753ES	S-Parameter Vector Network Analyzer	8/30/2018	Annuai	8/30/2019	MY40003841
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7410
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2018	Annual	7/11/2019	1322
SPEAG	ES3DV3	SAR Probe	3/13/2018	Annual	3/13/2019	3319
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/7/2018	Annual	3/7/2019	1368
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/22/2017	Annual	10/22/2018	1328004
Agllent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	. N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	СВТ	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BROPTE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	204

Object:	Date Issued:	Page 1 of 4
D2450V2 - SN: 797	09/11/2018	Page 1 of 4

### **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  $5\Omega$  from the previous measurement.

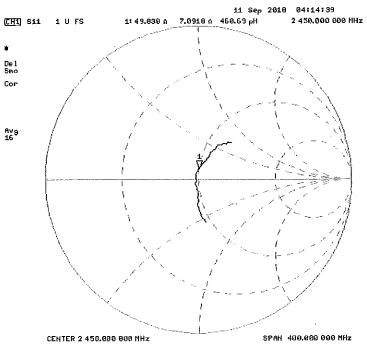
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

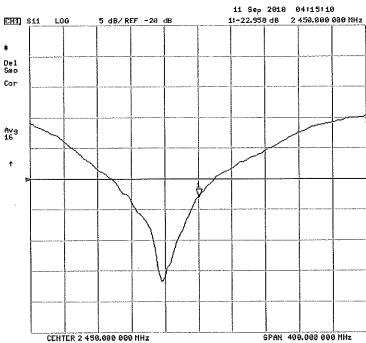
Calibration Date	Extension Date		Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g)	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	(Ohm)	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)		PASS/FAIL
9/11/2017	9/11/2018	1.152	5.27	5.52	4.74%	2.48	2.54	2.42%	53.8	49.8	4	7.4	7.1	0.3	-21.9	-23	-4.80%	PASS

Calibration Date Extension	nsion Date Electrical Delay (ns)	SAR Target Body (1g) W/kg @ 20.0 dBm	Body SAR (1g)	Deviation 1g (%)	SAR Target Body (10g) W/kg @ 20.0 dBm	Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Impedance Body (Ohm) Real		Difference (Ohm) Real	Impedance Body (Ohm) Imaginary	Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/11/2017 9/11/	11/2018 1.152	5.11	5.17	1.17%	2.42	2.37	-2.07%	49.7	49.8	0.1	9.1	7.2	1.9	-20.9	-22.6	-8.20%	PASS

Object:	Date Issued:	Page 2 of 4
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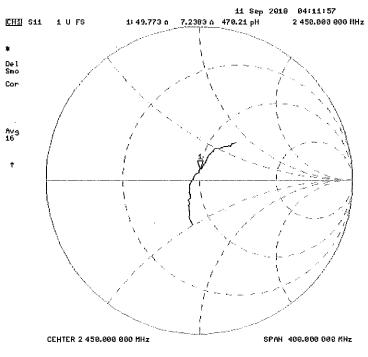
### Impedance & Return-Loss Measurement Plot for Head TSL

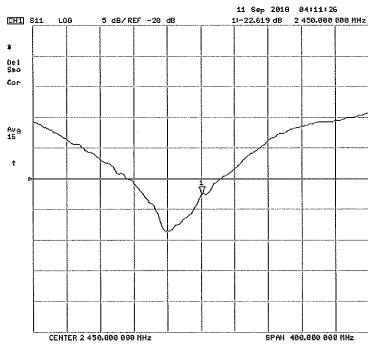




Object:	Date Issued:	Page 3 of 4
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## Impedance & Return-Loss Measurement Plot for Body TSL





Object:	Date Issued:	Page 4 of 4
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# **Certification of Calibration**

Object D2450V2 – SN: 797

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

Extended Calibration date: September 9, 2019

Description: SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	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	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	7/15/2019	Annual	7/15/2020	7547
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1323
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

#### Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K

Object:	Date Issued:	Page 1 of 4
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## **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:

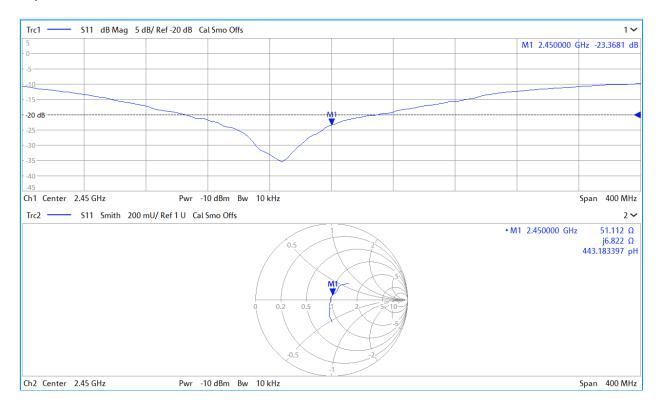
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance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

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

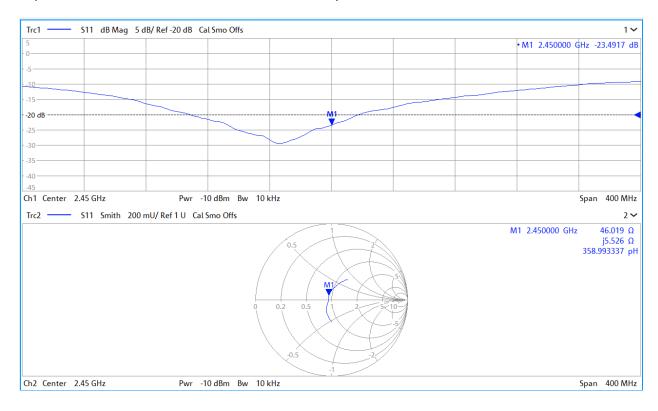
Calibration Date	Extension Date		Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	(0/)		(40-) M(4 G)	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/9/2019	1.152	5.27	5.19	-1.52%	2.48	2.41	-2.82%	53.8	51.1	2.7	7.4	6.8	0.6	-21.9	-23.4	-6.70%	PASS
Calibration Date	Extension Date		Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	(0/)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	(40-) M(4 (-)	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	9/9/2019	1.152	5.11	5.17	1.17%	2.42	2.38	-1.65%	49.7	46	3.7	9.1	5.5	3.6	-20.9	-23.5	-12.40%	PASS

Object:	Date Issued:	Page 2 of 4
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## Impedance & Return-Loss Measurement Plot for Head TSL



# Impedance & Return-Loss Measurement Plot for Body TSL



## Calibration Laboratory of

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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Accreditation No.: SCS 0108

Client

PC Test

Certificate No: D2450V2-981\_Aug18

# CALIBRATION CERTIFICATE

Object

D2450V2 - SN:981

Calibration procedure(s)

QA CAL-05.v10

Calibration procedure for dipole validation kits above 700 MHz

BN V 09-06/201

Calibration date:

August 16, 2018

BNV 08/10/2016

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  $(22 \pm 3)$ °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)	
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)		Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe EX3DV4	SN: 7349	04-Apr-18 (No. 217-02683)	Apr-19
DAE4	1	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
UAL-	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
Secondary Standards	₹D#	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)	
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 Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18
-	,	or marity (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	D 1 42/4
		•	Sel Tile
Approved by:	Katja Pokovic	Technical Manager	
	*		ASE COS

Issued: August 23, 2018

Certificate No: D2450V2-981\_Aug18

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

# **Calibration Laboratory of**

Schmid & Partner
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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:

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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 = 5.0 mm	
Frequency	2450 MHz ± 1 MHz	

# **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# **SAR result with Head TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.3 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 16.5 % (k=2)

# **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 W/kg ± 16.5 % (k=2)

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.0 Ω + 2.3 jΩ
Return Loss	- 25.6 dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.2 Ω + 4.7 jΩ
Return Loss	- 26.6 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1,162 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

#### Additional EUT Data

Manufactured by	SPEAG	
Manufactured on	December 30, 2014	

Certificate No: D2450V2-981\_Aug18

# Appendix (Additional assessments outside the scope of SCS 0108)

# **Measurement Conditions**

DASY system configuration, as far as not given on page 1 and 3.

Phantom	0.4144	
T Halltolli	SAM Head Phantom	For usage with cSAR3DV2-R/L
	<del></del>	1 0 404g0 Will OOA 10D VZ-11/L

# SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.0 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.2 W/kg ± 16.9 % (k=2)

# SAR result with SAM Head (Mouth)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.0 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.3 W/kg ± 16.9 % (k=2)

# SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.2 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 16.9 % (k=2)

# SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	34.7 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	17.5 W/kg ± 16.9 % (k=2)

Certificate No: D2450V2-981\_Aug18

# **DASY5 Validation Report for Head TSL**

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:981

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

Medium parameters used: f = 2450 MHz;  $\sigma = 1.86$  S/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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:

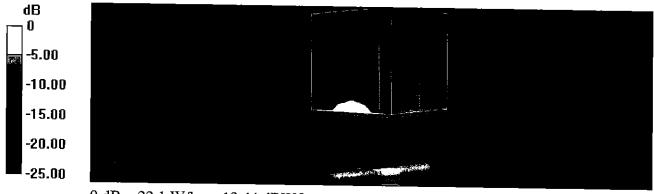
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.6 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.7 W/kg

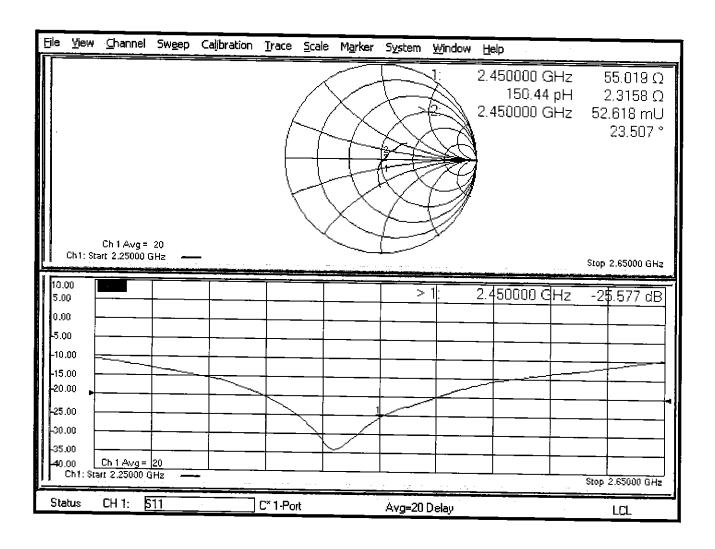
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.2 W/kg

Maximum value of SAR (measured) = 22.1 W/kg



0 dB = 22.1 W/kg = 13.44 dBW/kg

# Impedance Measurement Plot for Head TSL



# **DASY5 Validation Report for Body TSL**

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:981

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

Medium parameters used: f = 2450 MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 51.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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 = 107.0 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 25.3 W/kg

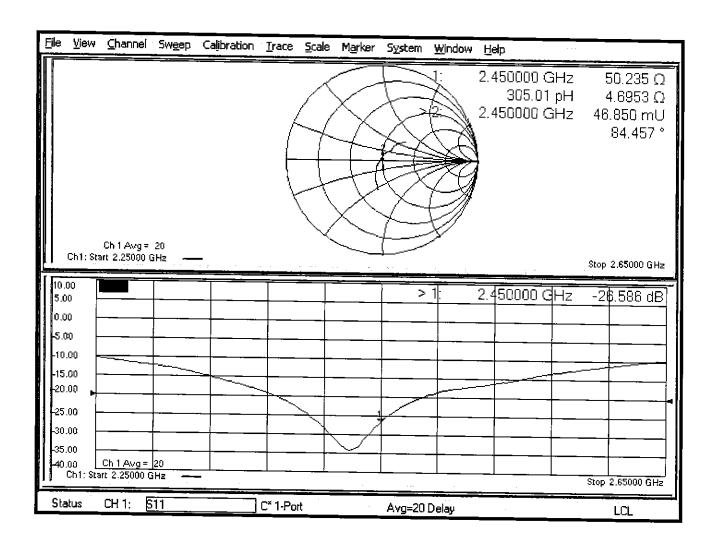
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.11 W/kg

Maximum value of SAR (measured) = 20.7 W/kg



0 dB = 20.7 W/kg = 13.16 dBW/kg

# Impedance Measurement Plot for Body TSL



## **DASY5 Validation Report for SAM Head**

Date: 16.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:981

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

Medium parameters used: f = 2450 MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: SAM Head
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

# SAM Head Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 26.4 W/kg

SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.33 W/kg

Maximum value of SAR (measured) = 22.0 W/kg

# SAM Head Mouth/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.9 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.3 W/kg

SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.35 W/kg

Maximum value of SAR (measured) = 21.7 W/kg

# SAM Head Neck/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 112.0 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 24.1 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.11 W/kg

Maximum value of SAR (measured) = 20.5 W/kg

# SAM Head Ear/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

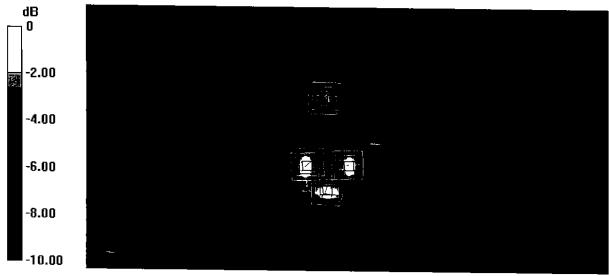
Reference Value = 91.03 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 15.8 W/kg

SAR(1 g) = 8.74 W/kg; SAR(10 g) = 4.4 W/kg

Maximum value of SAR (measured) = 13.5 W/kg

Certificate No: D2450V2-981\_Aug18



0 dB = 22.0 W/kg = 13.42 dBW/kg

## PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



# **Certification of Calibration**

Object D2450V2 – SN: 981

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

Calibration date: 08/09/2019

Description: SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	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	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	7/15/2019	Annual	7/15/2020	7547
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1323
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	304

Object:	Date Issued:	Page 1 of 4
D2450V2 – SN: 981	08/09/2019	Page 1 of 4

# **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:

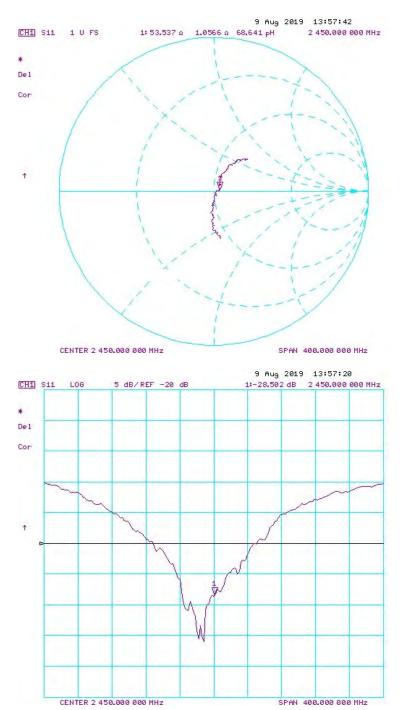
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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	(0/)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(40-) M(4 ©	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
8/16/2018	8/9/2019	1.162	5.23	5.53	5.74%	2.44	2.56	4.92%	55	53.5	1.5	2.3	1.1	1.2	-25.6	-28.5	-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	(0/)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	(40-) M(4 @	Deviation 10g (%)		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
8/16/2018	8/9/2019	1.162	5.09	4.98	-2.16%	2.42	2.28	-5.79%	50.2	47.8	2.4	4.7	1.1	3.6	-26.6	-31.8	-19.60%	PASS

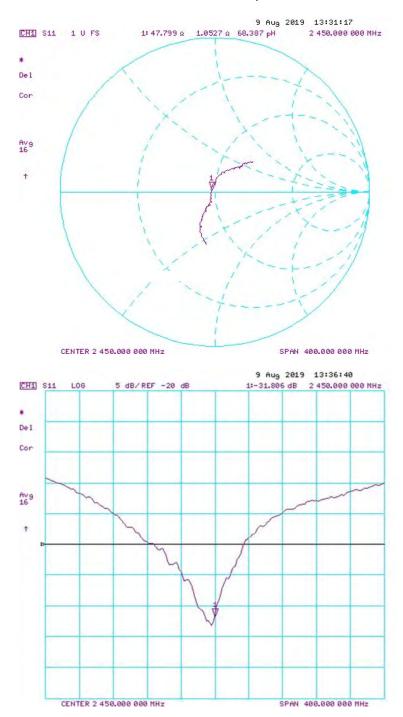
Object:	Date Issued:	Page 2 of 4	
D2450V2 – SN: 981	08/09/2019	Fage 2 01 4	

## Impedance & Return-Loss Measurement Plot for Head TSL



Object:	Date Issued:	Page 2 of 4
D2450V2 - SN: 981	08/09/2019	Page 3 of 4

## Impedance & Return-Loss Measurement Plot for Body TSL



Object:	Date Issued:	Dogo 4 of 4	
D2450V2 – SN: 981	08/09/2019	Page 4 of 4	

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





Schweizerischer Kalibrierdienst Service suïsse d'étalonnage Servizio svizzero di taratura

Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: SCS 0108

Client

PC Test

Certificate No: D2600V2=1004\_Apr18

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alibration date:	April 11, 2018		
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te measurements and the unce	ertainties with confidence p	probability are given on the following page	at units of measurements (SI).  is and are part of the certificate.
		ry facility: environment temperature (22 ±	
		ry radility: environment temperature (22 ±	:3)°C and humidity < 70%.
alibration Equipment used (M&	TE critical for calibration)		
mary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
wer meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
wer sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
wer sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	•
ference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
pe-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
eference Probe EX3DV4	SN: 7349		Apr-19
\E4	SN: 601	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
	1 0.11 001	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
condary Standards	ID#	Check Date (in house)	Scheduled Check
wer meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
wer sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
wer sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	
twork Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18 In house check: Oct-18
		·	
	Name	Function	Signature
librated by:	Michael Weber	Laboratory Technician	
			A. PUST
proved by:	Katja Pokovic	Technical Manager	
			LXU4
is calibration certificate shall no	of he reproduced assess in	And Latter 1 (a)	Issued: April 12, 2018

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

Certificate No: D2600V2-1004\_Apr18

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## **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z

not applicable or not measured

# Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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%.

Certificate No: D2600V2-1004\_Apr18

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## **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 ± 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 ± 0.2) °C	37.8 ± 6 %	2.03 mho/m ± 6 %	
Head TSL temperature change during test	< 0.5 °C			

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.1 W/kg ± 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 ± 0.2) °C	52.1 ± 6 %	2.19 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

# **SAR result with Body TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	54.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.7 W/kg ± 16.5 % (k=2)

Certificate No: D2600V2-1004\_Apr18 Page 3 of 8

## Appendix (Additional assessments outside the scope of SCS 0108)

## **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	47.7 Ω - 5.7 jΩ	
Return Loss	- 24.1 dB	

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	46.0 $Ω$ - 3.8 j $Ω$	
Return Loss	- 24.9 dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	ļ	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	December 23, 2006

#### **DASY5 Validation Report for Head TSL**

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004

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

Medium parameters used: f = 2600 MHz;  $\sigma = 2.03 \text{ S/m}$ ;  $\varepsilon_r = 37.8$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(7.7, 7.7, 7.7); 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:

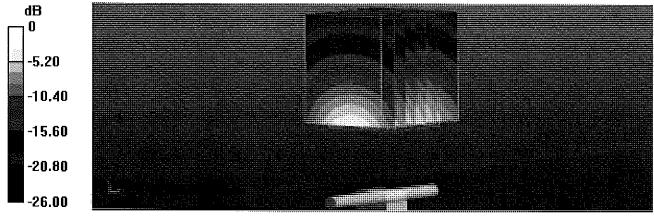
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 118.5 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.6 W/kg

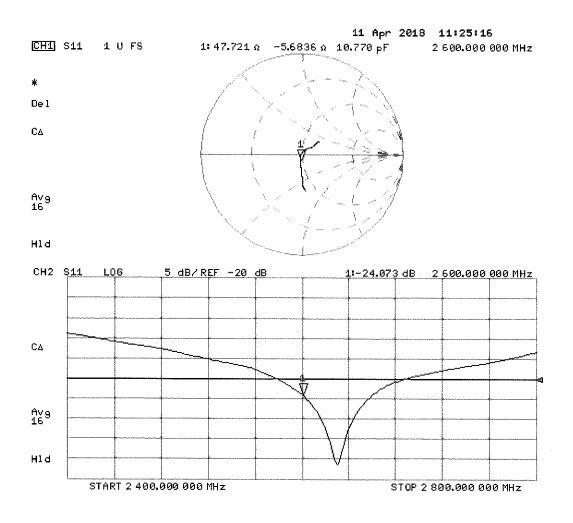
SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.35 W/kg

Maximum value of SAR (measured) = 23.9 W/kg



0 dB = 23.9 W/kg = 13.78 dBW/kg

# Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004

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

Medium parameters used: f = 2600 MHz;  $\sigma = 2.19 \text{ S/m}$ ;  $\varepsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(7.81, 7.81, 7.81); 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:

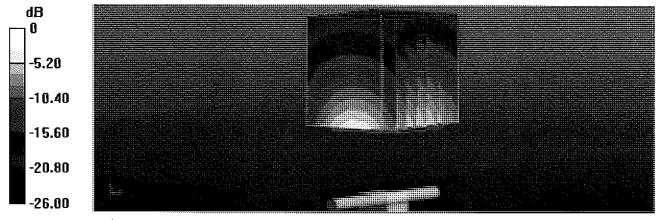
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.5 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.3 W/kg

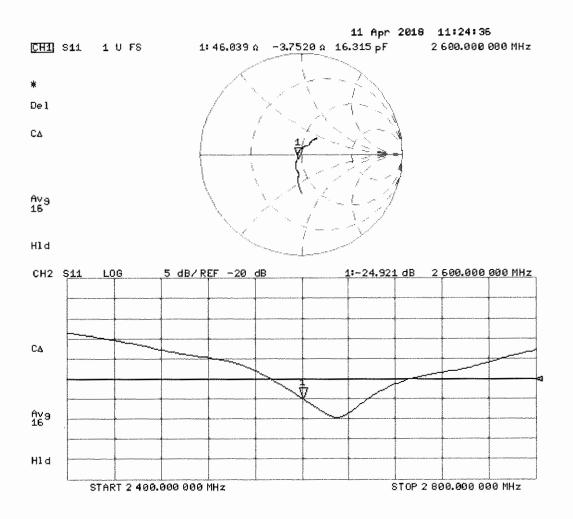
SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.2 W/kg

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



# PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



# **Certification of Calibration**

Object D2600V2 – SN: 1004

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

Extension Calibration date: 4/11/2019

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	3/11/2019	Annual	3/11/2020	US39170122
Agilent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1027293
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1126066
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./ Clock/ Humidity Monitor	10/9/2018	Biennial	10/9/2020	181647811
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330156
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
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	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
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	EX3DV4	SAR Probe	6/25/2018	Annual	6/25/2019	7409
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BROPTE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	304

Object:	Date Issued:	Page 1 of 4
D2600V2 – SN: 1004	04/11/2019	Page 1 of 4

## **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:

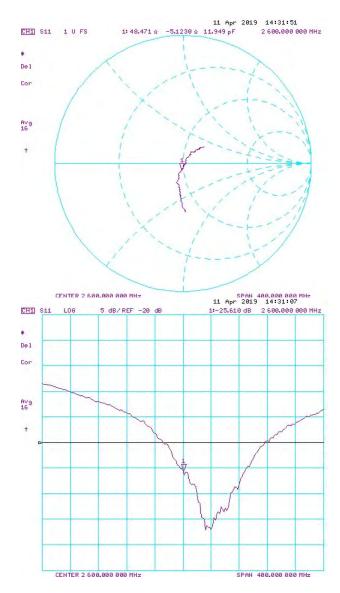
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance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

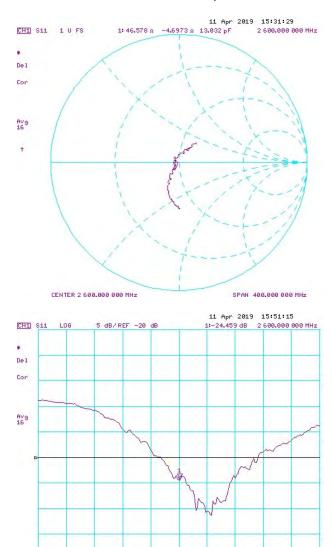
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	(0/)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(40-) M(4 (C)	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (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
4/11/2018	4/11/2019	1.149	5.59	5.51	-1.43%	2.51	2.47	-1.59%	47.7	48.5	0.8	-5.7	-5.1	0.6	-24.1	-25.6	-6.30%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)		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
4/11/2018	4/11/2019	1.149	5.48	5.65	3.10%	2.47	2.48	0.40%	46	46.6	0.6	-3.8	-4.7	0.9	-24.9	-24.5	1.80%	PASS

Object:	Date Issued:	Page 2 of 4	
D2600V2 – SN: 1004	04/11/2019	Fage 2 01 4	

#### Impedance & Return-Loss Measurement Plot for Head TSL



# Impedance & Return-Loss Measurement Plot for Body TSL



CENTER 2 600.000 000 MHz

SPAN 400.000 000 MHz

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





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client

**PC Test** 

Certificate No: D2600V2-1064\_Jun19

# **CALIBRATION CERTIFICATE**

Object

D2600V2 - SN:1064

Calibration procedure(s)

QA CAL-05.v11

Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date:

June 14, 2019

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	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	INLI
Approved by:	Katja Pokovic	Technical Manager	Elle

Issued: June 20, 2019

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Accreditation No.: SCS 0108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A not ap

not applicable or not measured

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

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	2600 MHz ± 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 ± 0.2) °C	37.3 ± 6 %	2.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	58.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	26.0 W/kg ± 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 ± 0.2) °C	50.5 ± 6 %	2.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	25.0 W/kg ± 16.5 % (k=2)

Certificate No: D2600V2-1064\_Jun19 Page 3 of 8

## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8 Ω - 6.9 jΩ
Return Loss	- 23.2 dB

# **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	46.6 Ω - 4.4 jΩ
Return Loss	- 24.9 dB

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.151 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

Certificate No: D2600V2-1064\_Jun19 Page 4 of 8

#### **DASY5 Validation Report for Head TSL**

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1064

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

Medium parameters used: f = 2600 MHz;  $\sigma = 2.03 \text{ S/m}$ ;  $\varepsilon_r = 37.3$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(7.69, 7.69, 7.69) @ 2600 MHz; Calibrated: 29.05.2019

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

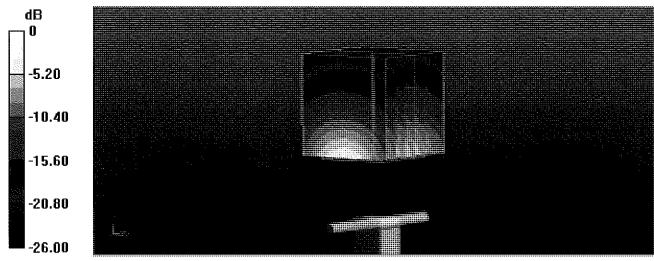
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 120.9 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 30.2 W/kg

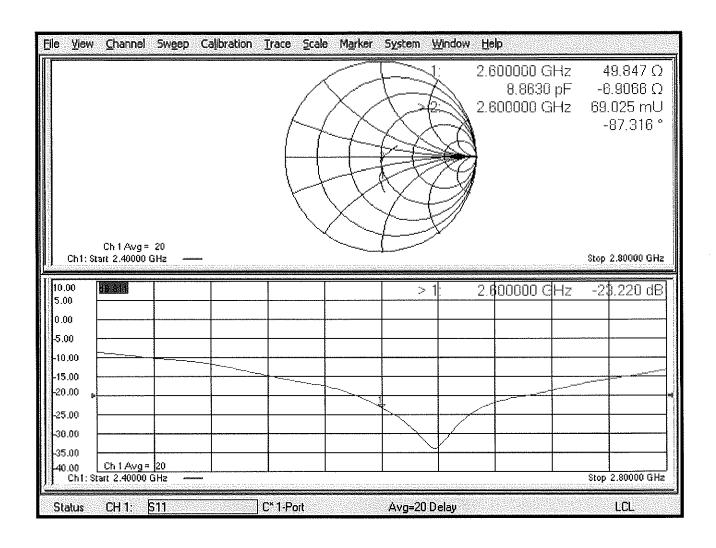
SAR(1 g) = 14.9 W/kg; SAR(10 g) = 6.59 W/kg

Maximum value of SAR (measured) = 25.1 W/kg



0 dB = 25.1 W/kg = 14.00 dBW/kg

## Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1064

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

Medium parameters used: f = 2600 MHz;  $\sigma = 2.22 \text{ S/m}$ ;  $\varepsilon_r = 50.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### **DASY52 Configuration:**

Probe: EX3DV4 - SN7349; ConvF(7.8, 7.8, 7.8) @ 2600 MHz; Calibrated: 29.05.2019

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

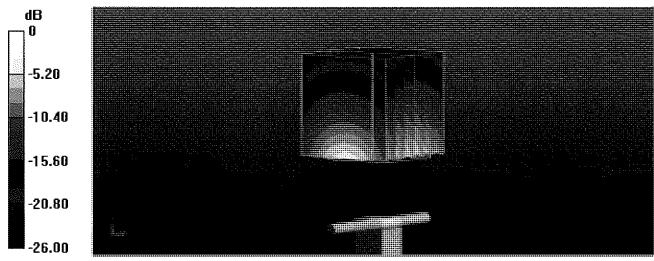
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.6 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 28.9 W/kg

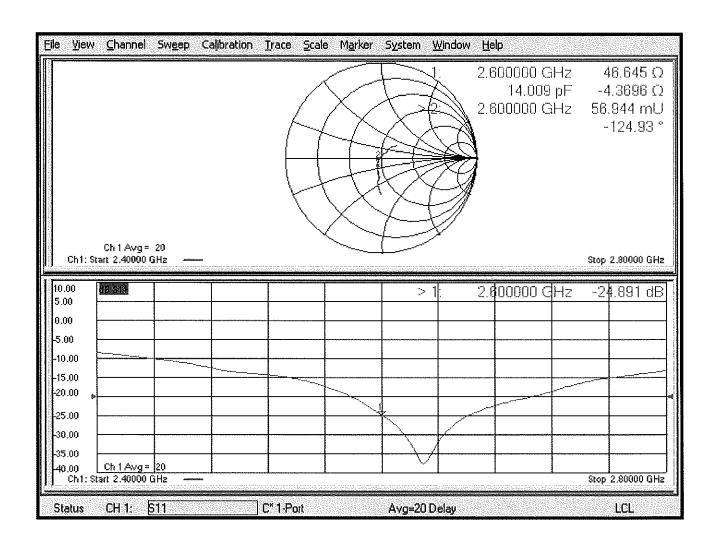
SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.33 W/kg

Maximum value of SAR (measured) = 23.6 W/kg



0 dB = 23.6 W/kg = 13.73 dBW/kg

## Impedance Measurement Plot for Body TSL



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





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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D3500V2-1059\_Jan18

## CALIBRATION CERTIFICATE

Object

D3500V2 - SN:1059

Calibration procedure(s)

QA CAL-22.v2

Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date:

January 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.)	Cohodulad Oalthurit
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NAP-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		Apr-18
DAE4	SN: 601	30-Dec-17 (No. EX3-3503_Dec17)	Dec-18
	1 314. 001	26-Oct-17 (No. DAE4-501_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)	
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		In house check: Oct-18
,	5/11 550/ 550500	18-Oct-01 (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	Mull
	7 4	· · · · · · · · · · · · · · · · · · ·	MILES
Approved by:	Kalja Pokovic	Technical Manager	10111
			16615

Issued: January 16, 2018

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Accreditation No.: SCS 0108

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The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Glossarv:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z

not applicable or not measured

## Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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%.

Certificate No: D3500V2-1059\_Jan18

### **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 = 4  mm, dz = 1.4  mm	Graded Ratio = 1.4 (Z direction)
Frequency	3500 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.5 ± 6 %	2.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	64.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 19.5 % (k=2)

## **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	51.3	3.31 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.0 ± 6 %	3.32 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	65.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 W/kg ± 19.5 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2 Ω - 7.1 jΩ
Return Loss	- 22.4 dB

## **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	53.4 Ω - 4.5 jΩ
Return Loss	- 25.3 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.136 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	January 20, 2017

### **DASY5 Validation Report for Head TSL**

Date: 11.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1059

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used: f = 3500 MHz;  $\sigma = 2.91 \text{ S/m}$ ;  $\varepsilon_r = 38.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### **DASY52 Configuration:**

Probe: EX3DV4 - SN3503; ConvF(7.8, 7.8, 7.8); 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=100 mW, d=10mm/Zoom Scan, dist=1.4mm

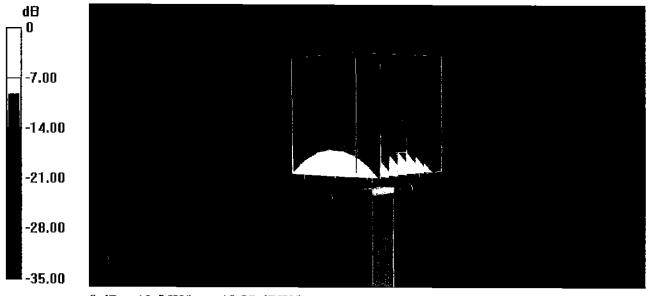
(8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.59 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.6 W/kg

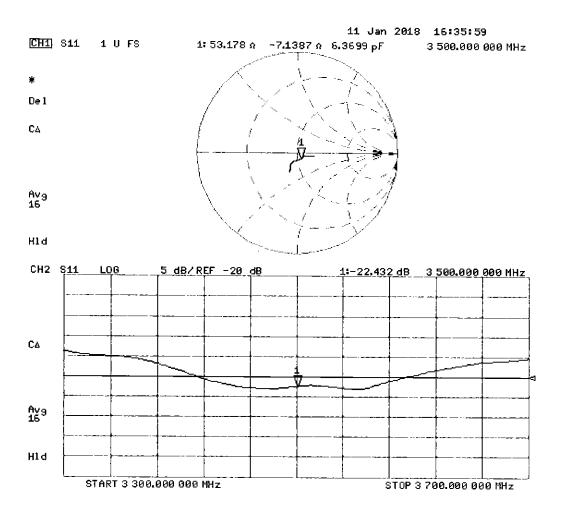
SAR(1 g) = 6.44 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 12.5 W/kg



0 dB = 12.5 W/kg = 10.97 dBW/kg

## Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 10.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1059

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used: f = 3500 MHz;  $\sigma = 3.32 \text{ S/m}$ ;  $\varepsilon_r = 50$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.43, 7.43, 7.43); 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=100 mW, d=10mm/Zoom Scan, dist=1.4mm

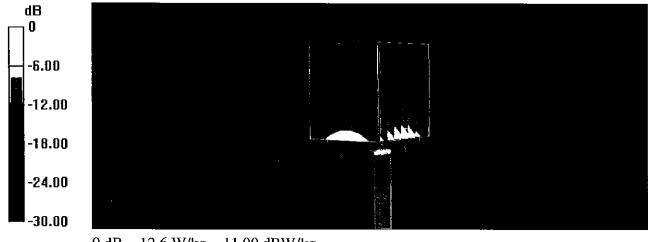
(8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.18 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 17.9 W/kg

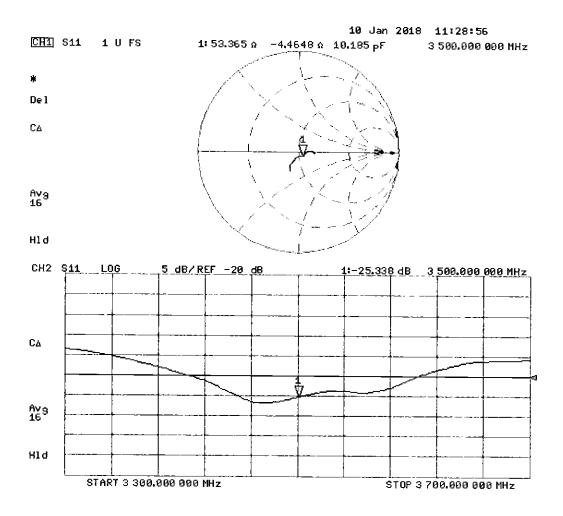
SAR(1 g) = 6.55 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

## Impedance Measurement Plot for Body TSL



## PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D3500V2 – SN: 1059

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

Extension Calibration date: 1/11/2019

Description: SAR Validation Dipole at 3500 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	2/8/2018	Annual	2/8/2019	US39170122
Agilent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Biennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330156
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
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	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
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/3/2018	Annual	10/3/2019	1558
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091
SPEAG	EX3DV4	SAR Probe	2/14/2018	Annual	2/14/2019	3914
SPEAG	EX3DV4	SAR Probe	8/24/2018	Annual	8/24/2019	3949

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K

Object:	Date Issued:	Page 1 of 5
D3500V2 – SN: 1059	01/11/2019	rage 1015

#### **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:

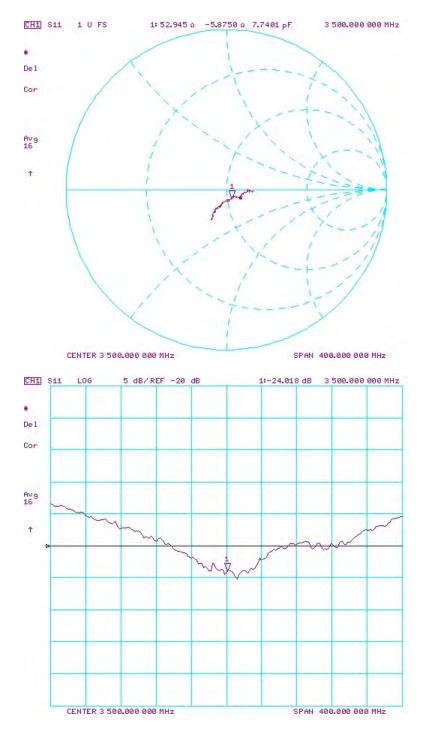
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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)	Head (1g) W/kg @ 20.0 dBm	asm	(%)	dBm	(10a) W/ka @		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 (%)	
1/11/2018	1/16/2019	1.136	6.46	6.23	-3.56%	2.44	2.34	-4.10%	53.2	52.9	0.3	-7.1	-5.9	1.2	-22.4	-24	-7.20%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)		Measured Body SAR (1g) W/kg @ 20.0 dBm			(10a) W/ka @	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
1/11/2018	1/16/2019	1.136	6.51	6	-7.83%	2.42	2.26	-6.61%	53.4	49.8	3.6	-4.5	-5	0.5	-25.3	-25.9	-2.40%	PASS

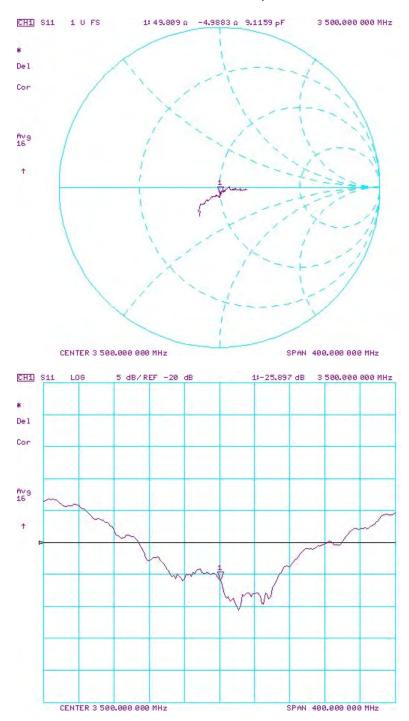
Object:	Date Issued:	Page 2 of 5
D3500V2 - SN: 1059	01/11/2019	raye 2 01 3

Impedance & Return-Loss Measurement Plot for Head TSL



Object:	Date Issued:	Page 3 of 5
D3500V2 – SN: 1059	01/11/2019	rage 3 01 3

## Impedance & Return-Loss Measurement Plot for Body TSL



Object:	Date Issued:	Page 4 of 5
D3500V2 - SN: 1059	01/11/2019	Page 4 of 5

## Calibration Laboratory of Schmid & Partner

**Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





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**Swiss Calibration Service** 

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Accreditation No.: SCS 0108

Client

PC Test

Certificate No: D3700V2-1018\_Jan18

## **CALIBRATION CERTIFICATE**

Object

D3700V2 - SN:1018

Calibration procedure(s)

**QA CAL-22.v2** 

Calibration procedure for dipole validation kits between 3-6 GHz

January 11, 2018

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.

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	30-Dec-17 (No. EX3-3503_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:	Michael Weber	Laboratory Technician	
		muunimi umini kalisa 194	M. EX
Approved by:	Katja Pokovic	Technical Manager	11/11/
			CX Co
			•

Issued: January 16, 2018

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

Certificate No: D3700V2-1018\_Jan18

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## Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossarv:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z not applicable or not measured

N/A

Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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 = 4  mm, dz = 1.4  mm	Graded Ratio = 1.4 (Z direction)
Frequency	3700 MHz ± 1 MHz	

## **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.7	3.12 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.3 ± 6 %	3.07 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## **SAR** result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 19.5 % (k=2)

## **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	51.0	3.55 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.7 ± 6 %	3.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	HAR.	

## **SAR result with Body TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	64.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)

Certificate No: D3700V2-1018\_Jan18 Page 3 of 8

## Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	53.0 Ω - 8.3 jΩ
Return Loss	- 21.4 dB

### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	51.5 Ω - 6.3 jΩ
Return Loss	- 23.9 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.144 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	December 18, 2015

Certificate No: D3700V2-1018\_Jan18

#### **DASY5 Validation Report for Head TSL**

Date: 11.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1018

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used: f = 3700 MHz;  $\sigma = 3.07 \text{ S/m}$ ;  $\varepsilon_r = 38.3$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### **DASY52** Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.5, 7.5, 7.5); 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=100 mW, d=10mm/Zoom Scan, dist=1.4mm

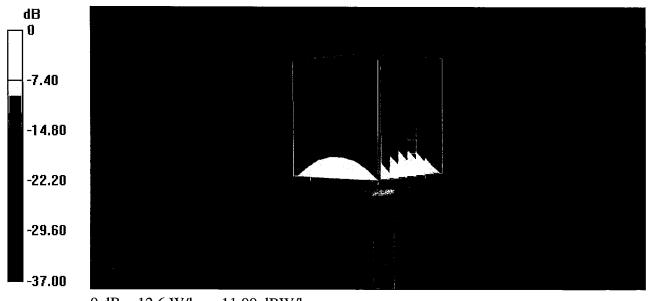
(8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.40 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 18.5 W/kg

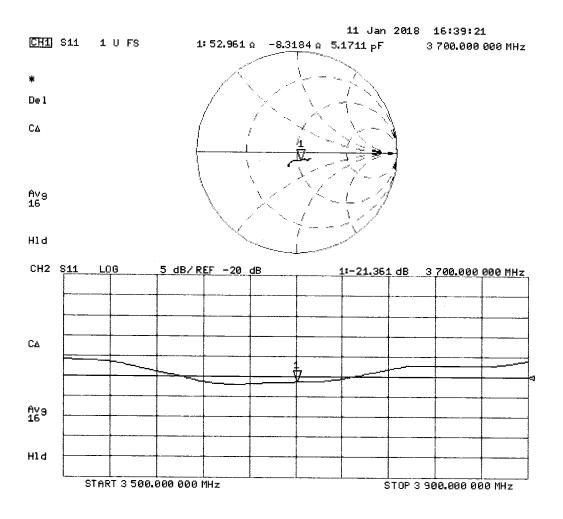
SAR(1 g) = 6.54 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

## Impedance Measurement Plot for Head TSL



## **DASY5 Validation Report for Body TSL**

Date: 10.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1018

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used: f = 3700 MHz;  $\sigma = 3.53$  S/m;  $\varepsilon_r = 49.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### **DASY52 Configuration:**

Probe: EX3DV4 - SN3503; ConvF(7.28, 7.28, 7.28); 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=100 mW, d=10mm/Zoom Scan , dist=1.4mm

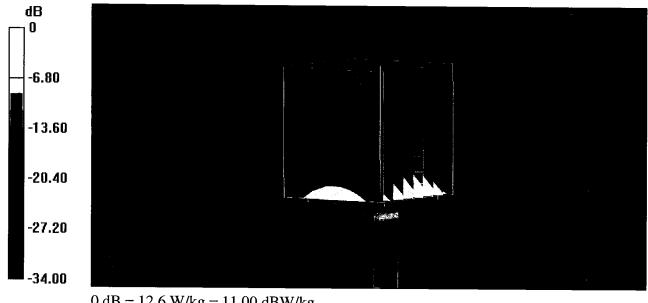
(8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.16 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 18.4 W/kg

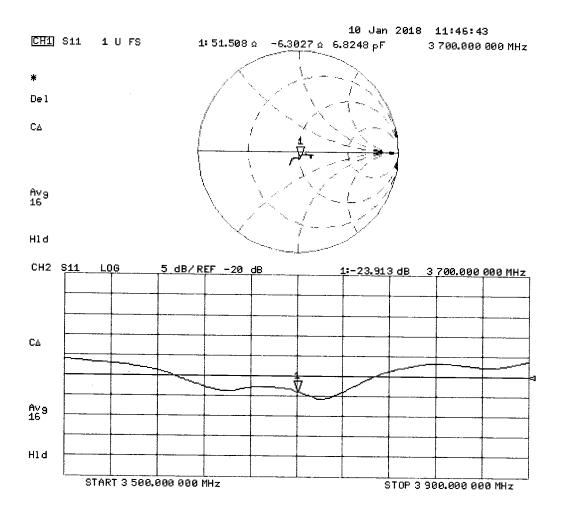
SAR(1 g) = 6.46 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

## Impedance Measurement Plot for Body TSL



### PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D3700V2 – SN: 1018

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

Extension Calibration date: 1/11/2019

Description: SAR Validation Dipole at 3500 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	2/8/2018	Annual	2/8/2019	US39170122
Agilent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Biennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330156
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
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	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
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/3/2018	Annual	10/3/2019	1558
SPEAG	DAE4	Dasy Data Acquisition Electronics		Annual	6/18/2019	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091
SPEAG	EX3DV4	SAR Probe	2/14/2018	Annual	2/14/2019	3914
SPEAG	EX3DV4	SAR Probe	8/24/2018	Annual	8/24/2019	3949

#### Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature			
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER			
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K			

Object:	Date Issued:	Page 1 of 4
D3700V2 – SN: 1018	01/11/2019	rage 1014

## **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:

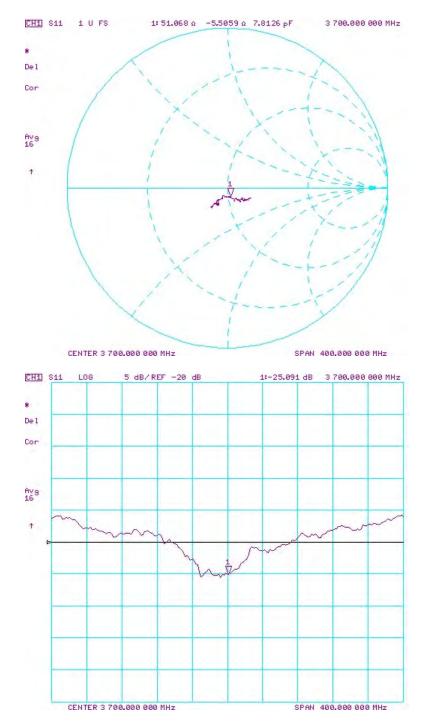
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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	(0/)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(40-) M(4 ©	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
1/11/2018	1/11/2019	1.144	6.58	6.22	-5.47%	2.42	2.27	-6.20%	53	51.1	1.9	-8.3	-5.5	2.8	-21.4	-25.1	-17.20%	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 (%)		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
1/11/2018	1/11/2019	1.144	6.43	6.08	-5.44%	2.31	2.21	-4.33%	51.5	54.2	2.7	-6.3	-2.3	4	-23.9	-26.9	-12.40%	PASS

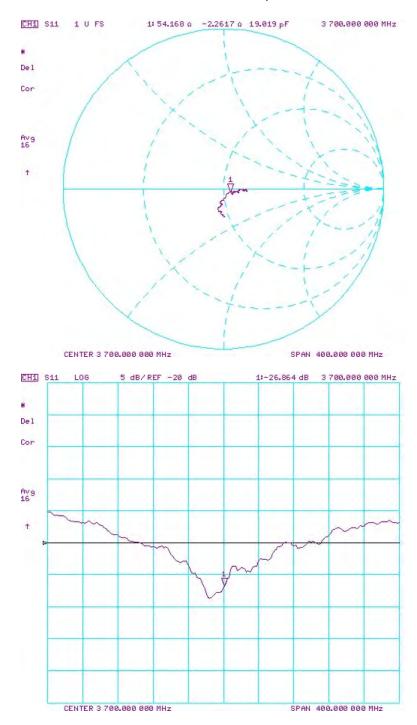
Object:	Date Issued:	Page 2 of 4
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#### Impedance & Return-Loss Measurement Plot for Head TSL



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## Impedance & Return-Loss Measurement Plot for Body TSL



#### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

Client

**PC Test** 

Certificate No: D5GHzV2-1237\_Aug18

## CALIBRATION CERTIFICATE

Object

D5GHzV2 - SN:1237

Calibration procedure(s)

QA CAL-22.v3

Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date:

August 10, 2018

GHZ BN 09-06-9018

BN 08/09/2019

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. 217-02572)	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: 3503	30-Dec-17 (No. EX3-3503_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
•	1		
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 Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	in house check: Oct-18
	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	A. M
			que
Approved by:	Katja Pokovic	Technical Manager	All Comments
		• •	

Issued: August 17, 2018

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

## Calibration Laboratory of

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst Service suisse d'étalonnage

Servizio svizzero di taratura
Swiss Calibration Service

Accreditation No.: SCS 0108

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

#### Glossary:

**TSL** 

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A

not applicable or not measured

## Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) 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 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 ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 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 ± 0.2) °C	35.6 ± 6 %	4.61 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.5 % (k=2)

## Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.98 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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.7 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.5 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	34.9 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)

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### 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	46.9 ± 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 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

### **Body TSL parameters at 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	46.3 ± 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 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.0 W/kg ± 19.5 % (k=2)

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# 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	46.0 ± 6 %	6.16 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	47.5 Ω - 3.5 jΩ
Return Loss	- 27.0 dB

#### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	50.1 Ω + 4.7 jΩ
Return Loss	- 26.7 dB

#### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	52.7 Ω + 0.8 jΩ
Return Loss	- 31.2 dB

### Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	46.5 Ω - 1.3 jΩ
Return Loss	- 28.2 dB

#### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.1 Ω + 6.2 jΩ
Return Loss	- 23.5 dB

## Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	53.6 Ω + 2.1 jΩ
Return Loss	- 27.9 dB

#### **General Antenna Parameters and Design**

	<del></del>
Electrical Delay (one direction)	1,195 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 04, 2015

Certificate No: D5GHzV2-1237\_Aug18

### **DASY5 Validation Report for Head TSL**

Date: 10.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

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

Medium parameters used: f = 5250 MHz;  $\sigma = 4.61$  S/m;  $\epsilon_r = 35.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5600 MHz;  $\sigma = 4.98$  S/m;  $\epsilon_r = 35.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5750 MHz;  $\sigma = 5.14$  S/m;  $\epsilon_r = 34.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.51, 5.51, 5.51) @ 5250 MHz, ConvF(5.05, 5.05, 5.05) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 (5GHz); 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=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 = 75.17 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 18.4 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 = 75.53 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 32.4 W/kg

SAR(1 g) = 8.6 W/kg; SAR(10 g) = 2.46 W/kg

Maximum value of SAR (measured) = 20.2 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

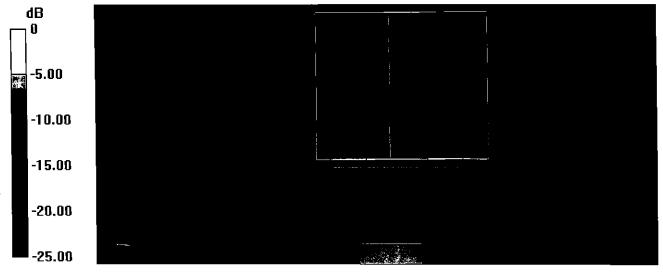
Reference Value = 73.04 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.32 W/kg

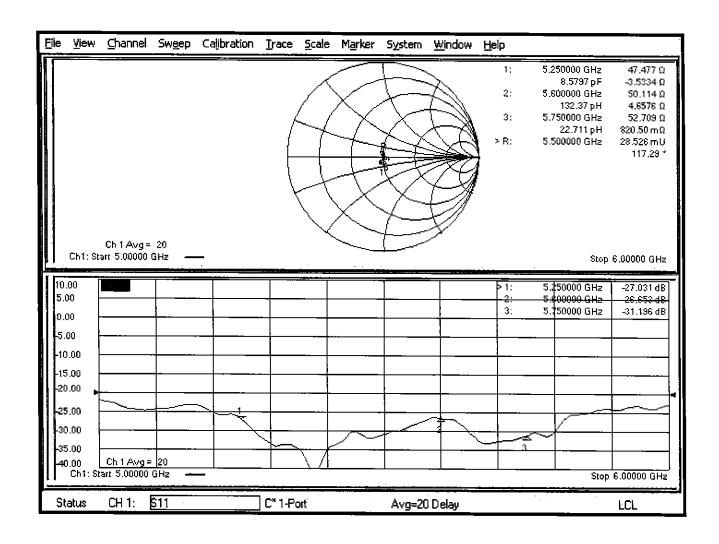
Maximum value of SAR (measured) = 19.9 W/kg

Certificate No: D5GHzV2-1237\_Aug18



0 dB = 19.9 W/kg = 12.99 dBW/kg

#### Impedance Measurement Plot for Head TSL



#### DASY5 Validation Report for Body TSL

Date: 10.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

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;  $\epsilon_r=46.9$ ;  $\rho=1000$  kg/m $^3$ , Medium parameters used: f=5600 MHz;  $\sigma=5.96$  S/m;  $\epsilon_r=46.3$ ;  $\rho=1000$  kg/m $^3$ , Medium parameters used: f=5750 MHz;  $\sigma=6.16$  S/m;  $\epsilon_r=46$ ;  $\rho=1000$  kg/m $^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.57, 4.57, 4.57) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 (5GHz); 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=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 = 68.22 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 17.3 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 = 67.51 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 32.1 W/kg

SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 18.5 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

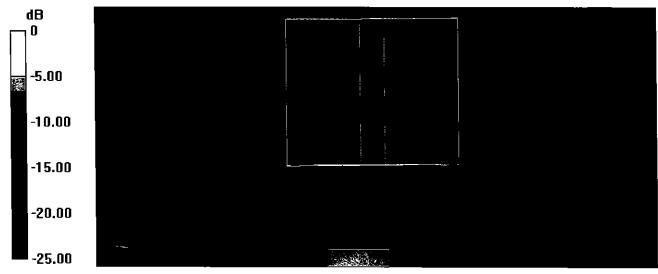
Reference Value = 65.91 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.7 W/kg

SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.14 W/kg

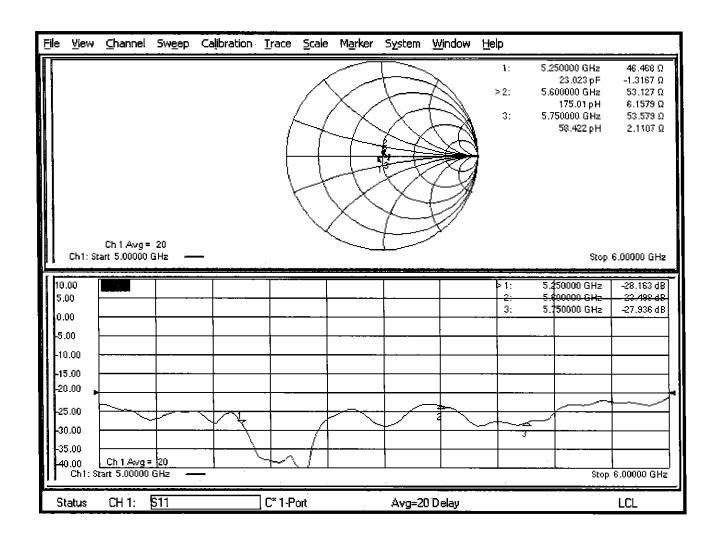
Maximum value of SAR (measured) = 18.0 W/kg

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0 dB = 18.0 W/kg = 12.55 dBW/kg

## Impedance Measurement Plot for Body TSL



## PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D5GHzV2 – SN: 1237

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

Extended Calibration date: 08/09/2019

Description: SAR Validation Dipole at 5GHz

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	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	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	7/15/2019	Annual	7/15/2020	7547
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1323
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	30K

Object:	Date Issued:	Dogo 1 of 4
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#### **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:

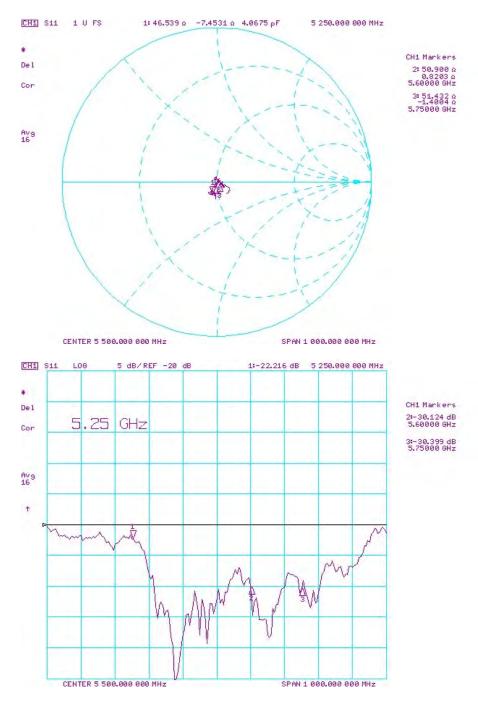
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance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

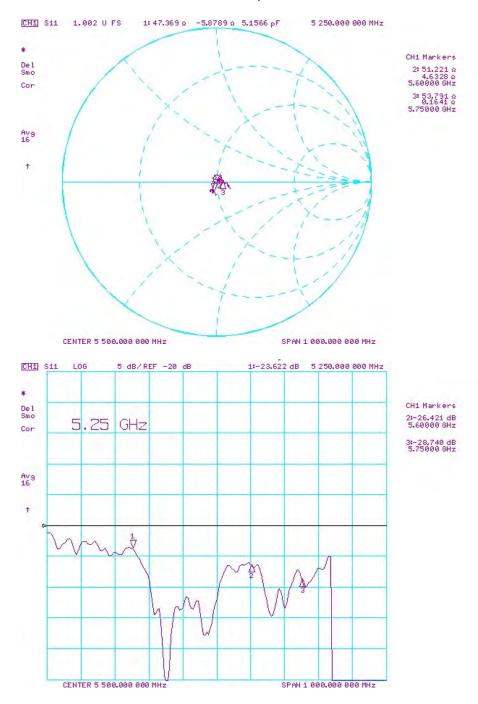
Frequ (M	uency IHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 17.0 dBm	Measured Head SAR (1g) W/kg @ 17.0 dBm	(96)	Certificate SAR Target Head (10g) W/kg @ 17.0 dBm	(10a) M//ka @	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured 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
52	250	8/10/2018	8/9/2019	1.195	4.065	3.81	-6.27%	1.18	1.09	-7.23%	47.5	46.5	1	-3.5	-7.5	4	-27	-22.2	17.70%	PASS
56	000	8/10/2018	8/9/2019	1.195	4.285	4.06	-5.25%	1.23	1.15	-6.12%	50.1	50.9	0.8	4.7	0.8	3.9	-26.7	-30.1	-12.80%	PASS
57	50	8/10/2018	8/9/2019	1.195	4.03	3.8	-5.71%	1.16	1.07	-7.36%	52.7	51.4	1.3	0.8	-1.4	2.2	-31.2	-30.4	2.60%	PASS
Frequ (M	uency IHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 17.0 dBm	Measured Body SAR (1g) W/kg @ 17.0 dBm	(96)	Certificate SAR Target Body (10g) W/kg @ 17.0 dBm	(10a) M/ka @	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
52	250	8/10/2018	8/9/2019	1.195	3.78	3.52	-6.88%	1.06	0.981	-7.45%	46.5	47.4	0.9	-1.3	-5.9	4.6	-28.2	-23.6	16.20%	PASS
56	600	8/10/2018	8/9/2019	1.195	3.925	3.81	-2.93%	1.1	1.05	-4.55%	53.1	51.2	1.9	6.2	4.6	1.6	-23.5	-26.4	-12.40%	PASS
57	50	8/10/2018	8/9/2019	1.195	3.795	3.58	-5.67%	1.06	1	-5.66%	53.6	53.8	0.2	2.1	0.2	1.9	-27.9	-28.7	-3.00%	PASS

Object:	Date Issued:	Dago 2 of 4
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#### Impedance & Return-Loss Measurement Plot for Head TSL



#### Impedance & Return-Loss Measurement Plot for Body TSL



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





Schweizerischer Kalibrierdienst
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S - Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: SCS 0108

Client

**PC Test** 

Certificate No: D750V3-1003\_Jan18

## **CALIBRATION CERTIFICATE**

Object

D750V3 - SN:1003

Calibration procedure(s)

QA CAL-05.v9

Calibration procedure for dipole validation kits above 700 MHz

Calibration date:

January 15, 2018

めい - 01-25-201 k

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.

12/06/201

All calibrations have been conducted in the closed laboratory facility: environment temperature (22  $\pm$  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)	Арг-18 Арг-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
Nelwork Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
Calibrated by:	Lelf Klysner	Laboratory Technician	Sed Wen
Approved by:	Kalja Pokovic	Technical Manager	leace.

Issued: January 15, 2018

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

## **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst
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Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

#### Glossarv:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z not applicable or not measured

## Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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	15 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5.0  mm$	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.28 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.42 W/kg ± 16.5 % (k=2)

## **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.0 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.58 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.71 W/kg ± 16.5 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	53.8 Ω - 2.1 jΩ
Return Loss	- 27.6 dB

## **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	49.2 Ω - 6.2 jΩ
Return Loss	- 24.0 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction) 1.043 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	January 21, 2009

## Appendix (Additional assessments outside the scope of SCS 0108)

### **Measurement Conditions**

DASY system configuration, as far as not given on page 1 and 3.

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L
---------	------------------	-----------------------------

## SAR result with SAM Head (Top)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	7.94 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.32 W/kg ± 16.9 % (k=2)

## SAR result with SAM Head (Mouth)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.22 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.52 W/kg ± 16.9 % (k=2)

## SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	-
SAR measured	250 mW input power	2.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.06 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.52 W/kg ± 16.9 % (k=2)

## SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.67 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.70 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.60 W/kg ± 16.9 % (k=2)

#### **DASY5 Validation Report for Head TSL**

Date: 12.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.9$  S/m;  $\varepsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### **DASY52** Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

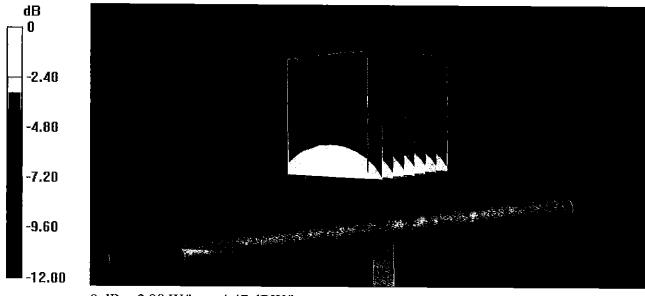
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 59.11 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.15 W/kg

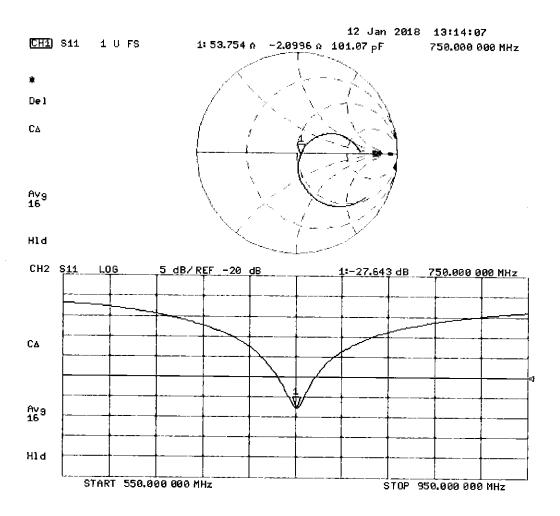
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.37 W/kg

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



## **DASY5 Validation Report for Body TSL**

Date: 12.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.96$  S/m;  $\varepsilon_r = 55$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### **DASY52** Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

## Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x8x7)/Cube 0:

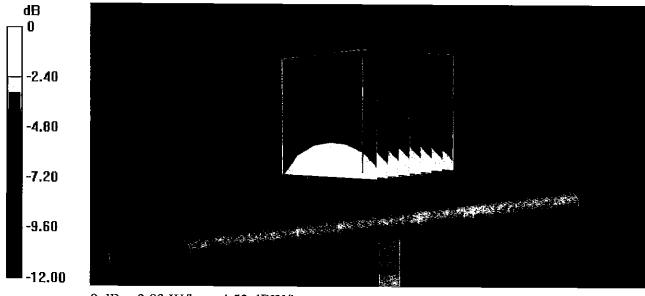
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.31 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.17 W/kg

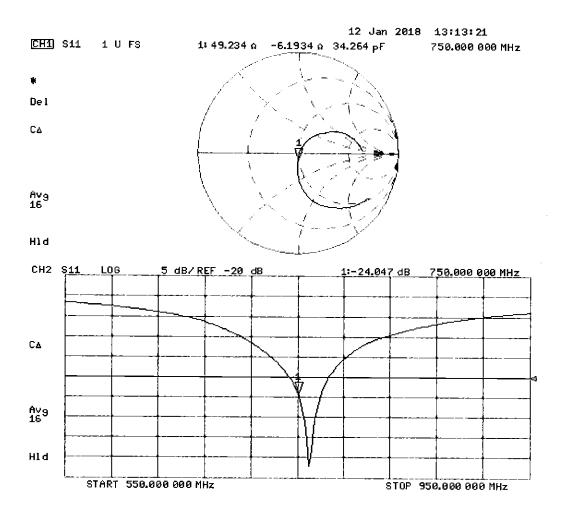
SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.43 W/kg

Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

## Impedance Measurement Plot for Body TSL



## **DASY5 Validation Report for SAM Head**

Date: 15.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.9$  S/m;  $\epsilon_r = 44.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

#### **DASY52 Configuration:**

- Probe: EX3DV4 SN7349; ConvF(10.22, 10.22, 10.22); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- · Phantom: SAM Head
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

## SAM Head/Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.79 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 2.89 W/kg

SAR(1 g) = 1.98 W/kg; SAR(10 g) = 1.33 W/kg

Maximum value of SAR (measured) = 2.58 W/kg

## SAM Head/Mouth/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.85 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 2.94 W/kg

SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.38 W/kg

Maximum value of SAR (measured) = 2.62 W/kg

## SAM Head/Neck/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.29 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.78 W/kg

SAR(1 g) = 2.01 W/kg; SAR(10 g) = 1.38 W/kg

Maximum value of SAR (measured) = 2.56 W/kg

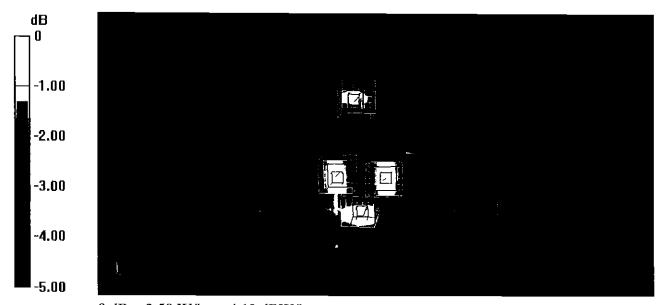
## SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 51.01 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 2.31 W/kg

SAR(1 g) = 1.67 W/kg; SAR(10 g) = 1.15 W/kg

Maximum value of SAR (measured) = 2.11 W/kg



0 dB = 2.58 W/kg = 4.12 dBW/kg

### PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D750V3 – SN: 1003

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

Extension Calibration date: 1/15/2019

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	2/8/2018	Annual	2/8/2019	US39170122
Agilent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Biennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330156
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
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/3/2018	Annual	10/3/2019	1558
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091
SPEAG	EX3DV4	SAR Probe	8/23/2018	Annual	8/23/2019	7308
SPEAG	EX3DV4	SAR Probe	6/25/2018	Annual	6/25/2019	7409

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	304

Object:	Date Issued:	Page 1 of 4
D750V3 - SN: 1003	01/15/2019	rage ror4

#### **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:

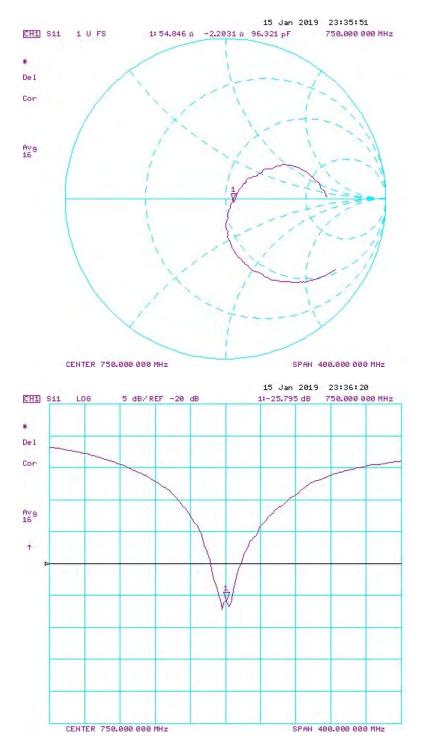
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance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

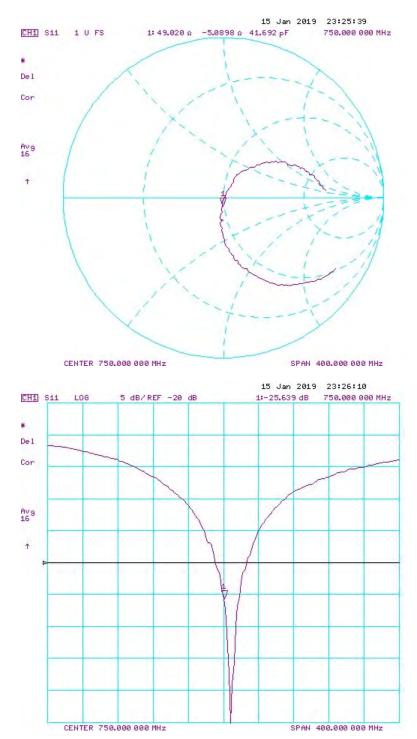
Calibration Date	Extension Date	Certificate Electrical Delay (ns)		M/0 @ 22.0	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	Measured Head SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate 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
1/15/2018	1/15/2019	1.043	1.656	1.75	5.68%	1.08	1.15	6.09%	53.8	54.8	1	-2.1	-2.2	0.1	-27.6	-25.8	6.50%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)		M/0- @ 22.0	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
1/15/2018	1/15/2019	1.043	1.716	1.84	7.23%	1.14	1.23	7.71%	49.2	49	0.2	-6.2	-5.1	1.1	-24	-25.6	-6.80%	PASS

Object:	Date Issued:	Page 2 of 4
D750V3 - SN: 1003	01/15/2019	Fage 2 01 4

### Impedance & Return-Loss Measurement Plot for Head TSL



### Impedance & Return-Loss Measurement Plot for Body TSL



Object:	Date Issued:	Page 4 of 4
D750V3 - SN: 1003	01/15/2019	Page 4 of 4

#### Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

Client

**PC Test** 

Certificate No: D750V3-1161\_Oct18

Object	D750V3 - SN:116	j)	
Calibration procedure(s)	QA CAL-05.v10 Calibration proce	dure for dipole validation kits abo	ve 700 MHz
			,
Calibration date:	October 19, 2018		its of measurements (SI). BNV
			10-30-20
his calibration certificate documer	nts the traceability to nati	onal standards, which realize the physical un	its of measurements (Si), BNV9
		robability are given on the following pages an	d are part of the certificate. 10-20
	·	, ,	
All calibrations have been conducte	ed in the closed laborator	y facility: environment temperature (22 ± 3)°(	C and humidity < 70%.
			-
Calibration Equipment used (M&TE	critical for calibration)		
Primans Standarda	lin a	Col Data (Continues No.)	0-1-1-1-1-0-0-01-0-0-01-0
	ID#	Cai Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power meter NRP Power sensor NRP-Z91	SN: 104778 SN: 103244	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672)	Apr-19 Apr-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673)	Apr-19 Apr-19 Apr-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682)	Apr-19 Apr-19 Apr-19 Apr-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17)	Apr-19 Apr-19 Apr-19 Apr-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house) 07-Oct-15 (In house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)  Check Date (in house) 07-Oct-15 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)  Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)  Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047,2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)  Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Retwork Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)  Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-19
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047,2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 04-Oct-18 (No. DAE4-601_Oct18)  Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-19

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

Certificate No: D750V3-1161\_Oct18

Page 1 of 8

#### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossary:

TSL tissue simulating liquid

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

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

- a) IEEE Std 1528-2013, "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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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%.

Certificate No: D750V3-1161\_Oct18 Page 2 of 8

#### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	750 MHz ± 1 MHz	

## **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	0.89 mho/m ± 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	2.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.03 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.26 W/kg ± 16.5 % (k=2)

#### **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity		
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m		
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.1 ± 6 %	0.96 mho/m ± 6 %		
Body TSL temperature change during test	< 0.5 °C	***			

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.43 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.55 W/kg ± 16.5 % (k=2)

Certificate No: D750V3-1161\_Oct18 Page 3 of 8

### Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	55.6 Ω - 1.9 jΩ
Return Loss	- 25.0 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.6 Ω - 4.2 jΩ
Return Loss	- 27.6 dB

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.032 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	November 19, 2015

Certificate No: D750V3-1161\_Oct18 Page 4 of 8

#### **DASY5 Validation Report for Head TSL**

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.89 \text{ S/m}$ ;  $\varepsilon_r = 40.8$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 04.10.2018

• Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

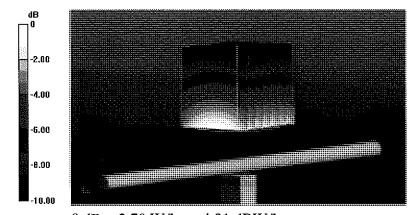
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.51 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.04 W/kg

SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.32 W/kg

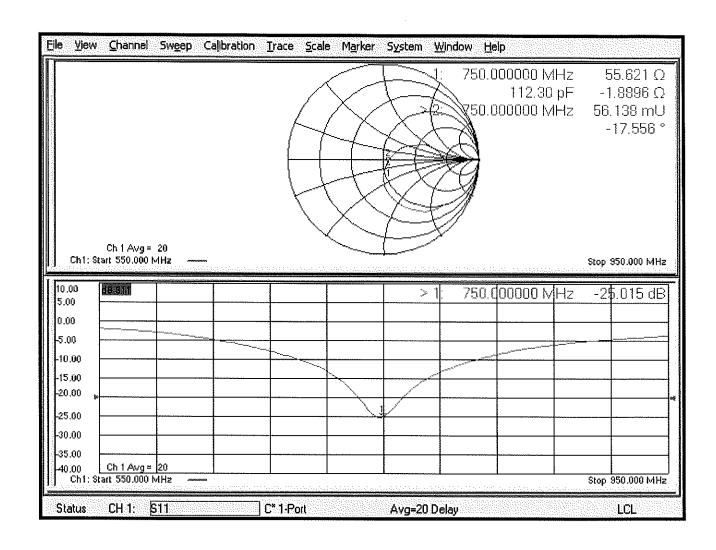
Maximum value of SAR (measured) = 2.70 W/kg



0 dB = 2.70 W/kg = 4.31 dBW/kg

Certificate No: D750V3-1161\_Oct18

## Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.96 \text{ S/m}$ ;  $\varepsilon_r = 55.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 04.10.2018

• Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

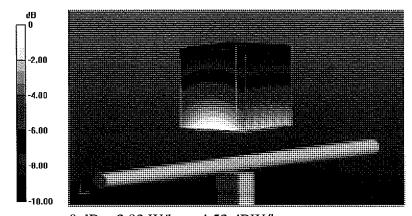
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.57 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.18 W/kg

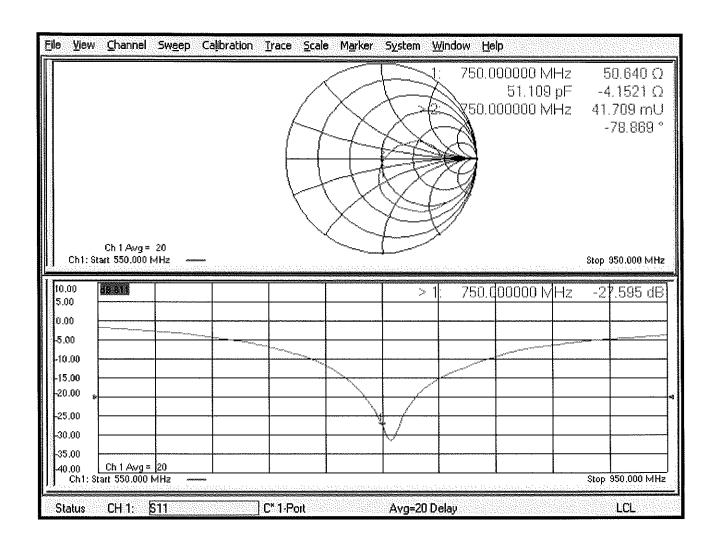
SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.39 W/kg

Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

## Impedance Measurement Plot for Body TSL



## PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D750V3 – SN:1161

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	4/24/2019	Annual	4/24/2020	7357
SPEAG	EX3DV4	SAR Probe	7/16/2019	Annual	7/16/2020	7410
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/18/2019	Annual	4/18/2020	1407

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

#### Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K

Object:	Date Issued:	Page 1 of 4
D750V3 - SN:1161	10/18/2019	Page 1 of 4

### **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:

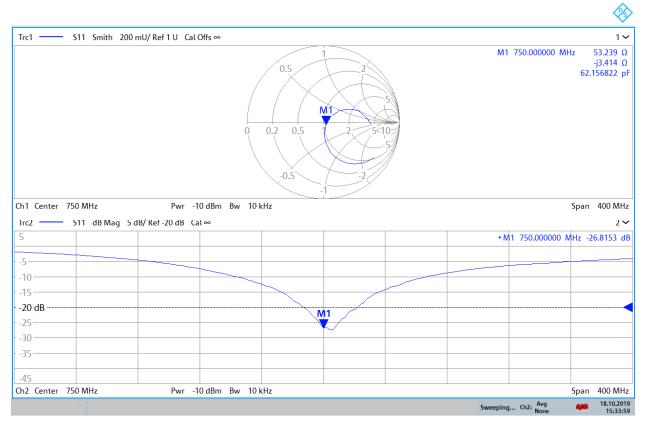
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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	Head SAR (1g)	(96)	Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	(10a) W/ka @	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
10/19/2018	10/18/2019	1.032	1.61	1.64	2.12%	1.05	1.08	2.66%	55.6	53.2	2.4	-1.9	-3.4	1.5	-25	-26.8	-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	(96)	Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	(10a) W/ka @	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
10/19/2018	10/18/2019	1.032	1.69	1.76	4.39%	1.11	1.17	5.41%	50.6	50	0.6	-4.2	-4	0.2	-27.6	-28.1	-1.60%	PASS

Object:	Date Issued:	Page 2 of 4
D750V3 - SN:1161	10/18/2019	

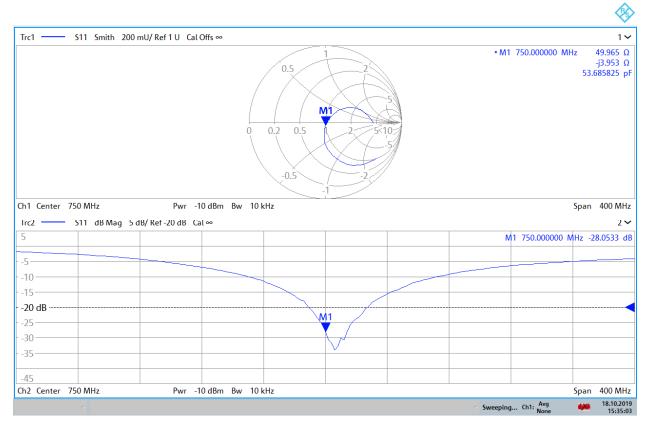
#### Impedance & Return-Loss Measurement Plot for Head TSL



15:34:00 18.10.2019

Object:	Date Issued:	Page 3 of 4
D750V3 - SN:1161	10/18/2019	

### Impedance & Return-Loss Measurement Plot for Body TSL



15:35:04 18.10.2019

Object:	Date Issued:	Page 4 of 4
D750V3 - SN:1161	10/18/2019	

### Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client

C Test

Certificate No: D835V2-4d133\_Oct18

CALIBRATION CERTIFICATE		
Object	D835V2:-SN:4d133	
Calibration procedure(s)	QA GAL-05:v10 Galibration procedure for dipole validation kits above 700 MHz ان اعداد ان ان انتخاب	
Calibration date:	October 19, 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	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
Secondary Standards	ID#	Check Date (In house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
*			<u> </u>
Approved by:	Katja Pokovic	Technical Manager	2711
			44.47
			•

Issued: October 22, 2018

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

Certificate No: D835V2-4d133\_Oct18

Page 1 of 8

#### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z

not applicable or not measured

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

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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%.

Certificate No: D835V2-4d133\_Oct18 Page 2 of 8

### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.2
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 ± 1 MHz	

Head TSL parameters
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.43 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.10 W/kg ± 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 ± 0.2) °C	54.9 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		aif on the tax

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.75 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.40 W/kg ± 16.5 % (k=2)

Certificate No: D835V2-4d133\_Oct18

### Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	50.6 Ω - 2.4 jΩ
Return Loss	- 32,2 dB

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	45.0 Ω - 6.7 jΩ
Return Loss	- 21.1 dB

### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.397 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 22, 2011

Certificate No: D835V2-4d133\_Oct18 Page 4 of 8

#### **DASY5 Validation Report for Head TSL**

Date: 19.10.2018

Test Laboratory: The name of your organization

#### DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d133

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

Medium parameters used: f = 835 MHz;  $\sigma = 0.91$  S/m;  $\varepsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: 04.10.2018

Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

• DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

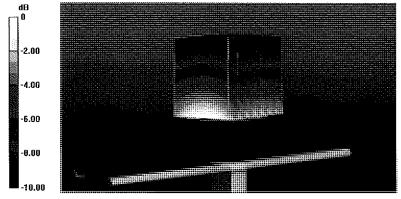
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 63.02 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.68 W/kg

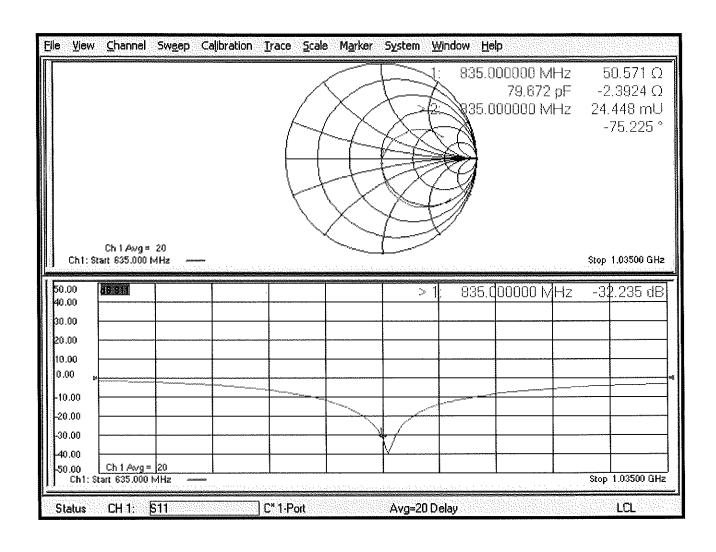
SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.54 W/kg

Maximum value of SAR (measured) = 3.24 W/kg



0 dB = 3.24 W/kg = 5.11 dBW/kg

### Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### **DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d133**

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

Medium parameters used: f = 835 MHz;  $\sigma = 0.98$  S/m;  $\varepsilon_r = 54.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: 04.10.2018

Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

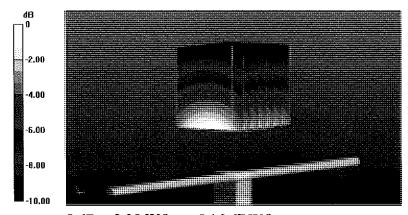
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 61.61 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.69 W/kg

SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg

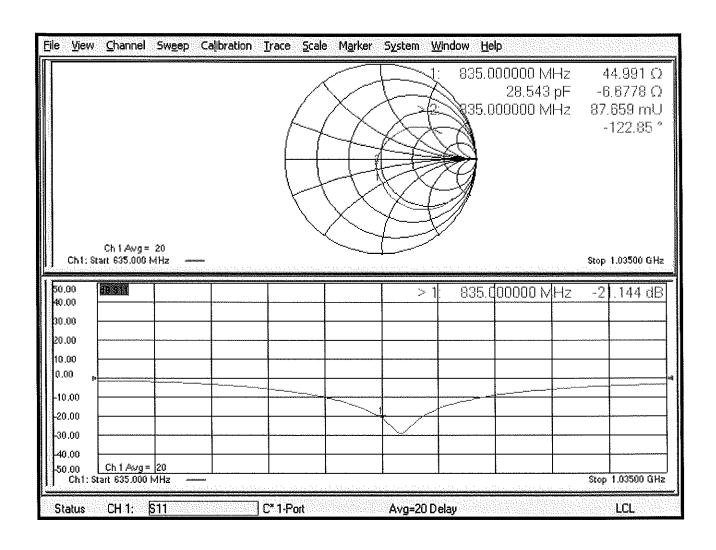
Maximum value of SAR (measured) = 3.28 W/kg



0 dB = 3.28 W/kg = 5.16 dBW/kg

Certificate No: D835V2-4d133\_Oct18

### **Impedance Measurement Plot for Body TSL**



### PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



## **Certification of Calibration**

Object D835V2 – SN:4d133

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 835 MHz.

Calibration Equipment used:

Manufacturer	Model	Description		Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	9/19/2019	Annual	9/19/2020	7551
SPEAG	EX3DV4	SAR Probe	4/24/2019	Annual	4/24/2020	7357
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2019	Annual	9/17/2020	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/18/2019	Annual	4/18/2020	1407

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

### Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	304

Object:	Date Issued:	Page 1 of 4
D835V2 - SN:4d133	10/18/2019	Page 1 of 4

### **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:

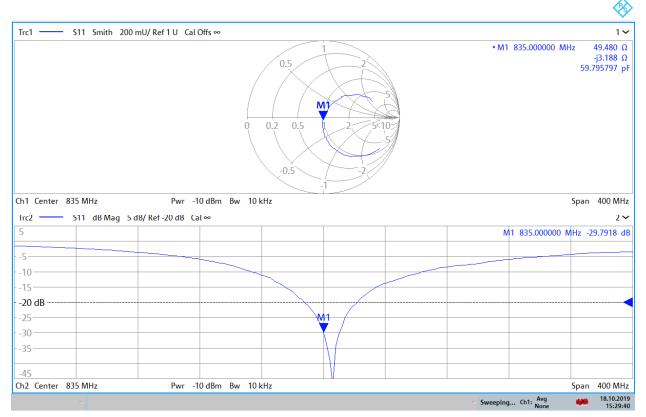
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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	Head SAR (1g)		Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	(10a) W/ka @	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
10/19/2018	10/18/2019	1.397	1.886	2.03	7.64%	1.22	1.32	8.20%	50.6	49.5	1.1	-2.4	-3.2	0.8	-32.2	-29.8	7.50%	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		Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	(40-) M(4 ©	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
10/19/2018	10/18/2019	1.397	1.95	2.07	6.15%	1.28	1.36	6.25%	45	45.1	0.1	-6.7	-5.1	1.6	-21.1	-22.6	-6.90%	PASS

Object:	Date Issued:	Page 2 of 4
D835V2 - SN:4d133	10/18/2019	Fage 2 01 4

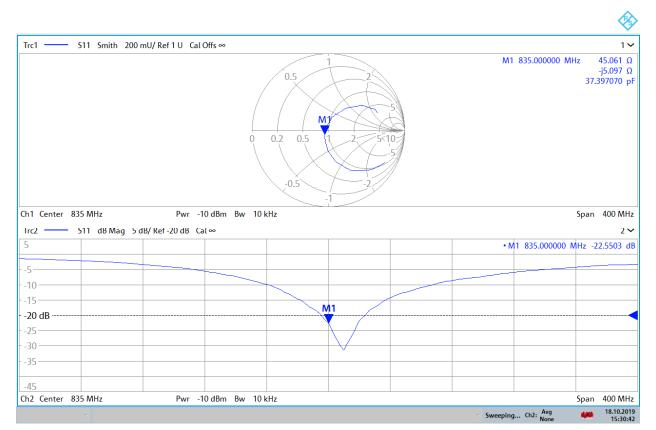
#### Impedance & Return-Loss Measurement Plot for Head TSL



15:29:41 18.10.2019

Object:	Date Issued:	Page 2 of 4
D835V2 - SN:4d133	10/18/2019	Page 3 of 4

### Impedance & Return-Loss Measurement Plot for Body TSL



15:30:43 18.10.2019

Object:	Date Issued:	Page 4 of 4
D835V2 - SN:4d133	10/18/2019	raye 4 01 4

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





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Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client

PC Test

Certificate No: D1750V2-1148\_May19

## **CALIBRATION CERTIFICATE**

Object

D1750V2 - SN:1148

Calibration procedure(s)

QA CAL-05.v11

Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

05-23-20

Calibration date:

May 15, 2019

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	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	31-Dec-18 (No. EX3-7349_Dec18)	Dec-19
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Seif Algan
Approved by:	Katja Pokovic	Technical Manager	AU.

Issued: May 15, 2019

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Certificate No: D1750V2-1148\_May19

### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A not applicable or not measured

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

- a) IEEE Std 1528-2013, "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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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%.

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### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5.0 mm	
Frequency	1750 MHz ± 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 ± 0.2) °C	40.0 ± 6 %	1.34 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	<b></b>	

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.0 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.5 W/kg ± 16.5 % (k=2)

### **Body TSL parameters**

The following parameters and calculations were applied.

<u> </u>	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5 ± 6 %	1.47 mho/m ± 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	9.35 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg ± 16.5 % (k=2)

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#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.4 Ω - 0.2 jΩ
Return Loss	- 37.0 dB

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	47.4 Ω - 0.5 jΩ
Return Loss	- 31.4 dB

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.222 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
-----------------------

## Appendix (Additional assessments outside the scope of SCS 0108)

### **Measurement Conditions**

DASY system configuration, as far as not given on page 1 and 3.

	Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L
- 1			

### SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.9 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 16.9 % (k=2)

### **SAR result with SAM Head (Mouth)**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.8 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 16.9 % (k=2)

### SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.6 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.9 W/kg ± 16.9 % (k=2)

### SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	7.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	28.7 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	3.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	16.0 W/kg ± 16.9 % (k=2)

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#### **DASY5 Validation Report for Head TSL**

Date: 08.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.34$  S/m;  $\varepsilon_r = 40$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.59, 8.59, 8.59) @ 1750 MHz; Calibrated: 31.12.2018

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

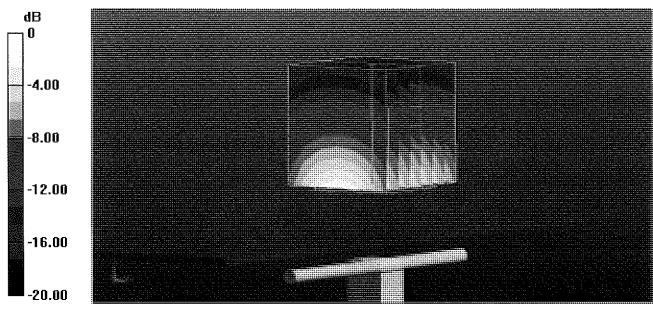
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.8 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.7 W/kg

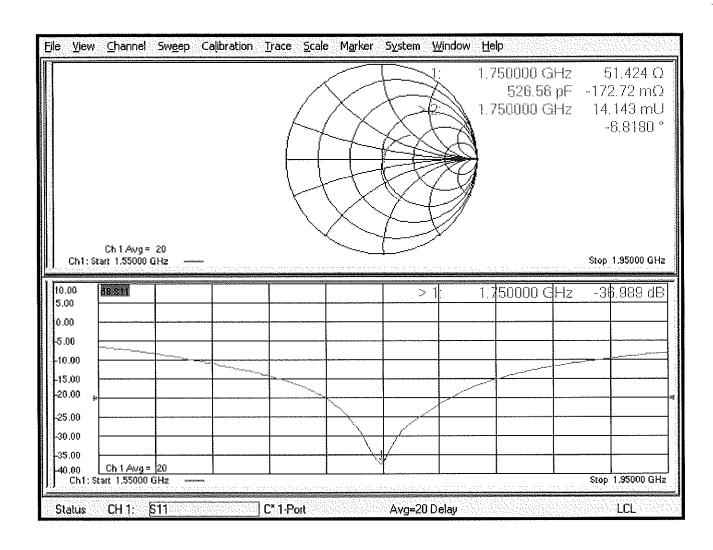
SAR(1 g) = 9.13 W/kg; SAR(10 g) = 4.83 W/kg

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



#### **DASY5 Validation Report for Body TSL**

Date: 08.05,2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.47 \text{ S/m}$ ;  $\varepsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### **DASY52 Configuration:**

Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1750 MHz; Calibrated: 31.12.2018

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

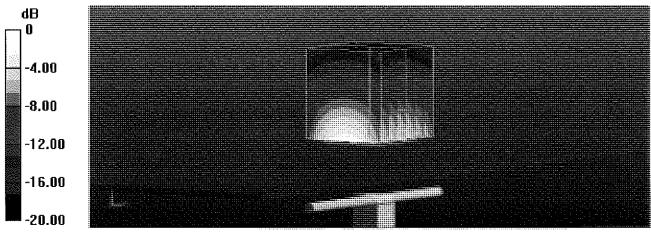
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.2 W/kg

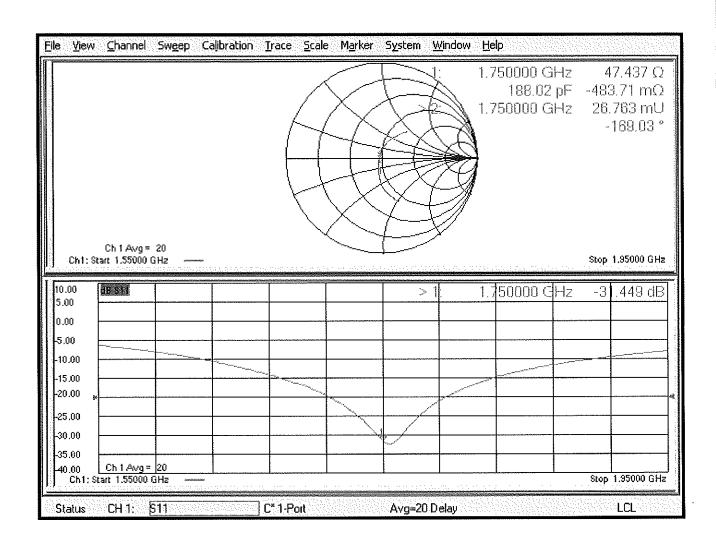
SAR(1 g) = 9.35 W/kg; SAR(10 g) = 4.93 W/kg

Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

## Impedance Measurement Plot for Body TSL



#### **DASY5 Validation Report for SAM Head**

Date: 15.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.37 \text{ S/m}$ ;  $\varepsilon_r = 42.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.59, 8.59, 8.59) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- · Phantom: SAM Head
- DASY52 52.10.2(1495); SEMCAD X 14.6,12(7450)

### SAM Head/Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.2 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 9.38 W/kg; SAR(10 g) = 5.04 W/kg

Maximum value of SAR (measured) = 14.2 W/kg

### SAM Head/Mouth/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.7 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.5 W/kg

SAR(1 g) = 9.34 W/kg; SAR(10 g) = 5.04 W/kg

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

#### SAM Head/Neck/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.3 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 15.5 W/kg

SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.95 W/kg

Maximum value of SAR (measured) = 13.1 W/kg

#### SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

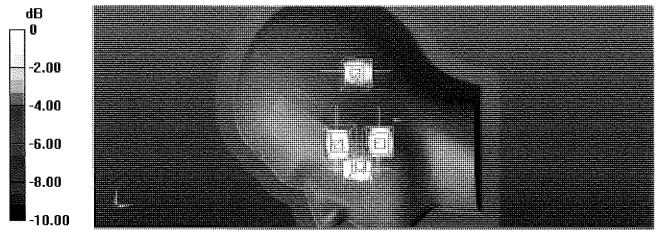
Reference Value = 90.82 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 12.0 W/kg

SAR(1 g) = 7.11 W/kg; SAR(10 g) = 3.98 W/kg

Maximum value of SAR (measured) = 10.2 W/kg

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0 dB = 10.2 W/kg = 10.09 dBW/kg

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





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CALIBRATION CERTIFICATE

Accreditation No.: SCS 0108

Issued: May 23, 2018

Client

**PC** Test

Certificate No: D1765V2-1008\_May18

	D1765V2 - SN:1	008	
Calibration procedure(s)	QA CAL-05.v10 Calibration proce	edure for dipole validation kits ab	OVE 700 MHz 7/16/2018 BNV 05/2012
Calibration date:	May 23, 2018		BN 05/2012
This calibration certificate docum The measurements and the unce	ents the traceability to nat rtainties with confidence p	ional standards, which realize the physical ur probability are given on the following pages ar	nits of measurements (SI). nd are part of the certificate.
All calibrations have been conduc	cted in the closed laborato	ory facility: environment temperature (22 ± 3)°	C and humidity < 70%.
Calibration Equipment used (M&7	ΓE critical for calibration)		
Primary Standards	iD#	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
ower sensor NRP-Z91	SN: 104778 SN: 103244	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672)	Apr-19 Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91			Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19 Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103244 SN: 103245	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673)	Apr-19 Apr-19 Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683)	Apr-19 Apr-19 Apr-19 Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682)	Apr-19 Apr-19 Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house) 07-Oct-15 (in house check Oct-16)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB374B0704 SN: US37292783	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585  Name	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18  Scheduled Check In house check: Oct-18

Certificate No: D1765V2-1008\_May18

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### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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Swiss Calibration Service

Accreditation No.: SCS 0108

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#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A not applicable or not measured

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

- a) 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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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%.

Certificate No: D1765V2-1008\_May18 Page 2 of 11

### **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 = 5.0 mm	
Frequency	1750 MHz ± 1 MHz	

### **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permitti∨ity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.34 mho/m ± 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	8.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.0 W/kg ± 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 ± 0.2) °C	53.2 ± 6 %	1.46 mho/m ± 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	9.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.9 W/kg ± 16.5 % (k=2)

Certificate No: D1765V2-1008\_May18 Page 3 of 11

### Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	47.7 Ω - 6.5 jΩ
Return Loss	- 23.0 dB

### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	43.3 Ω - 6.0 jΩ
Return Loss	- 20.3 dB

### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.210 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	October 06, 2005

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### Appendix (Additional assessments outside the scope of SCS 0108)

#### **Measurement Conditions**

DASY system configuration, as far as not given on page 1 and 3.

### SAR result with SAM Head (Top)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.4 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.9 W/kg ± 16.9 % (k=2)

### SAR result with SAM Head (Mouth)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.2 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.4 W/kg ± 16.9 % (k=2)

### SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.4 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.2 W/kg ± 16.9 % (k=2)

## SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	<b>7</b> .12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	28.7 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	16.1 W/kg ± 16.9 % (k=2)

Certificate No: D1765V2-1008\_May18 Page 5 of 11

#### **DASY5 Validation Report for Head TSL**

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.34 \text{ S/m}$ ;  $\varepsilon_r = 39$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 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:

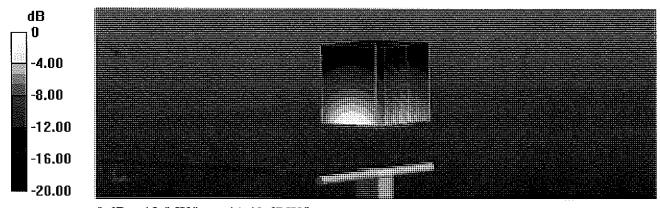
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.6 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.4 W/kg

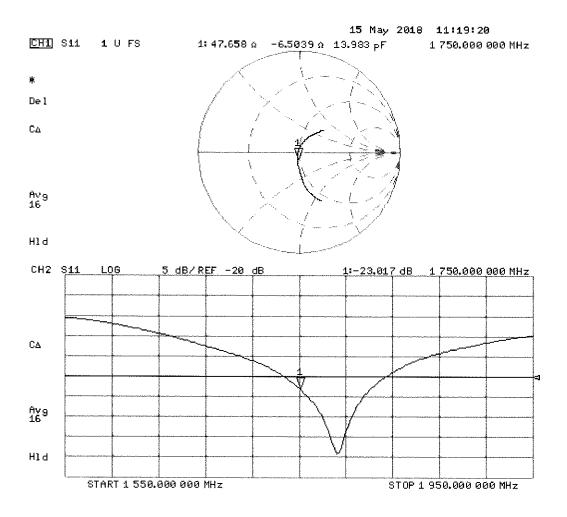
SAR(1 g) = 8.94 W/kg; SAR(10 g) = 4.71 W/kg

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



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

## Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.46 \text{ S/m}$ ;  $\varepsilon_r = 53.2$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 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:

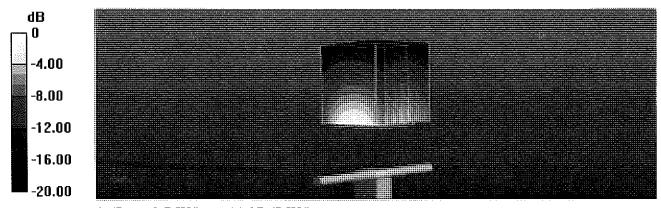
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.4 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 16.1 W/kg

SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.92 W/kg

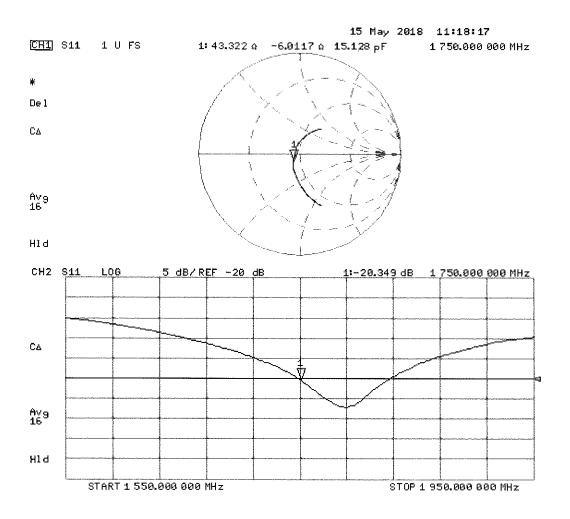
Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.37 dBW/kg

Certificate No: D1765V2-1008\_May18 Page 8 of 11

## Impedance Measurement Plot for Body TSL



#### **DASY5 Validation Report for SAM Head**

Date: 23.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.37 \text{ S/m}$ ;  $\varepsilon_r = 41.8$ ;  $\rho = 1000 \text{ kg/m}^3$ 

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 26.10.2017

· Phantom: SAM Head

• DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

#### SAM/Head/Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.26 W/kg; SAR(10 g) = 4.95 W/kg

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

#### SAM/Head/Mouth/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.2 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 9.47 W/kg; SAR(10 g) = 5.06 W/kg

Maximum value of SAR (measured) = 13.7 W/kg

#### SAM/Head/Neck/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.7 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 15.8 W/kg

SAR(1 g) = 9.26 W/kg; SAR(10 g) = 5.02 W/kg

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

#### SAM/Head/Ear/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

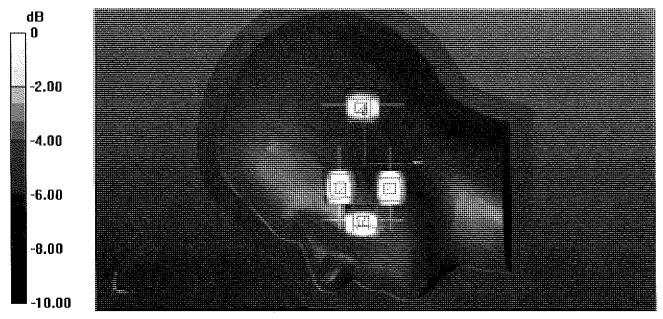
Reference Value = 90.46 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 11.8 W/kg

SAR(1 g) = 7.12 W/kg; SAR(10 g) = 4.01 W/kg

Maximum value of SAR (measured) = 10.3 W/kg

Certificate No: D1765V2-1008\_May18



0 dB = 10.3 W/kg = 10.13 dBW/kg

### PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



# **Certification of Calibration**

Object D1765V2 – SN: 1008

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

Extension Calibration date: 5/17/2019

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	3/11/2019	Annual	3/11/2020	US39170122
Agilent	N5182A	MXG Vector Signal Generator	11/28/2018	Annual	11/28/2019	MY47420603
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1027293
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1126066
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./ Clock/ Humidity Monitor	10/9/2018	Biennial	10/9/2020	181647811
Control Company	4352	Ultra Long Stem Thermometer	6/6/2018	Biennial	6/6/2020	181334678
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
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	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
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	EX3DV4	SAR Probe	6/25/2018	Annual	6/25/2019	7409
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	3914
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/14/2019	Annual	2/14/2020	1272
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K

Object:	Date Issued:	Page 1 of 4	
D1765V2 – SN: 1008	05/17/2019	rage 1014	

### **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:

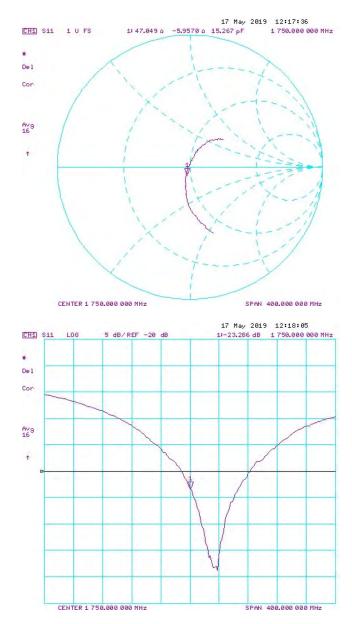
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance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

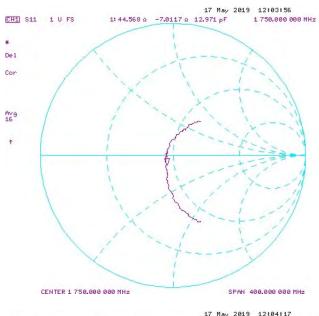
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	M/kg @ 20.0	(94)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(10a) W/ka @	Deviation 10g (%)		Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5/23/2019	5/17/2019	1.21	3.62	3.63	0.28%	1.9	1.92	1.05%	47.7	47	0.7	-6.5	-6	0.5	-23	-23.3	-1.20%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	W/kg @ 20.0	(%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	(10a) W/ka @	Deviation 10g (%)		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
5/23/2019	5/17/2019	1.21	3.74	3.95	5.61%	1.99	2.08	4.52%	43.3	44.6	1.3	-6	-7	1	-20.3	-20.5	-0.90%	PASS

Object:	Date Issued:	Page 2 of 4	
D1765V2 – SN: 1008	05/17/2019	Fage 2 01 4	

#### Impedance & Return-Loss Measurement Plot for Head TSL

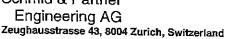


#### Impedance & Return-Loss Measurement Plot for Body TSL





# Calibration Laboratory of Schmid & Partner







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

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

Accreditation No.: SCS 0108

Client

**PC Test** 

Certificate No: D2300V2-1073\_Aug18

## BRATION CERTIFICATE

Object

D2300V2 - SN:1073

Calibration procedure(s)

QA CAL-05.v10

Calibration procedure for dipole validation kits above 700 MHz

Calibration date:

August 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  $(22 \pm 3)^{\circ}$ 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)	
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		Apr-19
DAE4	SN: 601	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
	SIN, 60	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
Secondary Standards	ID#	Charle Date (In f.	
Power meter EPM-442A	+	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
1	SN: US37292783	07-Oct-15 (iπ 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)	Iπ house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	
			17.110°E)
Approved by:	Katja Pokovic	Technical Manager	and the
	And the Control of th	en e	Jex cos

Issued: August 13, 2018

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

### Calibration Laboratory of

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage

Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A not applicable or not measured

# Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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%.

Certificate No: D2300V2-1073\_Aug18

Page 2 of 8

### **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	2300 MHz ± 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 ± 0.2) °C	38.2 ± 6 %	1.70 mho/m ± 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	12.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	49.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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 ± 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 ± 0.2) °C	52.2 ± 6 %	1.85 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	47.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.2 W/kg ± 16.5 % (k=2)

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 5.2 jΩ
Return Loss	- 25.7 dB

# **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	45.5 Ω - 4.1 jΩ
Return Loss	- 23.9 dB

### General Antenna Parameters and Design

Electrical Delay (one direction) 1.171 ns	Fleet-te-I Del ( P. d. )	
1.17 ( 115	Electrical Delay (one direction)	1 171 pc
		1.17 ( 115

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	November 16, 2015

Certificate No: D2300V2-1073\_Aug18

# **DASY5 Validation Report for Head TSL**

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073

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

Medium parameters used: f = 2300 MHz;  $\sigma = 1.7$  S/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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) @ 2300 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 = 115.9 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 24.1 W/kg

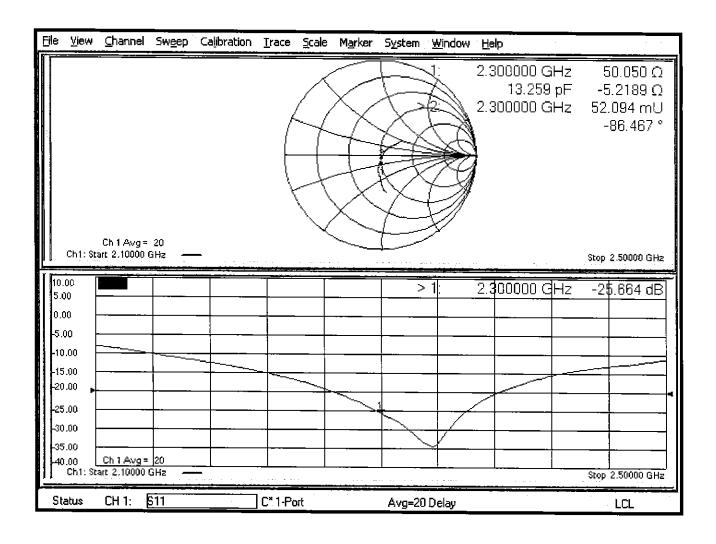
SAR(1 g) = 12.5 W/kg; SAR(10 g) = 6.02 W/kg

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



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

## Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073

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

Medium parameters used: f = 2300 MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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) @ 2300 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:

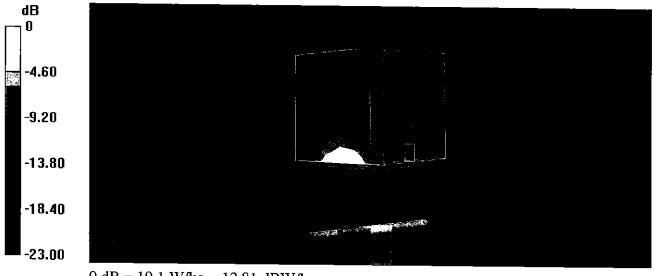
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 22.9 W/kg

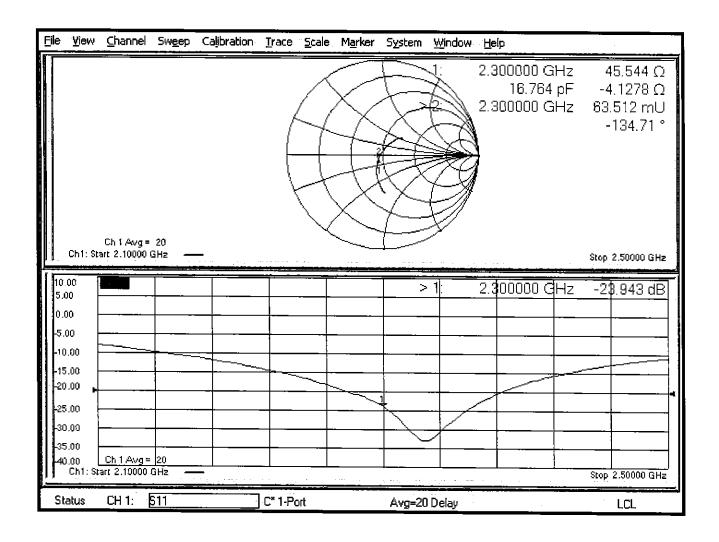
SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.86 W/kg

Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

# Impedance Measurement Plot for Body TSL



### PCTEST ENGINEERING LABORATORY, INC.



7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



# **Certification of Calibration**

Object D2300V2 – SN: 1073

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

Calibration date: 08/09/2019

Description: SAR Validation Dipole at 2300 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	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	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	7/15/2019	Annual	7/15/2020	7547
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1323
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

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

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	20K

Object:	Date Issued:	Page 1 of 4
D2300V2 – SN: 1073	08/09/2019	Page 1 of 4

#### **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:

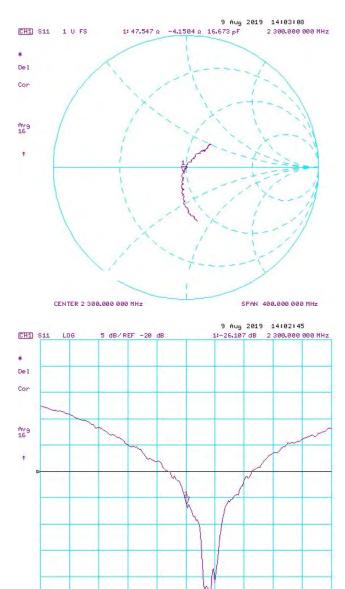
- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than  $5\Omega$  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	(0/)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	(40-) M(4 (C)	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
8/13/2018	8/9/2019	1.171	4.92	5.21	5.89%	2.38	2.49	4.62%	50.1	47.5	2.6	-5.2	-4.2	1	-25.7	-26.1	-1.60%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)		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
8/13/2018	8/9/2019	1.171	4.77	5.05	5.87%	2.32	2.4	3.45%	45.5	44.4	1.1	-4.1	-3.3	0.8	-23.9	-23.2	2.80%	PASS

Object:	Date Issued:	Page 2 of 4	
D2300V2 – SN: 1073	08/09/2019	Fage 2 01 4	

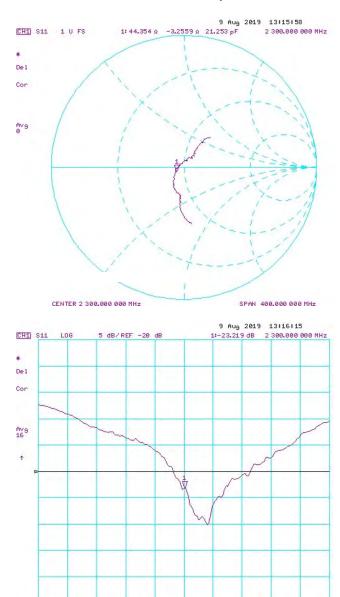
#### Impedance & Return-Loss Measurement Plot for Head TSL



CENTER 2 300.000 000 MHz

SPAN 400.000 000 MHz

### Impedance & Return-Loss Measurement Plot for Body TSL



CENTER 2 300.000 000 MHz

SPAN 400.000 000 MHz

#### Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client

**PC Test** 

Certificate No: D5GHzV2-1191\_Sep19

# **CALIBRATION CERTIFICATE**

Object D5GHzV2 - SN:1191

Calibration procedure(s) QA CAL-22.v4

Calibration Procedure for SAR Validation Sources between 3-6 GHz

09/26/2019

Calibration date:

Primary Standards

September 17, 2019

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)

ID#

· minur j Otariaa 20	1.5 "	our pare (corrinduto ric.)	Corrodated Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 3503	25-Mar-19 (No. EX3-3503_Mar19)	Mar-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Manu Seltz	Laboratory Technician	
Approved by	Valla Balcada	<del> </del>	
Approved by:	Katja Pokovic	Technical Manager	MUX.
			ran Martin and plant and a second

Cal Date (Certificate No.)

Issued: September 18, 2019

Scheduled Calibration

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

#### **Calibration Laboratory of**

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage Servizio svizzero di taratura

Swiss Calibration Service

Accreditation No.: SCS 0108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A

not applicable or not measured

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

- a) IEEE Std 1528-2013, "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
- b) 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

e) 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	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0  mm, dz = 1.4  mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 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 ± 0.2) °C	35.1 ± 6 %	4.53 mho/m ± 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	8.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1191\_Sep19

### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	W 44 10 M	

#### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 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	34.4 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

To following parameters and executations were appro-	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.44 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 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	46.9 ± 6 %	5.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL at 5250 MHz

Certificate No: D5GHzV2-1191\_Sep19

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg ± 19.5 % (k=2)

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Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

no lonowing parameters and careers and the same and the s	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	46.2 ± 6 %	5.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	44 FF FF	

## SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

**Body TSL parameters at 5750 MHz** 

The following parameters and calculations were applied.

no tonoming parameters and exceedings of	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	46.0 ± 6 %	6.19 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL at 5750 MHz

Certificate No: D5GHzV2-1191\_Sep19

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Page 6 of 19

# Body TSL parameters at 5800 MHz The following parameters and calculations were applied.

, in the second	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.26 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

# SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.0 W/kg ± 19.9 % (k=2)

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

Certificate No: D5GHzV2-1191\_Sep19

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	53.5 Ω - 6.2 jΩ
Return Loss	- 23.2 dB

# Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.4 Ω - 4.3 jΩ
Return Loss	- 22,8 dB

# Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	59.1 Ω + 1.9 jΩ
Return Loss	- 21.4 dB

Certificate No: D5GHzV2-1191\_Sep19 Page 8 of 19

### Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	50.9 Ω - 8.6 jΩ
Return Loss	- 21.3 dB

### Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	53.2 Ω - 4.1 jΩ
Return Loss	- 26.0 dB

### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.1 Ω - 4.2 jΩ
Return Loss	- 21.4 dB

#### Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	60.3 Ω + 2.3 jΩ
Return Loss	- 20.4 dB

## Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	57.5 Ω + 2.3 jΩ
Return Loss	- 22.7 dB

### **General Antenna Parameters and Design**

Flootrical Dalay (one direction)		
Liectifical Delay (offe direction)	Electrical Delay (one direction)	1.202 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

Certificate No: D5GHzV2-1191\_Sep19 Page 9 of 19

# Appendix (Additional assessments outside the scope of SCS 0108)

# Measurement Conditions (f=5200 MHz)

DASY system configuration, as far as not given on page 1 and 3.

- 7	, , , , , , , , , , , , , , , , , , ,		
	Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

### SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.9 % (k=2)

# SAR result with SAM Head (Mouth)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.8 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6 W/kg ± 19.9 % (k=2)

# SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6W/kg ± 19.9 % (k=2)

# SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	5.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.1 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	17.8 W/kg ± 19.9 % (k=2)

Certificate No: D5GHzV2-1191\_Sep19 Page 10 of 19

# Appendix (Additional assessments outside the scope of SCS 0108)

## **Measurement Conditions (f=5800 MHz)**

DASY system configuration, as far as not given on page 1 and 3.

_	3 - 1		
	Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

### SAR result with SAM Head (Top)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.7 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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	23.3 W/kg ± 19.9 % (k=2)

# SAR result with SAM Head (Mouth)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.5 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6 W/kg ± 19.9 % (k=2)

#### SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.9 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg ± 19.9 % (k=2)

#### SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	5.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.9 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.1 W/kg ± 19.9 % (k=2)

Certificate No: D5GHzV2-1191\_Sep19

#### **DASY5 Validation Report for Head TSL**

Date: 13.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

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

Medium parameters used: f = 5250 MHz;  $\sigma = 4.53$  S/m;  $\epsilon_r = 35.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5600 MHz;  $\sigma = 4.88$  S/m;  $\epsilon_r = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used: f = 5750 MHz;  $\sigma = 5.03 \text{ S/m}$ ;  $\varepsilon_r = 34.4$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.4, 5.4, 5.4) @ 5250 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

## 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 = 76.95 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 18.2 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 = 76.89 V/m: Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.9 W/kg

SAR(1 g) = 8.33 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

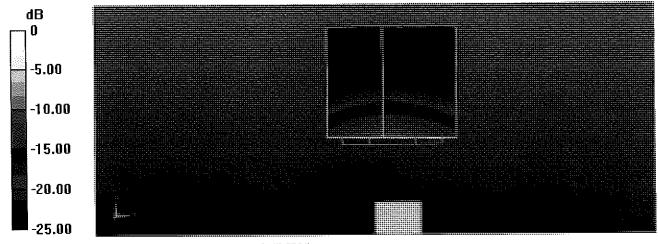
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.20 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.6 W/kg

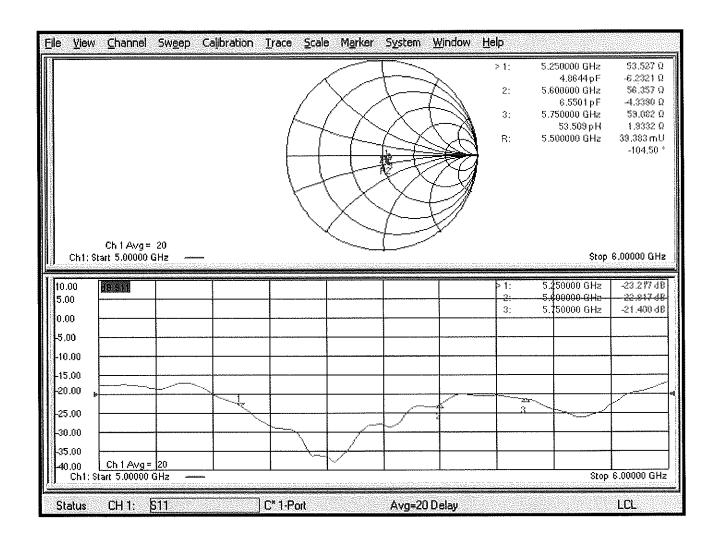
SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.29 W/kg

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



0 dB = 18.9 W/kg = 12.76 dBW/kg

#### Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 16.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5600

MHz, Frequency: 5750 MHz, Frequency: 5800 MHz

Medium parameters used: f = 5200 MHz;  $\sigma = 5.44$  S/m;  $\varepsilon_r = 46.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used: f = 5250 MHz;  $\sigma = 5.51 \text{ S/m}$ ;  $\varepsilon_r = 46.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Medium parameters used: f = 5600 MHz;  $\sigma = 5.98$  S/m;  $\varepsilon_r = 46.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used: f = 5750 MHz;  $\sigma = 6.19 \text{ S/m}$ ;  $\varepsilon_r = 46$ ;  $\rho = 1000 \text{ kg/m}^3$ ,

Medium parameters used: f = 5800 MHz;  $\sigma = 6.26 \text{ S/m}$ ;  $\varepsilon_r = 45.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

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) @ 5200 MHz, ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.74, 4.74, 4.74) @ 5600 MHz, ConvF(4.62, 4.62) @ 5750 MHz, ConvF(4.62, 4.62) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

## Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid; dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 68.78 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 28.7 W/kg

SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.11 W/kg

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

### 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 = 69.09 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.16 W/kg

Maximum value of SAR (measured) = 18.1 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 = 68.19 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 19.0 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 = 66.80 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 35.1 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.15 W/kg

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

# Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

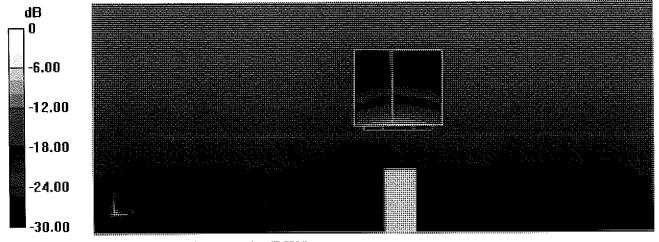
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.13 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 33.8 W/kg

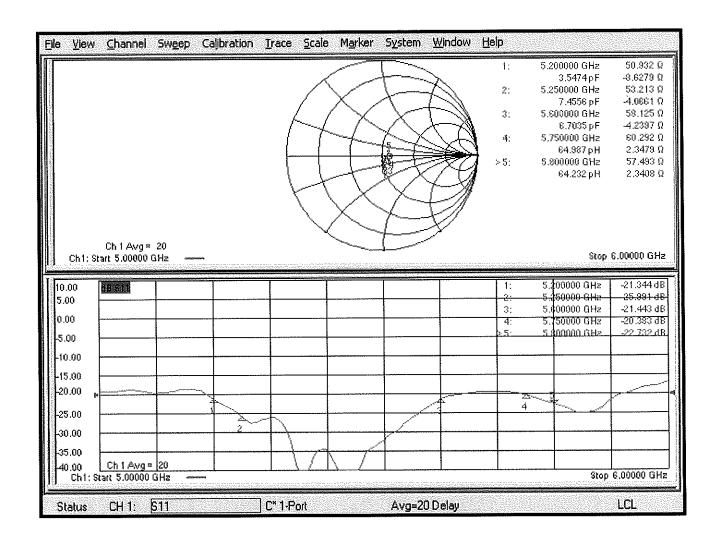
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.12 W/kg

Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

#### Impedance Measurement Plot for Body TSL



#### **DASY5 Validation Report for SAM Head**

Date: 17.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz;  $\sigma$  = 4.55 S/m;  $\epsilon_r$  = 36.2;  $\rho$  = 1000 kg/m³ , Medium parameters used: f = 5800 MHz;  $\sigma$  = 5.28 S/m;  $\epsilon_r$  = 34.9;  $\rho$  = 1000 kg/m³

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.64, 5.64, 5.64) @ 5200 MHz, ConvF(4.96, 4.96, 4.96) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- · Phantom: SAM Head
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

### SAM/Head/Top - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm

Reference Value = 74.84 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.34 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

## SAM/Head/Top - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm

Reference Value = 70.45 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 32.3 W/kg

SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg

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

# SAM/Head/Mouth - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm

Reference Value = 76.86 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 29.3 W/kg

SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.36 W/kg

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

# SAM/Head/Mouth - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

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dz=1.4mm

Reference Value = 71.46 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 34.0 W/kg

SAR(1 g) = 8.56 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 21.3 W/kg

Certificate No: D5GHzV2-1191\_Sep19

# SAM/Head/Neck - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm

Reference Value = 74.71 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 28.8 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

# **SAM/Head/Neck - 5800/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.62 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 32.1 W/kg

SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.26 W/kg

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

# **SAM/Head/Ear - 5200/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.89 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 5.11 W/kg; SAR(10 g) = 1.78 W/kg

Maximum value of SAR (measured) = 11.4 W/kg

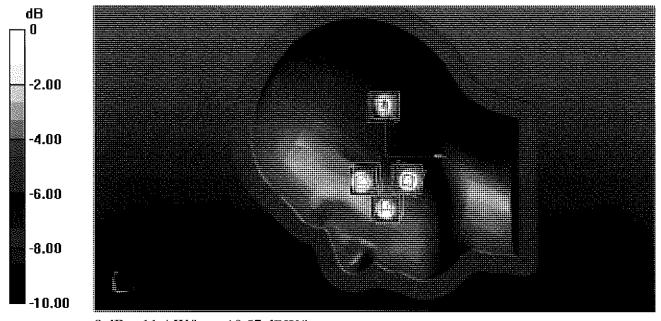
# SAM/Head/Ear - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.22 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 21.0 W/kg

SAR(1 g) = 5.6 W/kg; SAR(10 g) = 1.92 W/kg

Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 11.4 W/kg = 10.57 dBW/kg

# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

Client

**PC Test** 

Certificate No: EX3-7551\_Sep19

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# CALIBRATION CERTIFICATE

Object

EX3DV4 - SN:7551

Calibration procedure(s)

QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes

BN 2019

Calibration date:

September 19, 2019

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)

Certificate No: EX3-7551\_Sep19

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
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 E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

Name Function Signature

Calibrated by: Michael Weber Laboratory Technician

Approved by: Katja Pokovic Technical Manager

issued: September 19, 2019

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

#### Calibration Laboratory of

Certificate No: EX3-7551\_Sep19

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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

#### Glossary:

TSL tissue simulating liquid
NORMx,y,z sensitivity in free space
ConvF sensitivity in TSL / NORMx,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  $\varphi$   $\varphi$  rotation around probe axis

Polarization 9 9 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:

a) 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

b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from handheld and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep 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
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

September 19, 2019 EX3DV4 - SN:7551

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7551

**Basic Calibration Parameters** 

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)	
Norm $(\mu V/(V/m)^2)^A$	0.57	0.54	0.56	± 10.1 %	
DCP (mV) <sup>8</sup>	104.3	99.1	95.6		

allbration Deculte for Modulation Resnance

UID	Communication System Name		A dB	B dBõV	С	D dB	VR mV	Max dev.	Max Unc <sup>E</sup> (k=2)
0 C	CW	T X	0.00	0.00	1.00	0.00	181.1	± 3.0 %	± 4.7 %
		Y	0.00	0.00	1.00		174.4		
		Z	0.00	0.00	1.00		174.0		
10352- I AAA	Pulse Waveform (200Hz, 10%)	X	15.00	89.60	21.65	10.00	60.0	± 3.9 %	± 9.6 %
		Y	15.00	87.33	19.66		60.0		
		Z	15.00	88.48	20.15		60.0		
10353- Pulsi AAA	Pulse Waveform (200Hz, 20%)	X	15.00	90.79	21.23	6.99	80.0	± 2.7 %	± 9.6 %
	, , , ,	Y	15.00	87.95	18.66	į	80.0		
		Z	15.00	90.69	19.98		80.0		
10354- Put AAA	Pulse Waveform (200Hz, 40%)	X	15.00	94.66	21.81	3.98	95.0	± 1.2 %	± 9.6 %
		Y	15.00	89.03	17.62	]	95.0		
		Z	15.00	94.85	20.37		95.0	1	
10355- Puls	Pulse Waveform (200Hz, 60%)	Х	15.00	102.60	24.35	2,22	120.0	± 1.1 %	± 9.6 %
	, , , ,	Y	15.00	87.27	15.36		120.0	]	1
		Z	15.00	97.27	19.82		120.0	[	
10387- QP AAA	QPSK Waveform, 1 MHz	X	1.24	68.72	13.42	0.00	150.0	± 3.2 %	± 9.6 %
		Y	0.54	60.00	7.02		150.0	]	
		Z	0.39	60.00	3.70		150.0		
10388- QPS AAA	QPSK Waveform, 10 MHz	Х	2.73	71.86	17.85	0.00	150.0	± 1.4 %	± 9.6 %
		Y	1.99	66.53	14.73		150.0	]	
		Z	2.16	69.95	16.98		150.0		
10396-	64-QAM Waveform, 100 kHz	X	3.60	74.00	20.55	3.01	150.0	± 0.9 %	± 9.6 %
AAA		Y	2.73	68.63	17.73		150.0		
		Z	2.22	67.94	18.36		150.0		
10399-	64-QAM Waveform, 40 MHz	Х	3.66	68.17	16.52	0.00	150.0	± 2.1 %	± 9.6 %
AAA		Υ	3.37	66.52	15.34		150.0	]	
		Z	3.41	67.62	16.33		150.0		
10414- W	WLAN CCDF, 64-QAM, 40MHz	Х	4.90	65.94	15.82	0.00	150.0	± 4.2 %	± 9.6 %
		Y	4.76	65.46	15.39		150.0	_	
		Z	4.60	66.09	16.03		150.0		

Note: For details on UID parameters see Appendix

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<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

B Numerical linearization parameter: uncertainty not required.

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

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# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7551

#### **Sensor Model Parameters**

	C1 fF	C2 fF	α V <sup>-1</sup>	T1 ms.V <sup>-2</sup>	T2 ms.V <sup>-1</sup>	T3 ms	T4 V <sup>-2</sup>	T5 V <sup>-1</sup>	Т6
X	47.8	351.65	34.83	22.77	0.50	5.10	0.98	0.37	1.01
Ŷ	41.0	312.25	36.63	13.13	0.44	5.08	0.35	0.46	1.01
ż	25.5	199.44	38.63	11.25	0.42	5.10	0.00	0.26	1.01

#### **Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	120.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7551

## Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
750	41.9	0.89	10.11	10.11	10.11	0.50	0.80	± 12.0 %
835	41.5	0.90	9.88	9.88	9.88	0.38	0.92	± 12.0 %
1750	40.1	1.37	8.34	8.34	8.34	0.28	0.80	± 12.0 %
1900	40.0	1.40	8.05	8.05	8.05	0.29	0.80	± 12.0 %
2300	39.5	1.67	7.74	7.74	7.74	0.30	0.90	± 12.0 %
2450	39.2	1.80	7.30	7.30	7.30	0.32	0.90	± 12.0 %
2600	39.0	1.96	7.18	7.18	7.18	0.35	0.90	± 12.0 %

<sup>&</sup>lt;sup>c</sup> 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 uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency balld. Prequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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 ( $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of

the ConvF uncertainty for indicated target tissue parameters.

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.

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# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7551

# Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
750	55.5	0.96	10.09	10.09	10.09	0.45	0.80	± 12.0 %
835	55.2	0.97	9.92	9.92	9.92	0.42	0.80	± 12.0 %
1750	53.4	1.49	8.13	8.13	8.13	0.37	0.87	± 12.0 %
1900	53.3	1.52	7.69	7.69	7.69	0.41	0.80	± 12.0 %
2300	52.9	1.81	7.63	7.63	7.63	0.40	0.90	± 12.0 %
2450	52.7	1.95	7.41	7.41	7.41	0.36	0.90	± 12.0 %
2600	52.5	2.16	7.34	7.34	7.34	0.28	0.96	± 12.0 %

<sup>&</sup>lt;sup>C</sup> 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

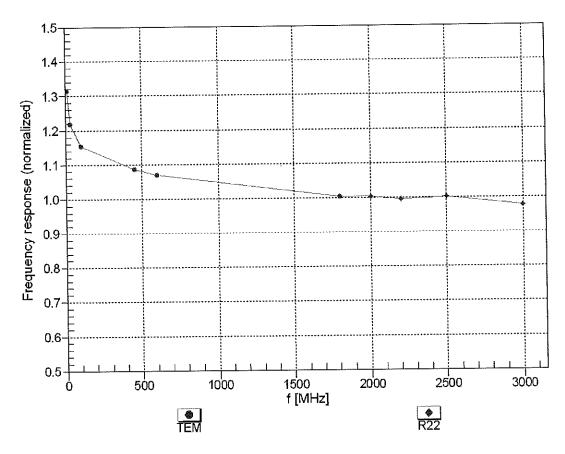
F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to

F At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of the ConvE uncertainty for indicated target tissue parameters.

the ConvF uncertainty for indicated target tissue parameters.

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)

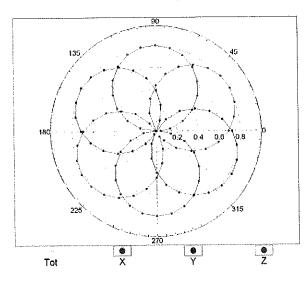


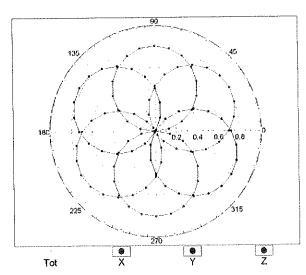
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

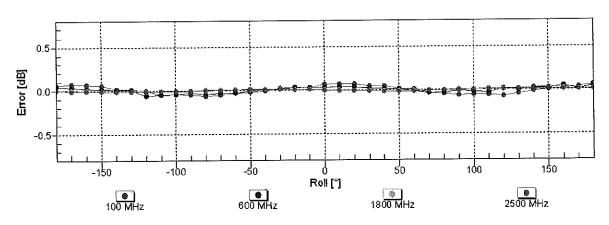
# Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$

f=600 MHz,TEM

f=1800 MHz,R22

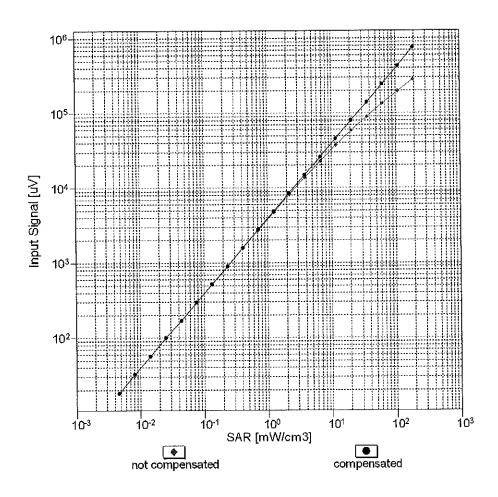


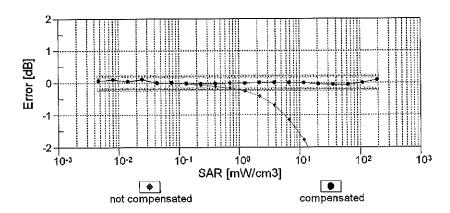




Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

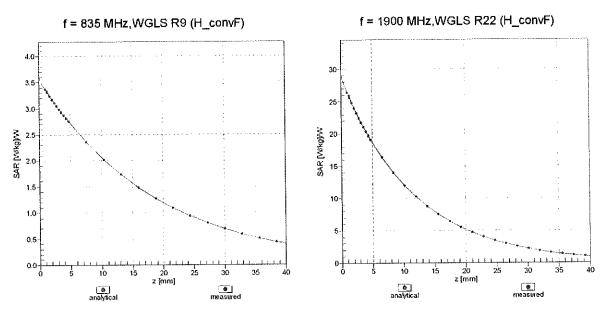
# Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f<sub>eval</sub>= 1900 MHz)



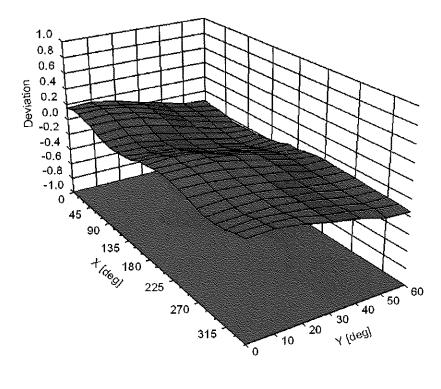


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

# **Conversion Factor Assessment**



Deviation from Isotropy in Liquid Error (φ, θ), f = 900 MHz



EX3DV4- SN:7551

## **Appendix: Modulation Calibration Parameters**

UID	Rev	Communication System Name	Group	PAR (dB)	Unc <sup>E</sup> (k=2)
0		CW	CW	0.00	± 4.7 %
10010	CAA	SAR Validation (Square, 100ms, 10ms)	Test	10.00	± 9.6 %
10011	CAB	UMTS-FDD (WCDMA)	WCDMA	2.91	±9.6%
10012	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	WLAN	1.87	± 9.6 %
10013	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	WLAN	9,46	±9.6 %
10021	DAC	GSM-FDD (TDMA, GMSK)	GSM	9.39	±9.6 %
10023	DAC	GPRS-FDD (TDMA, GMSK, TN 0)	GSM	9.57	±9.6 %
10024	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	GSM	6.56	± 9.6 %
10025	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	GSM	12.62	±9.6 %
10026	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	GSM	9.55	± 9.6 %
10027	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	GSM	4.80	± 9.6 %
10028	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	GSM	3.55	±9.6 %
10029	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	GSM	7.78	± 9.6 %
10030	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	Bluetooth	5.30	± 9.6 %
10031	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	Bluetooth	1.87	± 9.6 %
10032	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	Bluetooth	1.16	± 9.6 %
10033	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	Bluetooth	7.74	± 9.6 %
10034	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	Bluetooth	4.53	± 9.6 %
10035	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	Bluetooth	3.83	± 9.6 %
10036	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	Bluetooth	8.01	±9.6 %
10037	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	Bluetooth	4.77	±9.6 %
10038	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	Bluetooth	4.10	± 9.6 %
10039	CAB	CDMA2000 (1xRTT, RC1)	CDMA2000	4.57	±9.6 %
10042	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	AMPS	7.78	±9.6 %
10044	CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	AMPS	0.00	± 9.6 %
10048	CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	DECT	13.80	±9.6 %
10049	CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	DECT	10.79	± 9.6 %
10056	CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	TD-SCDMA	11.01	± 9.6 %
10058	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	GSM	6.52	± 9.6 %
10059	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	WLAN	2.12	± 9.6 %
10060	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	WLAN	2.83	± 9.6 %
10061	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	WLAN	3.60	± 9.6 %
10062	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	WLAN	8.68	± 9.6 %
10063	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	WLAN	8.63	± 9.6 %
10064	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	WLAN.	9.09	± 9.6 %
10065	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	WLAN	9.00	±9.6 %
10066	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	WLAN	9.38	± 9.6 %
10067	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	WLAN	10.12	± 9.6 %
10068	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	WLAN	10.24	± 9.6 %
10069	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	WLAN	10.56	± 9.6 %
10071	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	WLAN	9.83	± 9.6 %
10072	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	WLAN	9.62	±9.6 %
10073	CAB	IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 18 Mbps)	WLAN	9.94	± 9.6 %
10074	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 10 Mbps)	WLAN	10.30	± 9.6 %
10075	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	WLAN	10.77	± 9.6 %
10076	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	WLAN	10.77	± 9.6 %
10077	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	WLAN	11.00	± 9.6 %
10081	CAB	CDMA2000 (1xRTT, RC3)	CDMA2000	3.97	±9.6 %
10082	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	AMPS	4.77	± 9.6 %
10090	DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	GSM	6.56	±9.6 %
10097	CAB	UMTS-FDD (HSDPA)	WCDMA	3.98	±9.6 %
10097	CAB	UMTS-FDD (HSUPA, Subtest 2)	WCDMA	3.98	±9.6 %
10099	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	GSM	9.55	±9.6 %
10100	CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)			
10100	CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QFSK)	LTE-FDD	5.67	±9.6%
10101	CAE		LTE-FDD	6.42	±9.6 %
10102	CAG	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)  LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	LTE-FDD	6.60	±9.6%
10103	CAG		LTE-TDD	9.29	±9.6 %
10104	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	LTE-TDD	9.97	±9.6 %
10105		LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	LTE-TDD	10.01	±9.6%
10100	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	LTE-FDD	5.80	± 9.6 %

40400	040	LTE EDD (OC EDNA 4000) ED 40 MU- 46 OAM	LTE-FDD	6.43	± 9.6 %
10109	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)  LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	LTE-FDD	5.75	± 9.6 %
10110	CAG	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	LTE-FDD	6.44	± 9.6 %
10111	CAG	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 10-QAM)	LTE-FDD	6.59	± 9.6 %
10112	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 WHZ, 64-QAM)	LTE-FDD	6.62	± 9.6 %
10113	CAC	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	WLAN	8.10	±9.6 %
10115	CAC	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	WLAN	8.46	± 9.6 %
10116	CAC	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	WLAN	8.15	±9.6%
10117	CAC	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	WLAN	8.07	±9.6%
10118	CAC	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	WLAN	8.59	± 9.6 %
10119	CAC	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	WLAN	8.13	± 9.6 %
10140	CAE	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	LTE-FDD	6.49	± 9.6 %
10141	CAE	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	LTE-FDD	6.53	± 9.6 %
10142	CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10143	CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	LTE-FDD	6.35	± 9.6 %
10144	CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	LTE-FDD	6.65	± 9.6 %
10145	CAF	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	LTE-FDD	5.76	±9.6 %
10146	CAF	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	LTE-FDD	6.41	± 9.6 %
10147	CAF	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	LTE-FDD	6.72	± 9.6 %
10149	CAE	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	LTE-FDD	6.42	± 9.6 %
10150	CAE	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	LTE-FDD	6.60	± 9.6 %
10151	CAG	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	LTE-TDD	9.28	± 9.6 %
10152	CAG	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	LTE-TDD	9.92	±9.6%
10153	CAG	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)		10.05	± 9.6 %
10154	CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	LTE-FDD	5.75	±9.6%
10155	CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	LTE-FDD	6.43 5.79	± 9.6 % ± 9.6 %
10156	CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	LTE-FDD	6.49	± 9.6 %
10157	CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	LTE-FDD	6.62	± 9.6 %
10158	CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	LTE-FDD	6.56	± 9.6 %
10159	CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM) LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	LTE-FDD	5.82	± 9.6 %
10160	CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QF3R)	LTE-FDD	6.43	± 9.6 %
10161	CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 10-QAM)	LTE-FDD	6.58	± 9.6 %
10162 10166	CAE	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	LTE-FDD	5.46	± 9.6 %
10167	CAF	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	LTE-FDD	6.21	± 9.6 %
10168	CAF	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	LTE-FDD	6.79	± 9.6 %
10169	CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10170	CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-FDD	6.52	± 9.6 %
10171	AAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	LTE-FDD	6.49	± 9.6 %
10172	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	LTE-TDD	9.21	± 9.6 %
10173	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10174	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10175	CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	LTE-FDD	5.72	±9.6 %
10176	CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	LTE-FDD	6.52	±9.6%
10177	CAI	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10178	CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	LTE-FDD	6.52	± 9.6 %
10179	CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	LTE-FDD	6.50	± 9.6 %
10180	CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	LTE-FDD	6.50	± 9.6 %
10181	CAE	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	LTE-FDD	5.72	± 9.6 %
10182	CAE	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	LTE-FDD	6.52	± 9.6 %
10183	AAD	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	LTE-FDD	6.50	± 9.6 %
10184	CAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10185	CAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	LTE-FDD	6.51	± 9.6 %
10186	AAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	LTE-FDD	6.50	±9.6%
10187	CAF	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10188	CAF	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	LTE-FDD	6.52	± 9.6 %
10189	AAF	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	LTE-FDD	6.50	± 9.6 % ± 9.6 %
10193	CAC	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	WLAN WLAN	8.09 8.12	± 9.6 %
10194	CAC	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	WLAN	8.21	± 9.6 %
10195	CAC	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	WLAN	8.10	± 9.6 %
10196	CAC	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	WLAN	8.13	± 9.6 %
10197	CAC	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	WLAN	8.27	± 9.6 %
10198	CAC	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM) IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	WLAN	8.03	± 9.6 %
10219	CAC	TIELE GOZ. FITE (FITE WILKOU, F.Z. WIDPS, DE OR)	1 77-111		

10220	040	JEEE 000 dd - (UT Min ol do O Min ol do O Min			r
10220	CAC	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	WLAN	8.13	± 9.6 %
10221	CAC	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	WLAN	8.27	± 9.6 %
10222		IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	WLAN	8.06	± 9.6 %
	CAC	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	WLAN	8.48	± 9.6 %
10224	CAC	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	WLAN	8.08	± 9.6 %
10225	CAB	UMTS-FDD (HSPA+)	WCDMA	5.97	±9.6%
10226	CAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.49	± 9.6 %
10227	CAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	LTE-TDD	10.26	± 9.6 %
10228	CAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	LTE-TDD	9.22	± 9.6 %
10229	CAD	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	LTE-TDD	9.48	±9.6%
10230	CAD	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10231	CAD	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	LTE-TDD	9.19	± 9.6 %
10232	CAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	LTE-TDD	9.48	±9.6%
10233	CAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10234	CAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	LTE-TDD	9.21	±9.6%
10235	CAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10236	CAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10237	CAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	LTE-TDD	9.21	± 9.6 %
10238	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10239	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10240	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	LTE-TDD	9.21	±9.6%
10241	CAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.82	±9.6%
10242	CAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	LTE-TDD	9.86	± 9.6 %
10243	CAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	LTE-TDD	9.46	±9.6%
10244	CAD	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	LTE-TDD	10.06	± 9.6 %
10245	CAD	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	LTE-TDD	10.06	±9.6 %
10246	CAD	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	LTE-TDD	9.30	±9.6 %
10247	CAG	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	LTE-TDD	9.91	±9.6 %
10248	CAG	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	LTE-TDD	10.09	±9.6 %
10249	CAG	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	LTE-TDD	9.29	±9.6 %
10250	CAG	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	LTE-TDD	9.81	± 9.6 %
10251	CAG	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	LTE-TDD	10.17	± 9.6 %
10252	CAG	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	LTE-TDD	9.24	± 9.6 %
10253	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	LTE-TDD	9.90	±9.6%
10254	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	LTE-TDD	10.14	± 9.6 %
10255	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	LTE-TDD	9.20	± 9.6 %
10256	CAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.96	± 9.6 %
10257	CAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	LTE-TDD	10.08	±9.6 %
10258	CAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	LTE-TDD	9.34	± 9.6 %
10259	CAD	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	LTE-TDD	9.98	± 9.6 %
10260	CAD	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	LTE-TDD	9.97	±9.6 %
10261	CAD	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	LTE-TDD	9.24	± 9.6 %
10262		LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	LTE-TDD	9.83	± 9.6 %
10263	CAG	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	LTE-TDD	10.16	± 9.6 %
10264	CAG	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	LTE-TDD	9.23	±9.6 %
10265	CAG	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	LTE-TDD	9.92	± 9.6 %
10266	CAG	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	LTE-TDD	10.07	± 9.6 %
10267	CAG	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	LTE-TDD	9.30	± 9.6 %
10268	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	LTE-TDD	10.06	± 9.6 %
10269	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	LTE-TDD	10.13	± 9.6 %
10270	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	LTE-TDD	9.58	± 9.6 %
10274	CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	WCDMA	4.87	± 9.6 %
10275	CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	WCDMA	3.96	± 9.6 %
10277	CAA	PHS (QPSK)	PHS	11.81	± 9.6 %
10278	CAA	PHS (QPSK, BW 884MHz, Rolloff 0.5)	PHS	11.81	± 9.6 %
10279	CAA	PHS (QPSK, BW 884MHz, Rolloff 0.38)	PHS	12.18	± 9.6 %
10290	AAB	CDMA2000, RC1, SO55, Full Rate	CDMA2000	3.91	± 9.6 %
10291	AAB	CDMA2000, RC3, SO55, Full Rate	CDMA2000	3.46	± 9.6 %
10292	AAB	CDMA2000, RC3, SO32, Full Rate	CDMA2000	3.39	± 9.6 %
10293	AAB	CDMA2000, RC3, SO3, Full Rate	CDMA2000	3.50	± 9.6 %
10295	AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	CDMA2000	12.49	
10297	AAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	LTE-FDD	5.81	± 9.6 %
10297	AAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	LTE-FDD	5.72	± 9.6 %
10299	AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QFSK)	LTE-FDD	6.39	± 9.6 % ± 9.6 %
10200	, 0.32	= 1 = 1 DD   DD   DD   DD   DD   DD	FILTIUU	0.58	± 3.0 70

10300	AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	LTE-FDD	6.60	± 9.6 %
10301	AAA	IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC)	WiMAX	12.03	± 9.6 %
10302	AAA	IEEE 802.16e WIMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL	WIMAX	12.57	± 9.6 %
,		symbols)			- Laboratoria
10303	AAA	IEEE 802.16e WIMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)	WiMAX	12.52	± 9.6 %
10304	AAA	IEEE 802.16e WIMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)	WIMAX	11.86	± 9.6 %
10305	AAA	IEEE 802.16e WIMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15	WiMAX	15.24	± 9.6 %
		symbols)			
10306	AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18	WiMAX	14.67	±9.6%
		symbols)			
10307	AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18	WiMAX	14.49	±9.6%
		symbols)			
10308	AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)	WiMAX	14.46	±9.6%
10309	AAA	IEEE 802.16e WIMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18	WIMAX	14.58	±9.6%
		symbols)			
10310	AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18	WiMAX	14.57	±9.6%
	L	symbols)	1 TE EDD	0.00	1000
10311	AAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	LTE-FDD	6.06	± 9.6 %
10313	AAA	IDEN 1:3	IDEN	10.51	± 9.6 %
10314	AAA	IDEN 1:6	iDEN	13.48	± 9.6 %
10315	AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	WLAN	1.71	± 9.6 %
10316	AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	WLAN	8.36	± 9.6 %
10317	AAC	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	WLAN .	8.36	± 9.6 %
10352	AAA	Pulse Waveform (200Hz, 10%)	Generic	10.00	± 9.6 %
10353	AAA	Pulse Waveform (200Hz, 20%)	Generic	6.99	±9.6 %
10354	AAA	Pulse Waveform (200Hz, 40%)	Generic	3.98	± 9.6 %
10355	AAA	Pulse Waveform (200Hz, 60%)	Generic	2.22	± 9.6 %
10356	AAA	Pulse Waveform (200Hz, 80%)	Generic	0.97	± 9.6 %
10387	AAA	QPSK Waveform, 1 MHz	Generic	5.10	± 9.6 %
10388	AAA	QPSK Waveform, 10 MHz	Generic	5.22	± 9.6 %
10396	AAA	64-QAM Waveform, 100 kHz	Generic	6.27	±9.6%
10399	AAA	64-QAM Waveform, 40 MHz	Generic WLAN	6.27 8.37	± 9.6 % ± 9.6 %
10400	AAD	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	WLAN	8.60	± 9.6 %
10401	AAD	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	WLAN	8.53	± 9.6 %
10402	AAD	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	CDMA2000	3.76	± 9.6 %
10403	AAB	CDMA2000 (1xEV-DO, Rev. 0)	CDMA2000	3.77	± 9.6 %
10404	AAB	CDMA2000 (1xEV-DO, Rev. A) CDMA2000, RC3, SO32, SCH0, Full Rate	CDMA2000	5.22	± 9.6 %
10406	AAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL	LTE-TDD	7.82	±9.6 %
10410	AAG	Subframe=2,3,4,7,8,9, Subframe Conf=4)	-, -, 00	7.02	20.070
10414	AAA	WLAN CCDF, 64-QAM, 40MHz	Generic	8.54	± 9.6 %
10414	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	WLAN	1.54	± 9.6 %
10415	AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	WLAN	8.23	± 9.6 %
10417	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	WLAN	8.23	± 9.6 %
10417	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle,	WLAN	8.14	± 9.6 %
10-10	\ \tag{\tau_{\tau_{\tau_{\tau}}}}	Long preambule)	''		
10419	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle,	WLAN	8.19	± 9.6 %
10710	1,0.0.	Short preambule)	"		
10422	AAB	IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)	WLAN	8.32	± 9.6 %
		IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM)	WLAN	8.47	± 9.6 %
1 1(1423	AAR				
10423 10424	AAB		WLAN	8.40	± 9.6 %
10424	AAB	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM)	WLAN WLAN	8.40 8.41	± 9.6 % ± 9.6 %
10424 10425	AAB AAB	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)			
10424 10425 10426	AAB AAB AAB	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM)	WLAN	8.41	± 9.6 %
10424 10425 10426 10427	AAB AAB	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)	WLAN WLAN	8.41 8.45	±9.6 % ±9.6 % ±9.6 % ±9.6 %
10424 10425 10426 10427 10430	AAB AAB AAB AAD	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	WLAN WLAN WLAN	8.41 8.45 8.41	± 9.6 % ± 9.6 % ± 9.6 %
10424 10425 10426 10427 10430 10431	AAB AAB AAB AAB AAD	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	WLAN WLAN WLAN LTE-FDD	8.41 8.45 8.41 8.28	±9.6 % ±9.6 % ±9.6 % ±9.6 %
10424 10425 10426 10427 10430 10431 10432	AAB AAB AAB AAD AAD AAC	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	WLAN WLAN WLAN LTE-FDD LTE-FDD	8.41 8.45 8.41 8.28 8.38	±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 %
10424 10425 10426 10427 10430 10431 10432 10433	AAB AAB AAB AAD AAD AAC AAC	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	WLAN WLAN WLAN LTE-FDD LTE-FDD LTE-FDD	8.41 8.45 8.41 8.28 8.38 8.34	±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 %
10424 10425 10426 10427 10430 10431 10432 10433 10434	AAB AAB AAB AAD AAD AAC AAC AAA	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) LTE-FDD (OFDMA, 20 MHz, E-TM 3.1) W-CDMA (BS Test Model 1, 64 DPCH)	WLAN WLAN WLAN LTE-FDD LTE-FDD LTE-FDD LTE-FDD	8.41 8.45 8.41 8.28 8.38 8.34 8.34	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
10424 10425 10426 10427 10430 10431 10432 10433	AAB AAB AAB AAD AAD AAC AAC	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) LTE-FDD (OFDMA, 20 MHz, E-TM 3.1) W-CDMA (BS Test Model 1, 64 DPCH) LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL	WLAN WLAN WLAN LTE-FDD LTE-FDD LTE-FDD UTE-FDD WCDMA	8.41 8.45 8.41 8.28 8.38 8.34 8.34 8.60 7.82	± 9.6 % ± 9.6 %
10424 10425 10426 10427 10430 10431 10432 10433 10434 10435	AAB AAB AAB AAD AAD AAC AAC AAC	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) LTE-FDD (OFDMA, 20 MHz, E-TM 3.1) W-CDMA (BS Test Model 1, 64 DPCH) LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	WLAN WLAN WLAN LTE-FDD LTE-FDD LTE-FDD WCDMA LTE-TDD	8.41 8.45 8.41 8.28 8.38 8.34 8.34 8.60 7.82	± 9.6 % ± 9.6 %
10424 10425 10426 10427 10430 10431 10432 10433 10434 10435	AAB AAB AAB AAD AAD AAC AAC AAC AAA	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) LTE-FDD (OFDMA, 20 MHz, E-TM 3.1) W-CDMA (BS Test Model 1, 64 DPCH) LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)	WLAN WLAN WLAN LTE-FDD LTE-FDD LTE-FDD WCDMA LTE-TDD LTE-FDD LTE-TDD	8.41 8.45 8.41 8.28 8.38 8.34 8.34 8.60 7.82	±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 %
10424 10425 10426 10427 10430 10431 10432 10433 10434 10435	AAB AAB AAB AAD AAD AAC AAC AAC	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) LTE-FDD (OFDMA, 20 MHz, E-TM 3.1) W-CDMA (BS Test Model 1, 64 DPCH) LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	WLAN WLAN WLAN LTE-FDD LTE-FDD LTE-FDD WCDMA LTE-TDD	8.41 8.45 8.41 8.28 8.38 8.34 8.34 8.60 7.82	±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 %

10451	AAA	W-CDMA (BS Test Model 1, 64 DPCH, Clipping 44%)	WCDMA	7.59	± 9.6 %
10456	AAB	IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle)	WLAN	8.63	± 9.6 %
10457	AAA	UMTS-FDD (DC-HSDPA)	WCDMA	6.62	± 9.6 %
10458	AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	CDMA2000	6.55	± 9.6 %
10459	AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	CDMA2000	8.25	±9.6%
10460	AAA	UMTS-FDD (WCDMA, AMR)	WCDMA	2.39	± 9.6 %
10461	AAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10462	AAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.30	± 9.6 %
10463	AAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.56	± 9.6 %
10464	AAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10465	AAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.32	± 9.6 %
10466	AAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.57	± 9.6 %
10467	AAF	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10468	AAF	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.32	± 9.6 %
10469	AAF	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.56	± 9.6 %
10470	AAF	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10471	AAF	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.32	± 9.6 %
10472	AAF	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.57	± 9.6 %
10473	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10474	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.32	± 9.6 %
10475	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.57	± 9.6 %
10477	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.32	±9.6 %
10478	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.57	±9.6 %
10479	AAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.74	± 9.6 %
10480	AAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.18	±9.6 %
10481	AAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.45	±9.6 %
10482	AAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.71	±9.6 %
10483	AAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.39	± 9.6 %
10484	AAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.47	±9.6 %
10485	AAF	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.59	± 9.6 %
10486	AAF	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.38	± 9.6 %
10487	AAF	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.60	± 9.6 %
10488	AAF	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.70	± 9.6 %
10489	AAF	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.31	± 9.6 %
10490	AAF	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.54	± 9.6 %
10491	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.74	± 9.6 %

10100		LITE TOD (OO EDMA FOW DD 45 MIL 40 OAM III	LITE TOD	0.44	± 9.6 %
10492	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.41	
10493	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.55	± 9.6 %
10494	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.74	± 9.6 %
10495	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.37	± 9.6 %
10496	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.54	± 9.6 %
10497	AAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.67	± 9.6 %
10498	AAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.40	± 9.6 %
10499	AAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.68	± 9.6 %
10500	AAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.67	± 9.6 %
10501	AAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.44	± 9.6 %
10502	AAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.52	± 9.6 %
10503	AAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.72	± 9.6 %
10504	AAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.31	± 9.6 %
10505	AAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.54	± 9.6 %
10506	AAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.74	± 9.6 %
10507	AAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.36	± 9.6 %
10508	AAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.55	± 9.6 %
10509	AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.99	± 9.6 %
10510	AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.49	± 9.6 %
10511	AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.51	± 9.6 %
10512	AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.74	±9.6 %
10513	AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.42	± 9.6 %
10514	AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.45	± 9.6 %
10515	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	WLAN	1.58	± 9.6 %
10516	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 99pc duty cycle)	WLAN	1.57	± 9.6 %
10517	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 99pc duty cycle)	WLAN	1.58	± 9.6 %
10518	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	WLAN	8.23	± 9.6 %.
10519	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 99pc duty cycle)	WLAN	8.39	± 9.6 %
10520	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 99pc duty cycle)	WLAN	8.12	± 9.6 %
10521	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 99pc duty cycle)	WLAN	7.97	± 9.6 %
10522	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 99pc duty cycle)	WLAN	8.45	± 9.6 %
10523	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 99pc duty cycle)	WLAN	8.08	± 9.6 %
10524	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 99pc duty cycle)	WLAN	8.27	± 9.6 %
10525	AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	WLAN	8.36	± 9.6 %
10526	AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	WLAN	8.42	± 9.6 %
10527	AAB	IEEE 802.11ac WiFi (20MHz, MCS2, 99pc duty cycle)	WLAN	8.21	± 9.6 %
10528	AAB	IEEE 802.11ac WiFi (20MHz, MCS3, 99pc duty cycle)	WLAN	8.36	± 9.6 %
10529	AAB	IEEE 802.11ac WiFi (20MHz, MCS4, 99pc duty cycle)	WLAN	8.36	± 9.6 %
10531	AAB	IEEE 802.11ac WiFi (20MHz, MCS6, 99pc duty cycle)	WLAN	8.43	± 9.6 %
10532	AAB	IEEE 802.11ac WiFi (20MHz, MCS7, 99pc duty cycle)	WLAN	8.29	± 9.6 %
10533	AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 99pc duty cycle)	WLAN	8.38	± 9.6 %
10534	AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	WLAN	8.45	± 9.6 %

10535	AAB	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	WLAN	8.45	± 9.6 %
10536	AAB	IEEE 802.11ac WiFi (40MHz, MCS2, 99pc duty cycle)	WLAN	8.32	± 9.6 %
10537	AAB	IEEE 802.11ac WiFi (40MHz, MCS3, 99pc duty cycle)	WLAN	8.44	± 9.6 %
10538	AAB	IEEE 802.11ac WiFi (40MHz, MCS4, 99pc duty cycle)	WLAN	8.54	± 9.6 %
10540	AAB	IEEE 802.11ac WiFi (40MHz, MCS6, 99pc duty cycle)	WLAN	8.39	±9.6%
10541	AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 99pc duty cycle)	WLAN	8.46	± 9.6 %
10542	AAB	IEEE 802.11ac WiFi (40MHz, MCS8, 99pc duty cycle)	WLAN	8.65	± 9.6 %
10543	AAB	IEEE 802.11ac WiFi (40MHz, MCS9, 99pc duty cycle)	WLAN	8.65	± 9.6 %
10544	AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	WLAN	8.47	± 9.6 %
10545	AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	WLAN	8.55	± 9.6 %
10546	AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 99pc duty cycle)	WLAN	8.35	± 9.6 %
10547	AAB	IEEE 802.11ac WiFi (80MHz, MCS3, 99pc duty cycle)	WLAN	8.49	± 9.6 %
10548	AAB	IEEE 802.11ac WiFi (80MHz, MCS4, 99pc duty cycle)	WLAN	8.37	± 9.6 %
10550	AAB	IEEE 802.11ac WiFi (80MHz, MCS6, 99pc duty cycle)	WLAN	8.38	± 9.6 %
10551	AAB	IEEE 802.11ac WiFi (80MHz, MCS7, 99pc duty cycle)	WLAN	8.50	± 9.6 %
10552	AAB	IEEE 802.11ac WiFi (80MHz, MCS8, 99pc duty cycle)	WLAN	8.42	
10553	AAB	IEEE 802.11ac WiFi (80MHz, MCS9, 99pc duty cycle)	***		± 9.6 %
10554	AAC	IEEE 802.11ac WiFi (160MHz, MCS0, 99pc duty cycle)	WLAN	8.45	±9.6 %
10555	AAC	LIFEE 902.1 Tac WIFT (100MIF, MCSU, 99pc duty cycle)	WLAN	8.48	± 9.6 %
		IEEE 802.11ac WiFi (160MHz, MCS1, 99pc duty cycle)	WLAN	8.47	± 9.6 %
10556 10557	AAC	IEEE 802.11ac WiFi (160MHz, MCS2, 99pc duty cycle)	WLAN	8.50	± 9.6 %
	AAC	IEEE 802.11ac WiFi (160MHz, MCS3, 99pc duty cycle)	WLAN	8.52	± 9.6 %
10558	AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 99pc duty cycle)	WLAN	8.61	± 9.6 %
10560	AAC	IEEE 802.11ac WiFi (160MHz, MCS6, 99pc duty cycle)	WLAN	8.73	± 9.6 %
10561	AAC	IEEE 802.11ac WiFi (160MHz, MCS7, 99pc duty cycle)	WLAN	8.56	± 9.6 %
10562	AAC	IEEE 802.11ac WiFi (160MHz, MCS8, 99pc duty cycle)	WLAN	8.69	±9.6 %
10563	AAC	IEEE 802.11ac WiFi (160MHz, MCS9, 99pc duty cycle)	WLAN	8.77	± 9.6 %
10564	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty	WLAN	8.25	± 9.6 %
Ì		cycle)	172 (1)	0.20	= 0.0 %
10565	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 99pc duty	WLAN	8.45	± 9.6 %
		cycle)	1,511	0.40	2 0.0 %
10566	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 99pc duty	WLAN	8.13	± 9.6 %
.0000	,,,,,	cycle)	VVEAN	0.13	19.0 %
10567	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 99pc duty	WLAN	0.00	1000
10001	777	cycle)	WLAN	8.00	±9.6%
10568	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 99pc duty	341 431	0.07	1000
10306	~~~	cycle)	WLAN	8.37	± 9.6 %
10569	AAA		10/1 001		
10369	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 99pc duty	WLAN	8.10	± 9.6 %
10570	ΛΛΛ	cycle)			
105/0	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 99pc duty	WLAN	8.30	± 9.6 %
10==1		cycle)			
10571	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	WLAN	1.99	± 9.6 %
10572	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	WLAN	1.99	± 9.6 %
10573	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 90pc duty cycle)	WLAN	1.98	± 9.6 %
10574	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc duty cycle)	WLAN	1.98	± 9.6 %
10575	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty	WLAN	8.59	± 9.6 %
		cycle)			
10576	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty	WLAN	8.60	± 9.6 %
		cycle)			''' '
10577	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc duty	WLAN	8.70	± 9.6 %
		cycle)	''	50	- 5.5 /
10578	1	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc duty	WLAN	8.49	± 9.6 %
1 10076	AAA	LIGGE OVA. HU VVIPLA.4 GITZ EDOGO-UPLJIVI TA MIDOS MODE OFTA		1 0.70	~ 5.5 /6
10076	AAA	cycle)	***		
	ļ	cycle)		8 36	+96%
10578	AAA	cycle) IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty	WLAN	8.36	±9.6 %
10579	AAA	cycle) IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)	WLAN		
	ļ	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty		8.36 8.76	± 9.6 %
10579 10580	AAA	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)	WLAN	8.76	± 9.6 %
10579	AAA	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty	WLAN		
10579 10580 10581	AAA AAA	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)	WLAN WLAN	8.76 8.35	± 9.6 %
10579 10580	AAA	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)	WLAN	8.76	± 9.6 %
10579 10580 10581 10582	AAA AAA AAA	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)	WLAN WLAN WLAN	8.76 8.35 8.67	± 9.6 % ± 9.6 % ± 9.6 %
10579 10580 10581 10582 10583	AAA AAA AAA AAA	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	WLAN WLAN WLAN WLAN	8.76 8.35 8.67 8.59	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
10579 10580 10581 10582 10583 10584	AAA AAA AAA AAA AAB AAB	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)  IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	WLAN WLAN WLAN WLAN WLAN	8.76 8.35 8.67	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
10579 10580 10581 10582 10583 10584 10585	AAA AAA AAA AAB AAB AAB	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)  IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)  IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 90pc duty cycle)	WLAN WLAN WLAN WLAN	8.76 8.35 8.67 8.59	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
10579 10580 10581 10582 10583 10584	AAA AAA AAA AAA AAB AAB	cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)  IEEE 802.11g WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)  IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	WLAN WLAN WLAN WLAN WLAN	8.76 8.35 8.67 8.59 8.60	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %

				0.70	
10588	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 90pc duty cycle)	WLAN	8.76	±9.6 %
10589	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 90pc duty cycle)	WLAN	8.35	± 9.6 %
10590	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 90pc duty cycle)	WLAN	8.67	± 9.6 %
10591	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	WLAN	8.63	± 9.6 %
10592	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	WLAN	8.79	±9.6%
10593	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS2, 90pc duty cycle)	WLAN	8.64	± 9.6 %
10594	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS3, 90pc duty cycle)	WLAN	8.74	± 9.6 %
10595	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS4, 90pc duty cycle)	WLAN	8.74	± 9.6 %
10596	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS5, 90pc duty cycle)	WLAN	8.71	± 9.6 %
10597	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS6, 90pc duty cycle)	WLAN	8.72	± 9.6 %
10598	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS7, 90pc duty cycle)	WLAN	8.50	± 9.6 %
10599	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	WLAN	8.79	± 9.6 %
10600	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	WLAN	8.88	± 9.6 %
10601	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS2, 90pc duty cycle)	WLAN	8.82	± 9.6 %
10602	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS3, 90pc duty cycle)	WLAN	8.94	± 9.6 %
10603	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS4, 90pc duty cycle)	WLAN	9.03	±9.6%
10604	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS5, 90pc duty cycle)	WLAN	8.76	± 9.6 %
10605	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS6, 90pc duty cycle)	WLAN	8,97	± 9.6 %
10606	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS7, 90pc duty cycle)	WLAN	8.82	± 9.6 %
		IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	WLAN	8.64	± 9.6 %
10607 10608	AAB AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	WLAN	8.77	± 9.6 %
***************************************		IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	WLAN	8.57	± 9.6 %
10609	AAB_	IEEE 802.11ac WiFi (20MHz, MCS2, 90pc duty cycle)	WLAN	8.78	± 9.6 %
10610	AAB		WLAN	8.70	± 9.6 %
10611	AAB	IEEE 802.11ac WiFi (20MHz, MCS4, 90pc duty cycle)	WLAN	8.77	± 9.6 %
10612	AAB	IEEE 802.11ac WiFi (20MHz, MCS5, 90pc duty cycle)	WLAN	8.94	± 9.6 %
10613	AAB	IEEE 802.11ac WiFi (20MHz, MCS6, 90pc duty cycle)			
10614	AAB	IEEE 802.11ac WiFi (20MHz, MCS7, 90pc duty cycle)	WLAN	8.59	± 9.6 %
10615	AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 90pc duty cycle)	WLAN	8.82	± 9.6 %
10616	AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	WLAN	8.82	± 9.6 %
10617	AAB	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	WLAN	8.81	± 9.6 %
10618	AAB	IEEE 802.11ac WiFi (40MHz, MCS2, 90pc duty cycle)	WLAN	8.58	± 9.6 %
10619	AAB	IEEE 802.11ac WiFi (40MHz, MCS3, 90pc duty cycle)	WLAN	8.86	± 9.6 %
10620	AAB	IEEE 802.11ac WiFi (40MHz, MCS4, 90pc duty cycle)	WLAN	8.87	± 9,6 %
10621	AAB	IEEE 802.11ac WiFi (40MHz, MCS5, 90pc duty cycle)	WLAN	8.77	± 9.6 %
10622	AAB	IEEE 802.11ac WiFi (40MHz, MCS6, 90pc duty cycle)	WLAN	8.68	± 9.6 %
10623	AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 90pc duty cycle)	WLAN	8.82	± 9.6 %
10624	AAB	IEEE 802.11ac WiFi (40MHz, MCS8, 90pc duty cycle)	WLAN	8.96	±9.6%
10625	AAB	IEEE 802.11ac WiFi (40MHz, MCS9, 90pc duty cycle)	WLAN	8.96	± 9.6 %
10626	AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	WLAN	8.83	± 9.6 %
10627	AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)	WLAN	8.88	± 9.6 %
10628	AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 90pc duty cycle)	WLAN	8.71	± 9.6 %
10629	AAB	IEEE 802.11ac WiFi (80MHz, MCS3, 90pc duty cycle)	WLAN	8.85	± 9.6 %
10630	AAB	IEEE 802.11ac WiFi (80MHz, MCS4, 90pc duty cycle)	WLAN	8.72	± 9.6 %
10631	AAB	IEEE 802.11ac WiFi (80MHz, MCS5, 90pc duty cycle)	WLAN	8.81	± 9.6 %
10632	AAB	IEEE 802.11ac WiFi (80MHz, MCS6, 90pc duty cycle)	WLAN	8.74	± 9.6 %
10633	AAB	IEEE 802.11ac WiFi (80MHz, MCS7, 90pc duty cycle)	WLAN	8.83	± 9.6 %
10634	AAB	IEEE 802.11ac WiFi (80MHz, MCS8, 90pc duty cycle)	WLAN	8.80	±9.6%
10634	AAB	IEEE 802.11ac WiF1 (80MHz, MCS9, 90pc duty cycle)	WLAN	8.81	± 9.6 %
10635	AAC	IEEE 802.11ac Wif (80MHz, MCS), sope duty cycle)	WLAN	8.83	± 9.6 %
	AAC	IEEE 802.11ac WiFi (160MHz, MCS1, 90pc duty cycle)	WLAN	8.79	± 9.6 %
10637		IEEE 802.11ac WiFi (160MHz, MCS1, 30pc daty cycle)	WLAN	8.86	± 9.6 %
10638	AAC	IEEE 802.11ac WiFi (160MHz, MCS2, 90pc duty cycle)	WLAN	8.85	± 9.6 %
10639	AAC		WLAN	8.98	± 9.6 %
10640	AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 90pc duty cycle)	WLAN	9.06	± 9.6 %
10641	AAC	IEEE 802.11ac WiFi (160MHz, MCS5, 90pc duty cycle)	WLAN	9.06	± 9.6 %
10642	AAC	IEEE 802.11ac WiFi (160MHz, MCS6, 90pc duty cycle)	WLAN	8.89	± 9.6 %
10643	AAC	IEEE 802.11ac WiFi (160MHz, MCS7, 90pc duty cycle)			
10644	AAC	IEEE 802.11ac WiFi (160MHz, MCS8, 90pc duty cycle)	WLAN	9.05	± 9.6 %
10645	AAC	IEEE 802.11ac WiFi (160MHz, MCS9, 90pc duty cycle)	WLAN	9.11	± 9.6 %
	AAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,7)	LTE-TDD	11.96	± 9.6 %
10646		The man concents and continue and the configuration of the configuration	I I I L TOO	11.96	± 9.6 %
10646 10647	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,7)	LTE-TDD		
10646		CDMA2000 (1x Advanced)	CDMA2000	3.45	± 9.6 %
10646 10647	AAF	CDMA2000 (1x Advanced) LTE-TDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)	CDMA2000 LTE-TDD	3.45 6.91	± 9.6 % ± 9.6 %
10646 10647 10648	AAF AAA	CDMA2000 (1x Advanced)	CDMA2000	3.45	± 9.6 %

10658	10655	AAE	LTE-TDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)	LITE TOO	7.04	T
10669				LTE-TDD	7.21	± 9.6 %
10660					···	
10661		·				
10662					<del></del>	
10670   AAA   Bluetooth Low Energy   Bluetooth   2.19   ±9.6     10671   AAA   IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)   WLAN   9.09   ±9.6     10672   AAA   IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)   WLAN   8.57   ±9.6     10673   AAA   IEEE 802.11ax (20MHz, MCS2, 90pc duty cycle)   WLAN   8.78   ±9.6     10674   AAA   IEEE 802.11ax (20MHz, MCS2, 90pc duty cycle)   WLAN   8.74   ±9.6     10675   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.74   ±9.6     10676   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.77   ±9.6     10677   AAA   IEEE 802.11ax (20MHz, MCS6, 90pc duty cycle)   WLAN   8.77   ±9.6     10678   AAA   IEEE 802.11ax (20MHz, MCS6, 90pc duty cycle)   WLAN   8.73   ±9.6     10679   AAA   IEEE 802.11ax (20MHz, MCS6, 90pc duty cycle)   WLAN   8.78   ±9.6     10679   AAA   IEEE 802.11ax (20MHz, MCS8, 90pc duty cycle)   WLAN   8.88   ±9.6     10680   AAA   IEEE 802.11ax (20MHz, MCS8, 90pc duty cycle)   WLAN   8.89   ±9.6     10681   AAA   IEEE 802.11ax (20MHz, MCS8, 90pc duty cycle)   WLAN   8.80   ±9.6     10682   AAA   IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)   WLAN   8.62   ±9.6     10683   AAA   IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)   WLAN   8.83   ±9.6     10684   AAA   IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)   WLAN   8.26   ±9.6     10685   AAA   IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)   WLAN   8.26   ±9.6     10686   AAA   IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)   WLAN   8.26   ±9.6     10686   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.29   ±9.6     10686   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.29   ±9.6     10686   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.29   ±9.6     10687   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.29   ±9.6     10688   AAA   IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)   WLAN   8.29   ±9.6     10689   AAA   IEEE 802.11ax (20MHz, MCS4, 90pc duty cycle)   WLAN   8.29   ±9.6     10689   AAA   IEEE 802.11ax (20MHz, MCS4, 90pc	10662					± 9.6 %
10671	10670	AAA	Bluetooth Low Energy			± 9.6 %
10672		AAA	IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)			± 9.6 %
10673		AAA	IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)			± 9.6 %
10675			IEEE 802.11ax (20MHz, MCS2, 90pc duty cycle)	WLAN		± 9.6 %
10676			IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)	WLAN	8.74	±9.6%
10677			IEEE 802.11ax (20MHz, MCS4, 90pc duty cycle)			±9.6 %
10678		***************************************	IEEE 802.11ax (20MHz, MCS5, 90pc duty cycle)			± 9.6 %
10679			IEEE 802.11ax (20MHz, MCS6, 90pc duty cycle)			±9.6%
10680				·· · · · · · · · · · · · · · · · · · ·		± 9.6 %
10681		*****			+	± 9.6 %
10682						± 9.6 %
10683						
10684					<del>)</del>	
10685		***************************************	IEEE 802.11ax (20MHz, MCS1, 99nc duty cycle)		· · · · · · · · · · · · · · · · · · ·	± 9.6 %
10686			IEEE 802.11ax (20MHz, MCS2, 99pc duty cycle)		<del>-</del>	± 9.6 %
10687			IEEE 802.11ax (20MHz, MCS3, 99pc duty cycle)			± 9.6 %
10688	10687	AAA	IEEE 802.11ax (20MHz, MCS4, 99pc duty cycle)		··	± 9.6 %
10689	10688	AAA	IEEE 802.11ax (20MHz, MCS5, 99pc duty cycle)			±9.6%
10691   AAA   IEEE 802.11ax (20MHz, MCS8, 99pc duty cycle)	10689	AAA			8.55	±9.6%
10692	***************************************	<del></del>		WLAN	8.29	± 9.6 %
10693		·	IEEE 802.11ax (20MHz, MCS8, 99pc duty cycle)		8.25	± 9.6 %
10694         AAA         IEEE 802.11ax (20MHz, MCS11, 99pc duty cycle)         WLAN         8.57         ± 9.6           10695         AAA         IEEE 802.11ax (40MHz, MCS0, 90pc duty cycle)         WLAN         8.78         ± 9.6           10696         AAA         IEEE 802.11ax (40MHz, MCS1, 90pc duty cycle)         WLAN         8.91         ± 9.6           10697         AAA         IEEE 802.11ax (40MHz, MCS2, 90pc duty cycle)         WLAN         8.61         ± 9.6           10698         AAA         IEEE 802.11ax (40MHz, MCS3, 90pc duty cycle)         WLAN         8.89         ± 9.6           10700         AAA         IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)         WLAN         8.82         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.76         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.82         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.66         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)	<u>}</u>	*****	IEEE 802.11ax (20MHz, MCS9, 99pc duty cycle)			± 9.6 %
10695         AAA         IEEE 802.11ax (40MHz, MCS0, 90pc duty cycle)         WLAN         8.78         ± 9.6           10696         AAA         IEEE 802.11ax (40MHz, MCS1, 90pc duty cycle)         WLAN         8.91         ± 9.6           10697         AAA         IEEE 802.11ax (40MHz, MCS2, 90pc duty cycle)         WLAN         8.61         ± 9.6           10698         AAA         IEEE 802.11ax (40MHz, MCS3, 90pc duty cycle)         WLAN         8.89         ± 9.6           10700         AAA         IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.86         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.70         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.82         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.66         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS1, 90pc duty cycle)         <			IEEE 802.11ax (20MHz, MCS10, 99pc duty cycle)			± 9.6 %
10696         AAA         IEEE 802.11ax (40MHz, MCS1, 90pc duty cycle)         WLAN         8.91         ± 9.6           10697         AAA         IEEE 802.11ax (40MHz, MCS2, 90pc duty cycle)         WLAN         8.61         ± 9.6           10698         AAA         IEEE 802.11ax (40MHz, MCS3, 90pc duty cycle)         WLAN         8.89         ± 9.6           10699         AAA         IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)         WLAN         8.73         ± 9.6           10700         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.86         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.70         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.86         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.56         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.66         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)		·				± 9.6 %
10697         AAA         IEEE 802.11ax (40MHz, MCS2, 90pc duty cycle)         WLAN         8.61         ± 9.6           10698         AAA         IEEE 802.11ax (40MHz, MCS3, 90pc duty cycle)         WLAN         8.89         ± 9.6           10699         AAA         IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)         WLAN         8.62         ± 9.6           10700         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.70         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.70         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.56         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.69         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)         WLAN         8.66         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)				····		± 9.6 %
10698         AAA         IEEE 802.11ax (40MHz, MCS3, 90pc duty cycle)         WLAN         8.89         ± 9.6           10699         AAA         IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)         WLAN         8.82         ± 9.6           10700         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.86         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.82         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.56         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.69         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS1, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.32         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.55         ± 9.6           10709         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)         <					···	± 9.6 %
10699         AAA         IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)         WLAN         8.82         ± 9.6           10700         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.86         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.70         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.62         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.69         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)         WLAN         8.32         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.32         ± 9.6           10708         AAA         IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)         WLAN         8.33         ± 9.6           10710         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)	***************************************				+	
10700         AAA         IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)         WLAN         8.73         ± 9.6           10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.86         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.70         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.82         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.66         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)         WLAN         8.32         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.55         ± 9.6           10708         AAA         IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)         WLAN         8.33         ± 9.6           10710         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)         WLAN         8.39         ± 9.6           10712         AAA         IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)						
10701         AAA         IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)         WLAN         8.86         ± 9.6           10702         AAA         IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)         WLAN         8.70         ± 9.6           10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.82         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.56         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)         WLAN         8.66         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.32         ± 9.6           10708         AAA         IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)         WLAN         8.55         ± 9.6           10710         AAA         IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)         WLAN         8.29         ± 9.6           10711         AAA         IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)         WLAN         8.39         ± 9.6           10712         AAA         IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)		-				
10702       AAA       IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)       WLAN       8.70       ± 9.6         10703       AAA       IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)       WLAN       8.82       ± 9.6         10704       AAA       IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)       WLAN       8.56       ± 9.6         10705       AAA       IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)       WLAN       8.69       ± 9.6         10706       AAA       IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)       WLAN       8.32       ± 9.6         10707       AAA       IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)       WLAN       8.32       ± 9.6         10708       AAA       IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)       WLAN       8.33       ± 9.6         10710       AAA       IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)       WLAN       8.29       ± 9.6         10711       AAA       IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)       WLAN       8.39       ± 9.6         10712       AAA       IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)       WLAN       8.67       ± 9.6         10713       AAA       IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)       WLAN       8.33       ± 9.6         10714       AAA						
10703         AAA         IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)         WLAN         8.82         ± 9.6           10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.56         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)         WLAN         8.66         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.32         ± 9.6           10708         AAA         IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)         WLAN         8.55         ± 9.6           10709         AAA         IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)         WLAN         8.33         ± 9.6           10710         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)         WLAN         8.39         ± 9.6           10711         AAA         IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)         WLAN         8.39         ± 9.6           10712         AAA         IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)         WLAN         8.67         ± 9.6           10713         AAA         IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)						± 9.6 %
10704         AAA         IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)         WLAN         8.56         ± 9.6           10705         AAA         IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)         WLAN         8.69         ± 9.6           10706         AAA         IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)         WLAN         8.66         ± 9.6           10707         AAA         IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)         WLAN         8.32         ± 9.6           10708         AAA         IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)         WLAN         8.55         ± 9.6           10709         AAA         IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)         WLAN         8.33         ± 9.6           10710         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)         WLAN         8.29         ± 9.6           10711         AAA         IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)         WLAN         8.39         ± 9.6           10712         AAA         IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)         WLAN         8.67         ± 9.6           10713         AAA         IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)         WLAN         8.33         ± 9.6           10714         AAA         IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)		AAA				± 9.6 %
10705       AAA       IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)       WLAN       8.69       ± 9.6         10706       AAA       IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)       WLAN       8.66       ± 9.6         10707       AAA       IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)       WLAN       8.32       ± 9.6         10708       AAA       IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)       WLAN       8.55       ± 9.6         10709       AAA       IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)       WLAN       8.29       ± 9.6         10710       AAA       IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)       WLAN       8.39       ± 9.6         10711       AAA       IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)       WLAN       8.67       ± 9.6         10712       AAA       IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)       WLAN       8.67       ± 9.6         10713       AAA       IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)       WLAN       8.33       ± 9.6         10714       AAA       IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)       WLAN       8.26       ± 9.6	10704	AAA				± 9.6 %
10706       AAA       IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)       WLAN       8.66       ± 9.6         10707       AAA       IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)       WLAN       8.32       ± 9.6         10708       AAA       IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)       WLAN       8.55       ± 9.6         10709       AAA       IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)       WLAN       8.29       ± 9.6         10710       AAA       IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)       WLAN       8.39       ± 9.6         10711       AAA       IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)       WLAN       8.67       ± 9.6         10712       AAA       IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)       WLAN       8.67       ± 9.6         10713       AAA       IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)       WLAN       8.33       ± 9.6         10714       AAA       IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)       WLAN       8.26       ± 9.6			IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)			±9.6%
10708       AAA       IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)       WLAN       8.55       ± 9.6         10709       AAA       IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)       WLAN       8.33       ± 9.6         10710       AAA       IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)       WLAN       8.29       ± 9.6         10711       AAA       IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)       WLAN       8.39       ± 9.6         10712       AAA       IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)       WLAN       8.67       ± 9.6         10713       AAA       IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)       WLAN       8.33       ± 9.6         10714       AAA       IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)       WLAN       8.33       ± 9.6		AAA		WLAN	8.66	± 9.6 %
10709         AAA         IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)         WLAN         8.33         ± 9.6           10710         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)         WLAN         8.29         ± 9.6           10711         AAA         IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)         WLAN         8.39         ± 9.6           10712         AAA         IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)         WLAN         8.67         ± 9.6           10713         AAA         IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)         WLAN         8.33         ± 9.6           10714         AAA         IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)         WLAN         8.26         ± 9.6					8.32	± 9.6 %
10710         AAA         IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)         WLAN         8.29         ± 9.6           10711         AAA         IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)         WLAN         8.39         ± 9.6           10712         AAA         IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)         WLAN         8.67         ± 9.6           10713         AAA         IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)         WLAN         8.33         ± 9.6           10714         AAA         IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)         WLAN         8.26         ± 9.6						± 9.6 %
10711       AAA       IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)       WLAN       8.39       ± 9.6         10712       AAA       IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)       WLAN       8.67       ± 9.6         10713       AAA       IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)       WLAN       8.33       ± 9.6         10714       AAA       IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)       WLAN       8.26       ± 9.6			IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)			± 9.6 %
10712         AAA         IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)         WLAN         8.67         ± 9.6           10713         AAA         IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)         WLAN         8.33         ± 9.6           10714         AAA         IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)         WLAN         8.26         ± 9.6						± 9.6 %
10713         AAA         IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)         WLAN         8.33         ± 9.6           10714         AAA         IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)         WLAN         8.26         ± 9.6						± 9.6 %
10714 AAA IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle) WLAN 8.26 ± 9.6			IEEE OUZ.TRAX (40MHz, MOSS, 99PC duty cycle)			± 9.6 %
						± 9.6 %
A CHAPAL A DODE A LICED DAY LIMITED DAY 120 MARKATANA PARAMA A TANDANA A TANDANA A TANDANA A TANDANA A TANDANA	10715	AAA	IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)	WLAN	8.45	± 9.6 % ± 9.6 %
						± 9.6 %
						± 9.6 %
			IEEE 802.11ax (40MHz, MCS11, 99pc duty cycle)			± 9.6 %
		1			***************************************	± 9.6 %
			IEEE 802.11ax (80MHz, MCS1, 90pc duty cycle)			± 9.6 %
					***************************************	± 9.6 %
10722 AAA IEEE 802.11ax (80MHz, MCS3, 90pc duty cycle) WLAN 8.55 ± 9.6			IEEE 802.11ax (80MHz, MCS3, 90pc duty cycle)		<del></del>	±9.6%
10723 AAA IEEE 802.11ax (80MHz, MCS4, 90pc duty cycle) WLAN 8.70 ± 9.6					8.70	± 9.6 %
						±9.6%
					1	± 9.6 %
					<b>•</b>	± 9.6 %
10727 AAA IEEE 802.11ax (80MHz, MCS8, 90pc duty cycle) WLAN 8.66 ± 9.6	10/2/	AAA	IEEE 802.11ax (80MHz, MCS8, 90pc duty cycle)	WLAN	8.66	± 9.6 %

40700		LEEE 000 44 av (00MHz, MCCO, 00ma dutu avala)	WLAN	8,65	± 9.6 %
10728 10729	AAA AAA	IEEE 802.11ax (80MHz, MCS9, 90pc duty cycle) IEEE 802.11ax (80MHz, MCS10, 90pc duty cycle)	WLAN	8.64	± 9.6 %
10729	AAA	IEEE 802.11ax (80MHz, MCS10, 90pc duty cycle)	WLAN	8.67	± 9.6 %
10730	AAA	IEEE 802.11ax (80MHz, MCS), 99pc duty cycle)	WLAN	8.42	± 9.6 %
10731	AAA	IEEE 802.11ax (80MHz, MCS1, 99pc duty cycle)	WLAN	8.46	± 9.6 %
10732	AAA	IEEE 802.11ax (80MHz, MCS2, 99pc duty cycle)	WLAN	8.40	± 9.6 %
10734	AAA	IEEE 802.11ax (80MHz, MCS3, 99pc duty cycle)	WLAN	8.25	± 9.6 %
10735	AAA	IEEE 802.11ax (80MHz, MCS4, 99pc duty cycle)	WLAN	8.33	± 9.6 %
10736	AAA	IEEE 802.11ax (80MHz, MCS4, 39pc duty cycle)	WLAN	8.27	± 9.6 %
10737	AAA	IEEE 802.11ax (80MHz, MCS6, 99pc duty cycle)	WLAN	8.36	± 9.6 %
10737	AAA	IEEE 802.11ax (80MHz, MCS7, 99pc duty cycle)	WLAN	8,42	± 9.6 %
10736	AAA	IEEE 802.11ax (80MHz, MCS8, 99pc duty cycle)	WLAN	8.29	± 9.6 %
10739	AAA	IEEE 802.11ax (80MHz, MCS9, 99pc duty cycle)	WLAN	8.48	± 9.6 %
10741	AAA	IEEE 802.11ax (80MHz, MCS10, 99pc duty cycle)	WLAN	8.40	± 9.6 %
10741	AAA	IEEE 802.11ax (80MHz, MCS11, 99pc duty cycle)	WLAN	8.43	± 9.6 %
10742	AAA	IEEE 802.11ax (80MHz, MCS11, 99pc duty cycle)	WLAN	8.94	± 9.6 %
		IEEE 802.11ax (160MHz, MCS0, 90pc duty cycle)	WLAN	9.16	± 9.6 %
10744	AAA		WLAN	8.93	± 9.6 %
10745	AAA	IEEE 802.11ax (160MHz, MCS2, 90pc duty cycle)	WLAN	9.11	± 9.6 %
10746	AAA	IEEE 802.11ax (160MHz, MCS3, 90pc duty cycle)	WLAN	9.04	± 9.6 %
10747	AAA	IEEE 802.11ax (160MHz, MCS4, 90pc duty cycle)	WLAN	8.93	± 9.6 %
10748	AAA	IEEE 802.11ax (160MHz, MCS5, 90pc duty cycle)	WLAN	8.90	± 9.6 %
10749	AAA	IEEE 802.11ax (160MHz, MCS6, 90pc duty cycle)	WLAN		± 9.6 %
10750	AAA	IEEE 802.11ax (160MHz, MCS7, 90pc duty cycle)	WLAN	8.79 8.82	± 9.6 %
10751	AAA	IEEE 802.11ax (160MHz, MCS8, 90pc duty cycle)	WLAN	8.81	± 9.6 %
10752	AAA	IEEE 802.11ax (160MHz, MCS9, 90pc duty cycle)			± 9.6 %
10753	AAA	IEEE 802.11ax (160MHz, MCS10, 90pc duty cycle)	WLAN	9.00	
10754	AAA	IEEE 802.11ax (160MHz, MCS11, 90pc duty cycle)	WLAN	8.94	± 9.6 %
10755	AAA	IEEE 802.11ax (160MHz, MCS0, 99pc duty cycle)	WLAN	8.64	± 9.6 %
10756	AAA	IEEE 802.11ax (160MHz, MCS1, 99pc duty cycle)	WLAN	8.77	± 9.6 %
10757	AAA	IEEE 802.11ax (160MHz, MCS2, 99pc duty cycle)	WLAN	8.77	± 9.6 %
10758	AAA	IEEE 802.11ax (160MHz, MCS3, 99pc duty cycle)	WLAN	8.69	± 9.6 %
10759	AAA	IEEE 802.11ax (160MHz, MCS4, 99pc duty cycle)	WLAN	8.58	± 9.6 %
10760	AAA	IEEE 802.11ax (160MHz, MCS5, 99pc duty cycle)	WLAN	8.49	± 9.6 %
10761	AAA	IEEE 802.11ax (160MHz, MCS6, 99pc duty cycle)	WLAN	8.58	± 9.6 %
10762	AAA	IEEE 802.11ax (160MHz, MCS7, 99pc duty cycle)	WLAN	8,49	± 9.6 %
10763	AAA	IEEE 802.11ax (160MHz, MCS8, 99pc duty cycle)	WLAN	8.53	± 9.6 %
10764	AAA	IEEE 802.11ax (160MHz, MCS9, 99pc duty cycle)	WLAN	8.54	± 9.6 %
10765	AAA	IEEE 802.11ax (160MHz, MCS10, 99pc duty cycle)	WLAN	8.54	± 9.6 %
10766	AAA	IEEE 802,11ax (160MHz, MCS11, 99pc duty cycle)	WLAN	8.51	±9.6 %
10767	AAA	5G NR (CP-OFDM, 1 RB, 5 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	7.99	± 9.6 %
40700	1000	5G NR (CP-OFDM, 1 RB, 10 MHz, QPSK, 15 kHz)	5G NR FR1	8.01	± 9.6 %
10768	AAA	1 3G NR (CP-OFDINI, 1 RB, 10 MITZ, QF3N, 13 KTZ)	TDD	0.01	2 0.0 70
40700	ΛΛΛ	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)	5G NR FR1	8.01	± 9.6 %
10769	AAA	1 00 NA (OF-OFDIN, 1 AD, 10 MITZ, QFOA, 10 KITZ)	TDD	3.01	_ 5.5 /3
40770	AAA	5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)	5G NR FR1	8.02	± 9.6 %
10770	AAA	OU NA (OF OFDIN, 1 AD, 20 MINZ, QFOR, 10 KIZ)	TDD	0.02	- 0.0 /0
10774		5G NR (CP-OFDM, 1 RB, 25 MHz, QPSK, 15 kHz)	5G NR FR1	8.02	± 9.6 %
10771	AAA	100 14K (UF-UFDINI, 1 KD, 20 MITZ, QFOK, 10 KTZ)	TDD	0.02	= 0.0 /0
40770	A A A	5G NR (CP-OFDM, 1 RB, 30 MHz, QPSK, 15 kHz)	5G NR FR1	8.23	± 9.6 %
10772	AAA	ן של את (טד-טרטאו, דמם, של אותב, עדשת, וש אתב)	TDD	0.20	20.070
40770		5G NR (CP-OFDM, 1 RB, 40 MHz, QPSK, 15 kHz)	5G NR FR1	8.03	± 9.6 %
10773	AAA	ואר (טרייטרטואו, ד אם, 4ט ואוחב, ערפא, ופ גחב)	TDD	3.00	_ 0.0 /0
40774	1000	FO ND (OD OCDM 4 DB FO MULT ODDY 45 kHz)	5G NR FR1	8.02	± 9.6 %
10774	AAA	5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 15 kHz)	TDD	0.02	20.070
40770		FO ND (OD OFDM 50% DD 40 MU- ODOK 45 kU-)	5G NR FR1	8.30	± 9.6 %
10776	AAA	5G NR (CP-OFDM, 50% RB, 10 MHz, QPSK, 15 kHz)	TDD	0.00	
40770	0.4.4	FO ND (CD OCDM FOR DD 20 MUL ODOX 45 kU-)	5G NR FR1	8.34	± 9.6 %
10778	AAA	5G NR (CP-OFDM, 50% RB, 20 MHz, QPSK, 15 kHz)	TDD	0,04	20.070
40700		FO ND (OD OFDM FOR DD GO MIL ODOK 45 H E-)	5G NR FR1	8.38	± 9.6 %
10780	AAA	5G NR (CP-OFDM, 50% RB, 30 MHz, QPSK, 15 kHz)	1	0.30	2 3.0 /0
1055		SO NO COD OFDIA FOR DR. 40 MILE ODOIC 45 LILEY	TDD 5C ND ED1	8.38	± 9.6 %
10781	AAA	5G NR (CP-OFDM, 50% RB, 40 MHz, QPSK, 15 kHz)	5G NR FR1	0.30	± 5.0 %
		FO MD (OD OFDM FOX) OD FO MULE ODOY AF INLEY	TDD 5C ND EB1	8.43	± 9.6 %
10782	AAA	5G NR (CP-OFDM, 50% RB, 50 MHz, QPSK, 15 kHz)	5G NR FR1	0.43	2 9.0 %
		•	1 11111	1	

10783	AAA	5G NR (CP-OFDM, 100% RB, 5 MHz, QPSK, 15 kHz)	5G NR FR1	8.31	± 9.6 %
10784	AAA	5G NR (CP-OFDM, 100% RB, 10 MHz, QPSK, 15 kHz)	TDD 5G NR FR1	8.29	1060
10785	AAA	,	TDD		± 9.6 %
		5G NR (CP-OFDM, 100% RB, 15 MHz, QPSK, 15 kHz)	5G NR FR1	8,40	± 9.6 %
10786	AAA	5G NR (CP-OFDM, 100% RB, 20 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.35	± 9.6 %
10787	AAA	5G NR (CP-OFDM, 100% RB, 25 MHz, QPSK, 15 kHz)	5G NR FR1	8.44	± 9.6 %
10788	AAA	5G NR (CP-OFDM, 100% RB, 30 MHz, QPSK, 15 kHz)	5G NR FR1	8.39	± 9.6 %
10789	AAA	5G NR (CP-OFDM, 100% RB, 40 MHz, QPSK, 15 kHz)	5G NR FR1	8.37	± 9.6 %
10790	AAA	5G NR (CP-OFDM, 100% RB, 50 MHz, QPSK, 15 kHz)	5G NR FR1	8.39	± 9.6 %
10791	AAA	5G NR (CP-OFDM, 1 RB, 5 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	7.83	± 9.6 %
10792	AAA	5G NR (CP-OFDM, 1 RB, 10 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	7.92	± 9.6 %
10793	AAA	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	7.95	± 9.6 %
10794	AAA	5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	7.82	± 9.6 %
10795	AAA	5G NR (CP-OFDM, 1 RB, 25 MHz, QPSK, 30 kHz)	TDD		
			5G NR FR1 TDD	7.84	± 9.6 %
10796	AAA	5G NR (CP-OFDM, 1 RB, 30 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7.82	± 9.6 %
10797	AAA	5G NR (CP-OFDM, 1 RB, 40 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.01	± 9.6 %
10798	AAA	5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7.89	± 9.6 %
10799	AAA	5G NR (CP-OFDM, 1 RB, 60 MHz, QPSK, 30 kHz)	5G NR FR1	7.93	± 9.6 %
10801	AAA	5G NR (CP-OFDM, 1 RB, 80 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7.89	± 9.6 %
10802	AAA	5G NR (CP-OFDM, 1 RB, 90 MHz, QPSK, 30 kHz)	5G NR FR1	7.87	± 9.6 %
10803	AAA	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	7.93	± 9.6 %
10805	AAA	5G NR (CP-OFDM, 50% RB, 10 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.34	± 9.6 %
10806	AAA	5G NR (CP-OFDM, 50% RB, 15 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.37	± 9.6 %
10809	AAA	5G NR (CP-OFDM, 50% RB, 30 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.34	± 9.6 %
10810	AAA	5G NR (CP-OFDM, 50% RB, 40 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.34	± 9.6 %
10812	AAA	5G NR (CP-OFDM, 50% RB, 60 MHz, QPSK, 30 kHz)	TDD		
			5G NR FR1 TDD	8.35	±9.6%
10817	AAA	5G NR (CP-OFDM, 100% RB, 5 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.35	± 9.6 %
10818	AAA	5G NR (CP-OFDM, 100% RB, 10 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.34	± 9.6 %
10819	AAA	5G NR (CP-OFDM, 100% RB, 15 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.33	± 9.6 %
10820	AAA	5G NR (CP-OFDM, 100% RB, 20 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.30	± 9.6 %
10821	AAA	5G NR (CP-OFDM, 100% RB, 25 MHz, QPSK, 30 kHz)	5G NR FR1	8.41	± 9.6 %
10822	AAA	5G NR (CP-OFDM, 100% RB, 30 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.41	± 9.6 %
10823	AAA	5G NR (CP-OFDM, 100% RB, 40 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.36	± 9.6 %
10824	AAA	5G NR (CP-OFDM, 100% RB, 50 MHz, QPSK, 30 kHz)	TDD 5G NR FR1	8.39	±9.6%
			TDD	- +	

10825	AAA	5G NR (CP-OFDM, 100% RB, 60 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10827	AAA	5G NR (CP-OFDM, 100% RB, 80 MHz, QPSK, 30 kHz)	5G NR FR1	8.42	± 9.6 %
10828	AAA	5G NR (CP-OFDM, 100% RB, 90 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.43	± 9.6 %
10829	AAA	5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.40	± 9.6 %
10830	AAA	5G NR (CP-OFDM, 1 RB, 10 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.63	± 9.6 %
10831	AAA	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.73	± 9.6 %
10832	AAA	5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.74	± 9.6 %
10833	AAA	5G NR (CP-OFDM, 1 RB, 25 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.70	± 9.6 %
10834	AAA	5G NR (CP-OFDM, 1 RB, 30 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.75	±9.6 %
10835	AAA	5G NR (CP-OFDM, 1 RB, 40 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.70	± 9.6 %
10836	AAA	5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.66	± 9.6 %
10837	AAA	5G NR (CP-OFDM, 1 RB, 60 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.68	± 9.6 %
10839	AAA	5G NR (CP-OFDM, 1 RB, 80 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.70	± 9.6 %
10840	AAA	5G NR (CP-OFDM, 1 RB, 90 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.67	± 9.6 %
10841	AAA	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.71	±9.6%
10843	AAA	5G NR (CP-OFDM, 50% RB, 15 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.49	± 9.6 %
10844	AAA	5G NR (CP-OFDM, 50% RB, 20 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.34	± 9.6 %
10846	AAA	5G NR (CP-OFDM, 50% RB, 30 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10854	AAA	5G NR (CP-OFDM, 100% RB, 10 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.34	± 9.6 %
10855	AAA	5G NR (CP-OFDM, 100% RB, 15 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.36	± 9.6 %
10856	AAA	5G NR (CP-OFDM, 100% RB, 20 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.37	± 9.6 %
10857	AAA	5G NR (CP-OFDM, 100% RB, 25 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.35	± 9.6 %
10858	AAA	5G NR (CP-OFDM, 100% RB, 30 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.36	± 9.6 %
10859	AAA	5G NR (CP-OFDM, 100% RB, 40 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.34	± 9.6 %
10860	AAA	5G NR (CP-OFDM, 100% RB, 50 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10861	AAA	5G NR (CP-OFDM, 100% RB, 60 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.40	± 9.6 %
10863	AAA	5G NR (CP-OFDM, 100% RB, 80 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10864	AAA	5G NR (CP-OFDM, 100% RB, 90 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.37	± 9.6 %
10865	AAA	5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10866	AAA	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.68	± 9.6 %
10868	AAA	5G NR (DFT-s-OFDM, 100% RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5,89	± 9.6 %
10869	AAA	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 120 kHz)	5G NR FR2 TDD	5.75	± 9.6 %
10870	AAA	5G NR (DFT-s-OFDM, 100% RB, 100 MHz, QPSK, 120 kHz)	5G NR FR2 TDD	5.86	± 9.6 %

10871	AAA	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, 16QAM, 120 kHz)	5G NR FR2	5.75	± 9.6 %
10872	AAA	5G NR (DFT-s-OFDM, 100% RB, 100 MHz, 16QAM, 120 kHz)	5G NR FR2 TDD	6.52	± 9.6 %
10873	AAA	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	6.61	± 9.6 %
10874	AAA	5G NR (DFT-s-OFDM, 100% RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	6.65	± 9.6 %
10875	AAA	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 120 kHz)	5G NR FR2 TDD	7.78	± 9.6 %
10876	AAA	5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 120 kHz)	5G NR FR2	8.39	± 9.6 %
10877	AAA	5G NR (CP-OFDM, 1 RB, 100 MHz, 16QAM, 120 kHz)	5G NR FR2 TDD	7.95	± 9.6 %
10878	AAA	5G NR (CP-OFDM, 100% RB, 100 MHz, 16QAM, 120 kHz)	5G NR FR2	8.41	± 9.6 %
10879	AAA	5G NR (CP-OFDM, 1 RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	8.12	± 9.6 %
10880	AAA	5G NR (CP-OFDM, 100% RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	8.38	± 9.6 %
10881	AAA	5G NR (DFT-s-OFDM, 1 RB, 50 MHz, QPSK, 120 kHz)	5G NR FR2	5.75	± 9.6 %
10882	AAA	5G NR (DFT-s-OFDM, 100% RB, 50 MHz, QPSK, 120 kHz)	5G NR FR2 TDD	5.96	± 9.6 %
10883	AAA	5G NR (DFT-s-OFDM, 1 RB, 50 MHz, 16QAM, 120 kHz)	5G NR FR2	6.57	± 9.6 %
10884	AAA	5G NR (DFT-s-OFDM, 100% RB, 50 MHz, 16QAM, 120 kHz)	5G NR FR2	6.53	± 9.6 %
10885	AAA	5G NR (DFT-s-OFDM, 1 RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2	6.61	± 9.6 %
10886	AAA	5G NR (DFT-s-OFDM, 100% RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2	6.65	± 9.6 %
10887	AAA	5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 120 kHz)	5G NR FR2	7.78	± 9.6 %
10888	AAA	5G NR (CP-OFDM, 100% RB, 50 MHz, QPSK, 120 kHz)	5G NR FR2	8.35	± 9.6 %
10889	AAA	5G NR (CP-OFDM, 1 RB, 50 MHz, 16QAM, 120 kHz)	5G NR FR2	8.02	± 9.6 %
10890	AAA	5G NR (CP-OFDM, 100% RB, 50 MHz, 16QAM, 120 kHz)	5G NR FR2	8.40	± 9.6 %
10891	AAA	5G NR (CP-OFDM, 1 RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2	8.13	± 9.6 %
10892	AAA	5G NR (CP-OFDM, 100% RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2	8.41	± 9.6 %

<sup>&</sup>lt;sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

# Calibration Laboratory of

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland





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Client

**PC Test** 

Accreditation No.: SCS 0108

Certificate No: EX3-7417\_Feb19

C

## **CALIBRATION CERTIFICATE**

Object

EX3DV4 - SN:7417

Calibration procedure(s)

QA CAL-D1 (9) QA CAL-25 VS, QA CAL-25 V7 Calibration procedure for dosimetric E-field probes

12-96-20

Calibration date:

February 19, 2019

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: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
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 E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

Name Function Signature
Calibrated by: Claudio Leubler Laboratory Technician

Approved by: Katja Pokovic Technical Manager

Issued: February 20, 2019

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

#### **Calibration Laboratory of**

Schmid & Partner
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Zeughausstrasse 43, 8004 Zurich, Switzerland





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Swiss Calibration Service

Accreditation No.: SCS 0108

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Glossary:

TSL NORMx,y,z tissue simulating liquid sensitivity in free space

ConvF DCP sensitivity in TSL / NORMx,y,z diode compression point

CF A, B, C, D crest factor (1/duty\_cycle) of the RF signal modulation dependent linearization parameters

Polarization φ

φ rotation around probe axis

Polarization 9

9 rotation around an axis that is in the plane normal to probe axis (at measurement center),

i.e., 9 = 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:

- a) 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
- b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from handheld and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization θ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep 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
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom
  exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

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## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7417

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m) <sup>2</sup> ) <sup>A</sup>	0.54	0.43	0.53	± 10.1 %
DCP (mV) <sup>8</sup>	98.7	97.4	100.4	

**Calibration Results for Modulation Response** 

UID	Communication System Name		A dB	B dBõV	С	D dB	VR mV	Max dev.	Max Unc <sup>E</sup> (k=2)
0	CW	X	0.00	0.00	1,00	0.00	144.6	± 3.3 %	± 4.7 %
		Y	0.00	0.00	1.00		149.7		
		Z	0.00	0.00	1.00		143.1		
10352-	Pulse Waveform (200Hz, 10%)	X	15.00	88.38	19.65	10.00	60.0	± 3.3 %	± 9.6 %
AAA		Y	4.33	71.38	13.30		60.0		
		Z	7.40	77.44	14.95		60.0		
10353-	Pulse Waveform (200Hz, 20%)	X	15.00	92.19	20.43	6.99	80.0	± 2.2 %	± 9.6 %
AAA		Y	5.53	76.01	13.64		80.0		ļ
		Z	15.00	85.74	16.43	]	80.0		
10354-	Pulse Waveform (200Hz, 40%)	Х	15.00	107.68	26.54	3.98	95.0	± 1.3 %	± 9.6 %
AAA		Y	9.05	79.53	12.66		95.0		
	***	Z	15.00	90.71	17.41		95.0		
10355-	Pulse Waveform (200Hz, 60%)	Х	15.00	127.17	33.83	2.22	120.0	± 1.2 %	± 9.6 %
AAA		Y	0.26	60.00	4.45	]	120.0		
		Z	15.00	99.84	20.30		120.0		
10387-	QPSK Waveform, 1 MHz	X	0.56	60.62	7.74	0.00	150.0	± 3.6 %	± 9.6 %
AAA		Y	0.42	60.00	4.69		150.0		
		Z	0.44	60.00	5.48		150.0		
10388-	QPSK Waveform, 10 MHz	X	2.27	69.09	16.46	0.00	150.0	± 1.3 %	± 9.6 %
AAA		Υ	1.94	67.43	15.43		150.0		
		Z	2.06	68.27	16.05		150.0	]	
10396-	64-QAM Waveform, 100 kl-lz	X	3.15	72.71	19.95	3.01	150.0	± 2.5 %	± 9.6 %
AAA		Υ	2.04	67.08	18.19	]	150.0		
		Z	2.07	66.03	16.88		150.0		
10399-	64-QAM Waveform, 40 MHz	Х	3.52	67.53	16.10	0.00	150.0	± 2.4 %	± 9.6 %
AAA		Υ	3.32	66.83	15.68		150.0		
		Z	3.38	67.15	15.89		150.0		
10414-	WLAN CCDF, 64-QAM, 40MHz	X	4.80	65.90	15.74	0.00	150.0	± 4.4 %	± 9.6 %
AAA		Y	4.58	65.58	15.59		150.0		
	1	Z	4.60	65.76	15.65		150.0	]	

Note: For details on UID parameters see Appendix

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%.

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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.

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# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7417

**Sensor Model Parameters** 

	C1 fF	C2 fF	α V⁻¹	T1 ms.V <sup>-2</sup>	T2 ms.V <sup>-1</sup>	T3 ms	T4 V <sup>-2</sup>	T5 V⁻¹	Т6
X	37.6	279.10	35.33	9.45	0.00	5.09	1.69	0.14	1.01
Υ	29.6	227.60	37.50	5.19	0.43	5.04	0.00	0.16	1.01
Z	28.8	214.34	35.37	6.91	0.00	5.04	0.00	0.24	1.00

#### **Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	120.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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# DASY/EASY - Parameters of Probe: EX3DV4 - SN:7417

#### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) F	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
750	41.9	0.89	10.36	10.36	10.36	0.54	0.99	± 12.0 %
835	41.5	0.90	10.07	10.07	10.07	0.48	0.84	± 12.0 %
1750	40.1	1.37	8.39	8.39	8.39	0.38	0.85	± 12.0 %
1900	40.0	1.40	8.11	8.11	8.11	0.39	0.84	± 12.0 %
2300	39.5	1.67	7.73	7.73	7.73	0.30	0.93	± 12.0 %
2450	39.2	1.80	7.46	7.46	7.46	0.39	0.95	± 12.0 %
2600	39.0	1.96	7.17	7.17	7.17	0.31	1.05	± 12.0 %

<sup>&</sup>lt;sup>c</sup> 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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 released 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.

Galpha/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.

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## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7417

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) F	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
750	55.5	0.96	10.35	10.35	10.35	0.63	0.84	± 12.0 %
835	55.2	0.97	10.11	10.11	10.11	0.43	0.84	± 12.0 %
1750	53.4	1.49	8,21	8.21	8.21	0.43	0.88	± 12.0 %
1900	53.3	1.52	7.86	7.86	7.86	0.43	0.87	± 12.0 %
2300	52.9	1.81	7.64	7.64	7.64	0.41	0.93	± 12.0 %
2450	52.7	1.95	7.51	7.51	7.51	0.40	0.95	± 12.0 %
2600	52.5	2.16	7.37	7.37	7.37	0.33	1.05	± 12.0 %

<sup>&</sup>lt;sup>c</sup> 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

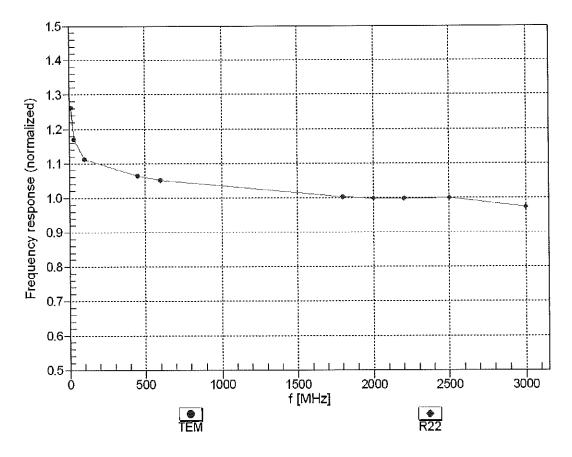
F At frequencies below 3 GHz the validity of these pages of the convF assessed at 1 and 1

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.

<sup>&</sup>lt;sup>G</sup> 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.

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# Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



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

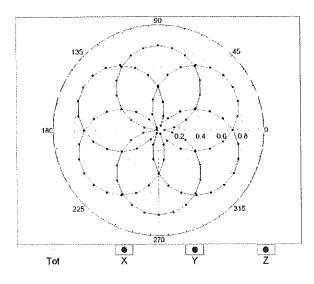
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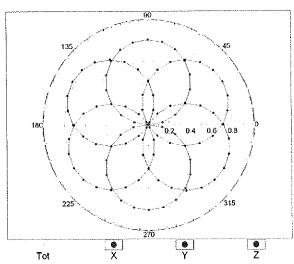
# Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$

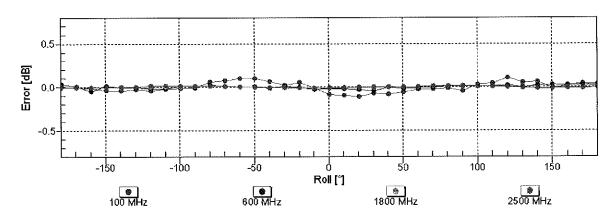


1Hz.TEM

f=1800 MHz,R22

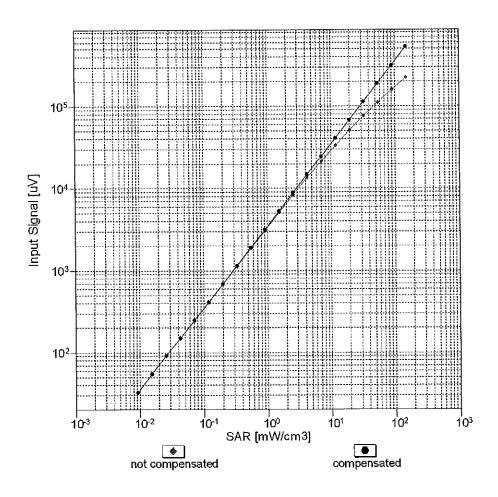


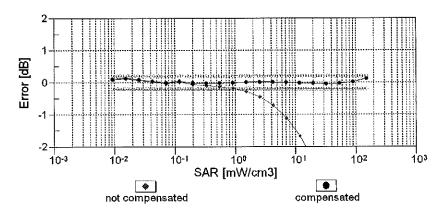




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

## Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f<sub>eval</sub>= 1900 MHz)

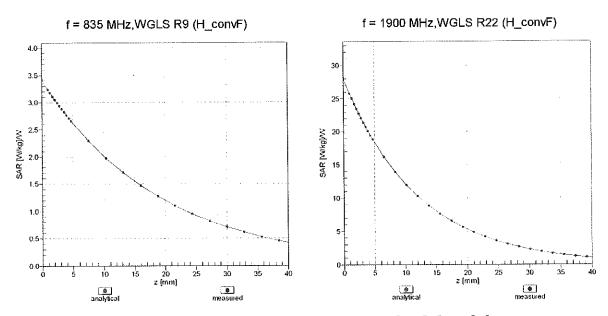




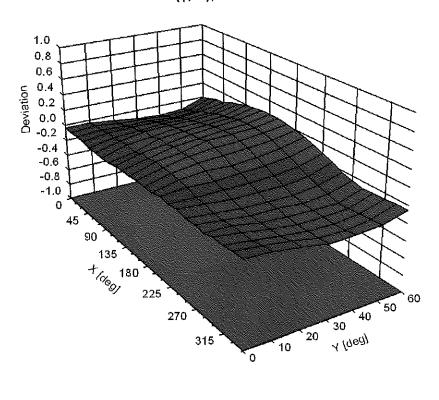
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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## **Conversion Factor Assessment**



Deviation from Isotropy in Liquid Error ( $\phi$ ,  $\vartheta$ ), f = 900 MHz



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# **Appendix: Modulation Calibration Parameters**

DIU	Rev	Communication System Name	Group	PAR	Unc⁵
0		CM		(dB)	(k=2)
10010	- CAA	CW CAR Velidation (Company)	CW	0.00	± 4.7 %
10010	CAA	SAR Validation (Square, 100ms, 10ms)	Test	10.00	± 9.6 %
10011	CAB	UMTS-FDD (WCDMA) IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	WCDMA	2.91	± 9.6 %
10012	CAB		WLAN	1.87	±9.6%
10013	DAC	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	WLAN	9.46	±9.6%
10021	DAC	GSM-FDD (TDMA, GMSK)	GSM	9.39	±9.6%
10023	DAC	GPRS-FDD (TDMA, GMSK, TN 0) GPRS-FDD (TDMA, GMSK, TN 0-1)	GSM	9.57	±9.6 %
10024	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	GSM	6.56	± 9.6 %
10026	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	GSM	12.62	± 9.6 %
10027	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	GSM GSM	9.55	± 9.6 %
10028	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	GSM	4.80	± 9.6 %
10029	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	GSM	3.55	± 9.6 %
10030	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	Bluetooth	7.78	± 9.6 %
10031	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	Bluetooth	5.30 1.87	± 9.6 % ± 9.6 %
10032	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	Bluetooth	1.16	
10033	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	Bluetooth	7.74	± 9.6 % ± 9.6 %
10034	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	Bluetooth	4.53	
10035	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	Bluetooth	3,83	± 9.6 % ± 9.6 %
10036	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	Bluetooth	8.01	±9.6%
10037	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	Bluetooth	4.77	± 9.6 %
10038	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	Bluetooth	4.10	± 9.6 %
10039	CAB	CDMA2000 (1xRTT, RC1)	CDMA2000	4.57	± 9.6 %
10042	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	AMPS	7.78	± 9.6 %
10044	CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	AMPS	0.00	± 9.6 %
10048	CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	DECT	13.80	± 9.6 %
10049	CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	DECT	10.79	± 9.6 %
10056	CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	TD-SCDMA	11.01	± 9.6 %
10058	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	GSM	6.52	± 9.6 %
10059	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	WLAN	2.12	± 9.6 %
10060	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	WLAN	2.83	± 9.6 %
10061	ÇAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	WLAN	3.60	± 9.6 %
10062	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	WLAN	8.68	±9.6 %
10063	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	WLAN	8.63	± 9.6 %
10064	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	WLAN	9.09	±9.6 %
10065	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	WLAN	9.00	±9.6%
10066	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	WLAN	9.38	± 9.6 %
10067	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	WLAN	10.12	±9.6 %
10068	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	WLAN	10.24	± 9.6 %
10069	CAC	IEEE 802.11a/h WiFl 5 GHz (OFDM, 54 Mbps)	WLAN	10.56	±9.6%
10071	CAB	IEEE 802.11g WiFl 2.4 GHz (DSSS/OFDM, 9 Mbps)	WLAN	9.83	±9.6%
10072	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	WLAN	9.62	±9.6%
10073	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	WLAN	9.94	± 9.6 %
10074	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	WLAN	10.30	± 9.6 %
10075	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	WLAN	10.77	± 9.6 %
10076	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	WLAN	10.94	± 9.6 %
10077	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	WLAN	11.00	±9.6%
10081	CAB	CDMA2000 (1xRTT, RC3)	CDMA2000	3.97	±9.6%
10082	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	AMPS	4.77	±9.6 %
10090	DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	GSM	6.56	±9.6%
10097	CAB	UMTS-FDD (HSDPA)	WCDMA	3.98	±9.6 %
10098	CAB	UMTS-FDD (HSUPA, Subtest 2)	WCDMA	3.98	±9.6 %
10099	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	GSM	9.55	±9.6 %
10100	CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	LTE-FDD	5.67	± 9.6 %
10101	CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	LTE-FDD	6.42	±9.6 %
10102	CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	LTE-FDD	6.60	± 9.6 %
10103	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	LTE-TDD	9.29	±9.6 %
10104	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	LTE-TDD	9.97	± 9.6 %
10105	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	LTE-TDD	10.01	± 9.6 %
10108	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	LTE-FDD	5.80	± 9.6 %

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10109   CAG   LIE-FID (SC-FDMA, 100% NS, 10 MPZ, 10-DAM)			175 FD 700 FD144 4000/ FD 40.441 40.0440	LTE EDD	0.40	+060/
10111	10109	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	LTE-FDD	6.43	±9.6%
10112				***************************************		
10113						
101141 CAC   EEE 802.11n (I-T Greenfield, 13 SMpps, BPSK)   WLAN   8.10   ±9.6 %   10116   CAC   EEE 802.11n (I-T Greenfield, 13 Mbps, 64-CAM)   WLAN   8.45   ±9.6 %   10117   CAC   EEE 802.11n (I-T Greenfield, 13 Mbps, 64-CAM)   WLAN   8.15   ±9.6 %   10117   CAC   EEE 802.11n (I-T Mored, 13 Mbps, 64-CAM)   WLAN   8.07   ±9.6 %   10118   CAC   EEE 802.11n (I-T Mored, 13 Mbps, 16-CAM)   WLAN   8.09   ±9.6 %   10119   CAC   EEE 802.11n (I-T Mored, 13 Mbps, 16-CAM)   WLAN   8.13   ±9.6 %   10119   CAC   EEE 802.11n (I-T Mored, 13 Mbps, 16-CAM)   WLAN   8.13   ±9.6 %   10119   CAC   EEE 802.11n (I-T Mored, 13 Mbps, 16-CAM)   WLAN   8.13   ±9.6 %   10119   CAC   EEE 802.11n (I-T Mored, 13 Mbps, 16-CAM)   WLAN   8.13   ±9.6 %   10119   CAC   EEE 802.11n (I-T Mored, 18 Mbps, 16-CAM)   WLAN   8.13   ±9.6 %   10119   CAC   EEE 802.11n (I-T Mored, 18 Mbps, 16-CAM)   WLAN   8.13   ±9.6 %   101141   CAE   T-EF-DD (SC-FDMA, 1009 K-B. 3 Mhtz, 16-CAM)   T-EF-DD   6.49   ±9.6 %   101141   CAE   T-EF-DD (SC-FDMA, 1009 K-B. 3 Mhtz, 16-CAM)   T-EF-DD   5.73   ±9.6 %   10144   CAE   T-EF-DD (SC-FDMA, 1009 K-B. 3 Mhtz, 64-CAM)   T-EF-DD   6.65   ±9.6 %   10144   CAE   T-EF-DD (SC-FDMA, 1009 K-B. 3 Mhtz, 64-CAM)   T-EF-DD   6.65   ±9.6 %   10146   CAF   T-EF-DD (SC-FDMA, 1009 K-B. 1 Mhtz, 16-CAM)   T-EF-DD   6.65   ±9.6 %   10147   CAF   T-EF-DD (SC-FDMA, 1009 K-B. 1 Mhtz, 16-CAM)   T-EF-DD   6.41   ±9.6 %   10147   CAF   T-EF-DD (SC-FDMA, 50% R-B. 2 Mhtz, 16-CAM)   T-EF-DD   6.42   ±9.6 %   10147   CAF   T-EF-DD (SC-FDMA, 50% R-B. 2 Mhtz, 16-CAM)   T-EF-DD   6.42   ±9.6 %   10147   CAF   T-EF-DD (SC-FDMA, 50% R-B, 2 Mhtz, 16-CAM)   T-EF-DD   6.42   ±9.6 %   10155   CAG   T-EF-DD (SC-FDMA, 50% R-B, 2 Mhtz, 16-CAM)   T-EF-DD   6.42   ±9.6 %   10155   CAG   T-EF-DD (SC-FDMA, 50% R-B, 2 Mhtz, 16-CAM)   T-EF-DD   6.42   ±9.6 %   10155   CAG   T-EF-DD (SC-FDMA, 50% R-B, 2 Mhtz, 16-CAM)   T-EF-DD   6.43   ±9.6 %   10155   CAG   T-EF-DD (SC-FDMA, 50% R-B, 5 Mhtz, 16-CAM)   T-EF-DD   6.50   ±9.6 %   10156   CAG   T-EF-DD (SC-FDMA, 50% R-						
10115   CAC   EEE 802.11n (HT Greenfielt, 81 Mbps, 16-OAM)						
10116   CAC   EEE 802.11n (HT Greenfielt, 136 Mbps, 84-CAM)						
10119						
10119   CAC   EEE 802.11n (HT Mixed, 21 Mibbs, 18-CAMb)						
10140   CAC   LTE-FDD (SC-FDMA, 100%, RB, 15 MHz, 18-QAM)						
10141   CAE						
10141   CAE   LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-CAM)						
10142   CAE   LTE-FDD   (SC-FDMA, 100% RB, 3 MHz, QPSK)   LTE-FDD   5.73   ± 9.6 %   10143   CAE   LTE-FDD   (SC-FDMA, 100% RB, 3 MHz, 46-CAMM)   LTE-FDD   6.55   ± 9.6 %   10144   CAE   LTE-FDD   (SC-FDMA, 100% RB, 3 MHz, 64-CAMM)   LTE-FDD   6.55   ± 9.6 %   10145   CAF   LTE-FDD   (SC-FDMA, 100% RB, 3 MHz, 64-CAMM)   LTE-FDD   6.56   ± 9.6 %   10146   CAF   LTE-FDD   (SC-FDMA, 100% RB, 1.4 MHz, 2 PSK)   LTE-FDD   6.57   ± 9.6 %   10140   CAF   LTE-FDD   (SC-FDMA, 100% RB, 1.4 MHz, 2 PSK)   LTE-FDD   6.72   ± 9.6 %   10140   CAF   LTE-FDD   (SC-FDMA, 100% RB, 1.4 MHz, 36-CAMM)   LTE-FDD   6.72   ± 9.6 %   10150   CAE   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 16-CAMM)   LTE-FDD   6.72   ± 9.6 %   10150   CAE   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 16-CAMM)   LTE-FDD   6.42   ± 9.6 %   10150   CAE   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 0.0 CMM)   LTE-FDD   6.60   ± 9.6 %   10151   CAG   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 0.0 CMM)   LTE-FDD   6.60   ± 9.6 %   10152   CAG   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 0.0 CMM)   LTE-FDD   9.28   ± 9.6 %   10153   CAG   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 16-CAMM)   LTE-TDD   9.28   ± 9.6 %   10154   CAG   LTE-FDD   (SC-FDMA, 500% RB, 2.0 MHz, 16-CAMM)   LTE-FDD   5.75   ± 9.6 %   10155   CAG   LTE-FDD   (SC-FDMA, 500% RB, 1.0 MHz, 0.0 CMM)   LTE-FDD   5.75   ± 9.6 %   10156   CAG   LTE-FDD   (SC-FDMA, 500% RB, 1.0 MHz, 0.0 CMM)   LTE-FDD   5.75   ± 9.6 %   10156   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 0.0 CMM)   LTE-FDD   5.75   ± 9.6 %   10157   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 0.0 CMM)   LTE-FDD   5.79   ± 9.6 %   10158   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 0.0 CMM)   LTE-FDD   5.64   ± 9.6 %   10158   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 0.0 CMM)   LTE-FDD   5.64   ± 9.6 %   10159   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 0.0 CMM)   LTE-FDD   5.62   ± 9.6 %   10159   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 0.0 CMMz, 0.0 CMM   LTE-FDD   5.72   ± 9.6 %   10159   CAG   LTE-FDD   (SC-FDMA, 500% RB, 5 MHz, 64-CAMM)   LTE-FDD   5.62   ± 9.						***************************************
10144   CAE						
10144   CAE	<u> </u>					
10146   CAF						
10146   CAF   LTE-FDD (SC-FDMA, 100% RB, 14 MHz, 16-QAM)   LTE-FDD   6.41   ±9.6 %   10147   CAF   LTE-FDD (SC-FDMA, 100% RB, 14 MHz, 16-QAM)   LTE-FDD   6.72   ±9.6 %   10149   CAE   LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)   LTE-FDD   6.42   ±9.6 %   10150   CAE   LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)   LTE-FDD   6.80   ±9.6 %   10150   CAE   LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 04-QAM)   LTE-FDD   9.28   ±9.6 %   10152   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 04-QAM)   LTE-TDD   9.28   ±9.6 %   10152   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 04-QAM)   LTE-TDD   9.28   ±9.6 %   10153   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 04-QAM)   LTE-TDD   9.28   ±9.6 %   10153   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 04-QAM)   LTE-TDD   9.95   ±9.6 %   10153   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 04-QAM)   LTE-TDD   5.75   ±9.6 %   10156   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)   LTE-FDD   6.43   ±9.6 %   10156   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)   LTE-FDD   6.43   ±9.6 %   10157   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)   LTE-FDD   6.43   ±9.6 %   10159   CAG   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.49   ±9.6 %   10159   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 04-QAM)   LTE-FDD   6.62   ±9.6 %   10159   CAG   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.62   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.65   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.56   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.58   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.58   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.58   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.58   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 04-QAM)   LTE-FDD   6.58   ±9.6 %   10160   CAE   LTE-FDD (SC-FDMA, 18R, 20 MHz, 04-QAM)   LTE-FDD   6.59   ±9.6 %   10160   CAE   LTE-FDD (SC-FDM	A	<del></del>				
10147   CAF   LTE-FDD (SC-FDMA, 100% RB, 14 MHz, 64-QAM)   LTE-FDD   6.72   ±9.6 %   10149   CAE   LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)   LTE-FDD   6.42   ±9.6 %   10151   CAG   LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)   LTE-FDD   6.60   ±9.6 %   10151   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)   LTE-FDD   9.28   ±9.6 %   10153   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)   LTE-FDD   9.92   ±9.6 %   10153   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)   LTE-TDD   9.92   ±9.6 %   10153   CAG   LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)   LTE-TDD   10.05   ±9.6 %   10154   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)   LTE-FDD   6.43   ±9.6 %   10156   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)   LTE-FDD   6.43   ±9.6 %   10156   CAG   LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)   LTE-FDD   6.43   ±9.6 %   10156   CAG   LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)   LTE-FDD   6.49   ±9.6 %   10158   CAG   LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)   LTE-FDD   6.49   ±9.6 %   10158   CAG   LTE-FDD (SC-FDMA, 50% RB, 5 MHz, GPSK)   LTE-FDD   6.49   ±9.6 %   10158   CAG   LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)   LTE-FDD   6.49   ±9.6 %   10159   CAG   LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)   LTE-FDD   6.56   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)   LTE-FDD   6.56   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)   LTE-FDD   6.56   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)   LTE-FDD   6.58   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, 64-QAM)   LTE-FDD   6.58   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, GPSK)   LTE-FDD   6.58   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, GPSK)   LTE-FDD   6.58   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, GPSK)   LTE-FDD   6.57   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 18, 20 MHz, 16-QAM)   LTE-FDD   6.59   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 18, 20 MHz, 16-QAM)   LTE-FDD   6.59   ±9.6 %   101610   CAE   LTE-FDD (SC-FDMA, 18, 20 MHz,						
10149   CAE						
10150   CAE   LTE-FDD   SC-FDMA, 50% RB, 20 MHz, G4-QAM)   LTE-FDD   9.28 ± 9.6 %   10151   CAG   LTE-TDD   SC-FDMA, 50% RB, 20 MHz, QPSK)   LTE-TDD   9.28 ± 9.6 %   10153   CAG   LTE-TDD   SC-FDMA, 50% RB, 20 MHz, G4-QAM)   LTE-TDD   9.28 ± 9.6 %   10153   CAG   LTE-TDD   SC-FDMA, 50% RB, 20 MHz, G4-QAM)   LTE-TDD   9.28 ± 9.6 %   10153   CAG   LTE-TDD   SC-FDMA, 50% RB, 20 MHz, G4-QAM)   LTE-FDD   SC-FDMA, 50% RB, 10 MHz, QPSK)   LTE-FDD   S.75 ± 9.6 %   10155   CAG   LTE-FDD   SC-FDMA, 50% RB, 10 MHz, QPSK)   LTE-FDD   S.75 ± 9.6 %   10156   CAG   LTE-FDD   SC-FDMA, 50% RB, 5MHz, QPSK)   LTE-FDD   SC-FDMA, 50% RB, 5MHz, SC-QSM)   LTE-FDD   SC-SDMA, 50% RB, 14 MHz, SC-QSM)   LTE-FDD   SC-SDMA, 1 RB, 20 MHz,						
10151						
10152						
10153						
10154	***************************************		LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)		<del></del>	
10155						
10156						
10157						
10158   CAG						
10159   CAG   LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)   LTE-FDD   6.56   £ 9.8 %   10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)   LTE-FDD   6.43   £ 9.6 %   10161   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)   LTE-FDD   6.43   £ 9.6 %   10162   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)   LTE-FDD   6.58   £ 9.6 %   10162   CAE   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, QPSK)   LTE-FDD   6.58   £ 9.6 %   10166   CAF   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, QPSK)   LTE-FDD   6.21   £ 9.6 %   10168   CAF   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, 6-QAM)   LTE-FDD   6.21   £ 9.6 %   10168   CAF   LTE-FDD (SC-FDMA, 50% RB, 14 MHz, 6-QAM)   LTE-FDD   6.79   £ 9.6 %   10169   CAE   LTE-FDD (SC-FDMA, 18, 20 MHz, 16-QAM)   LTE-FDD   6.79   £ 9.6 %   10170   CAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)   LTE-FDD   6.79   £ 9.6 %   10171   CAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)   LTE-FDD   6.79   £ 9.6 %   10172   CAG   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-FDD   6.52   £ 9.6 %   10172   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-FDD   6.49   £ 9.6 %   10172   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-FDD   6.49   £ 9.6 %   10173   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-TDD   9.48   £ 9.6 %   10173   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-TDD   9.48   £ 9.6 %   10175   CAG   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-TDD   9.48   £ 9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)   LTE-FDD   5.72   £ 9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)   LTE-FDD   5.72   £ 9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)   LTE-FDD   6.52   £ 9.6 %   10178   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)   LTE-FDD   6.50   £ 9.6 %   10182   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)   LTE-FDD   6.50   £ 9.6 %   10183   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)   LTE-FDD   6.50   £ 9.6 %   10184   CAE   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)   LTE-FDD   6.50   £ 9.6 %   10184   CAE   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-Q						
10160   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)						
10161   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)						
10162   CAE   LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)						
10166   CAF						
10167   CAF						
10168						
10169   CAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)   LTE-FDD   5.73   ±9.6 %   10170   CAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-FDD   6.52   ±9.6 %   10171   AAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-FDD   6.49   ±9.6 %   10172   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)   LTE-TDD   9.21   ±9.6 %   10173   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)   LTE-TDD   9.48   ±9.6 %   10174   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-TDD   9.48   ±9.6 %   10175   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-TDD   5.72   ±9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)   LTE-FDD   5.72   ±9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)   LTE-FDD   5.72   ±9.6 %   10177   CAI   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)   LTE-FDD   5.73   ±9.6 %   10178   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)   LTE-FDD   5.73   ±9.6 %   10179   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.52   ±9.6 %   10180   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.50   ±9.6 %   10180   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.50   ±9.6 %   10181   CAE   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, GPSK)   LTE-FDD   5.72   ±9.6 %   10182   CAE   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, GPSK)   LTE-FDD   5.72   ±9.6 %   10183   CAE   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, GPSK)   LTE-FDD   5.72   ±9.6 %   10184   CAE   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, GPSK)   LTE-FDD   5.73   ±9.6 %   10184   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GPSK)   LTE-FDD   6.50   ±9.6 %   10186   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GPSK)   LTE-FDD   6.50   ±9.6 %   10188   CAF   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GA-QAM)   LTE-FDD   6.51   ±9.6 %   10188   CAF   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GA-QAM)   LTE-FDD   6.51   ±9.6 %   10188   CAF   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GA-QAM)   LTE-FDD   6.50   ±9.6 %   10188   CAF   LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, GA-QAM)   LTE-FDD   6.50   ±9.6 %   10196   CAC   LEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)   WLAN   8.12   ±9.6 %   10196   CAC   LEEE 802.11n (HT						
10170   CAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)   LTE-FDD   6.52   ± 9.6 %   10171   AAE   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-FDD   6.49   ± 9.6 %   10172   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)   LTE-TDD   9.21   ± 9.6 %   10173   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-TDD   9.48   ± 9.6 %   10174   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-TDD   9.48   ± 9.6 %   10175   CAG   LTE-FDD (SC-FDMA, 1 RB, 20 MHz, G4-QAM)   LTE-TDD   10.25   ± 9.6 %   10175   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)   LTE-FDD   5.72   ± 9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, G4-QAM)   LTE-FDD   5.72   ± 9.6 %   10178   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)   LTE-FDD   5.73   ± 9.6 %   10178   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.52   ± 9.6 %   10179   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10180   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10180   CAG   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10181   CAE   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10182   CAE   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10183   AAD   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10183   AAD   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10185   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10186   AAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10186   AAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10187   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10188   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10189   AAF   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10189   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10189   CAE   LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, G4-QAM)   LTE-FDD   6						
10170						
10172   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)   LTE-TDD   9.21   ± 9.6 %   10173   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)   LTE-TDD   9.48   ± 9.6 %   10174   CAG   LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)   LTE-TDD   10.25   ± 9.6 %   10175   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)   LTE-FDD   5.72   ± 9.6 %   10176   CAG   LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)   LTE-FDD   5.72   ± 9.6 %   10177   CAI   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)   LTE-FDD   5.73   ± 9.6 %   10178   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)   LTE-FDD   5.73   ± 9.6 %   10179   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.52   ± 9.6 %   10180   CAG   LTE-FDD (SC-FDMA, 1 RB, 5 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10180   CAG   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)   LTE-FDD   5.72   ± 9.6 %   10182   CAE   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)   LTE-FDD   5.72   ± 9.6 %   10183   AAD   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10184   CAE   LTE-FDD (SC-FDMA, 1 RB, 15 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10185   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)   LTE-FDD   6.50   ± 9.6 %   10185   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10185   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10185   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.51   ± 9.6 %   10186   AAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10186   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10187   CAC   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10186   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10186   CAE   LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10187   CAC   LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10189   CAC   LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.6 %   10199   CAC   LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, G4-QAM)   LTE-FDD   6.50   ± 9.		<del></del>				
10173   CAG						<del></del>
10174						
10175         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10176         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10177         CAI         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10178         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10179         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10180         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, GPSK)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GPSK)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, GPSK)         LTE-FDD         <						
10176         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10177         CAI         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10178         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10179         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10180         CAG         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.51         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, GPSK)         LTE-FDD		CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)			
10177         CAI         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10178         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10179         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10180         CAG         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.52         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         6.50         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD<			LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)			
10178         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10179         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10180         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)         LTE-FDD         6.50         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, GPSK)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, GPSK)         LTE-FDD <td></td> <td></td> <td>LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)</td> <td></td> <td></td> <td></td>			LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)			
10179         CAG         LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10180         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.52         ± 9.6 %           10198         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD						
10180         CAG         LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, G4-QAM)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.52         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)						
10181         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)         LTE-FDD         5.72         ± 9.6 %           10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.52         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)						
10182         CAE         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.52         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         W						
10183         AAD         LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         W						
10184         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10185         CAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.12         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN<						
10164         CAC         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         LTE-FDD         6.51         ± 9.6 %           10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.10         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)						
10186         AAE         LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)         WLAN         8.12         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %						
10187         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         LTE-FDD         5.73         ± 9.6 %           10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)         WLAN         8.12         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %			LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)			
10188         CAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)         LTE-FDD         6.52         ± 9.6 %           10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)         WLAN         8.12         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %						
10189         AAF         LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)         LTE-FDD         6.50         ± 9.6 %           10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)         WLAN         8.12         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %					***	
10193         CAC         IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)         WLAN         8.09         ± 9.6 %           10194         CAC         IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)         WLAN         8.12         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %		CAF				
10194         CAC         IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)         WLAN         8.12         ± 9.6 %           10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %						
10195         CAC         IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)         WLAN         8.21         ± 9.6 %           10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %	10193	CAC				
10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %						
10196         CAC         IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)         WLAN         8.10         ± 9.6 %           10197         CAC         IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)         WLAN         8.13         ± 9.6 %           10198         CAC         IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)         WLAN         8.27         ± 9.6 %	10195	CAC				
10198 CAC IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM) WLAN 8.27 ± 9.6 %		CAC				
10198 CAC   IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)   WLAN   8.27   ± 9.6 %	10197	CAC	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)			
		CAC	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)			
	10219	CAC	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	WLAN	8.03	± 9.6 %

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10220	CAC	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	WLAN	8.13	± 9.6 %
10221	CAC	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	WLAN	8.27	±9.6 %
10222	CAC	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	WLAN	8.06	± 9.6 %
10223	CAC	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	WLAN	8.48	± 9.6 %
10224	CAC	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	WLAN	8.08	± 9.6 %
10225	CAB	UMTS-FDD (HSPA+)	WCDMA	5.97	± 9.6 %
10226	CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.49	± 9.6 %
10227	CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	*****		
			LTE-TDD	10.26	±9.6%
10228	CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	LTE-TDD	9.22	± 9.6 %
10229	CAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10230	CAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10231	CAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	LTE-TDD	9.19	±9.6%
10232	CAF	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	LTE-TDD	9.48	±9.6 %
10233	CAF	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	LTE-TDD	10.25	± 9.6 %
10234	CAF	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	LTE-TDD	9.21	± 9.6 %
10235	CAF	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10236	CAF				
		LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	LTE-TDD	10.25	±9.6 %
10237	CAF	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	LTE-TDD	9.21	± 9.6 %
10238	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	LTE-TDD	9.48	±9.6%
10239	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	LTE-TDD	10.25	±9.6%
10240	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	LTE-TDD	9.21	±9.6%
10241	CAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.82	± 9.6 %
10242	CAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	LTE-TDD	9.86	± 9.6 %
10243	CAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	LTE-TDD	9.46	± 9.6 %
10244	CAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)			
10245	CAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	LTE-TDD	10.06	± 9.6 %
			LTE-TDD	10.06	±9.6%
10246	CAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	LTE-TDD	9.30	±9.6%
10247	CAF	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	LTE-TDD	9.91	± 9.6 %
10248	CAF	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	LTE-TDD	10.09	± 9.6 %
10249	CAF	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	LTE-TDD	9.29	± 9.6 %
10250	CAF	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	LTE-TDD	9.81	±9.6%
10251	CAF	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	LTE-TDD	10.17	±9.6 %
10252	CAF	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	LTE-TDD	9.24	± 9.6 %
10253	CAF				
		LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	LTE-TDD	9.90	±9.6 %
10254	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	LTE-TDD	10.14	± 9.6 %
10255	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	LTE-TDD	9.20	± 9.6 %
10256	CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.96	± 9.6 %
10257	CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	LTE-TDD	10.08	± 9.6 %
10258	CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	LTE-TDD	9.34	± 9.6 %
10259	CAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	LTE-TDD	9.98	± 9.6 %
10260	CAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	LTE-TDD	9.97	± 9.6 %
10261	CAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK)		······	
			LTE-TDD	9.24	± 9.6 %
10262	CAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	LTE-TDD	9.83	±9.6%
10263	CAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	LTE-TDD	10.16	± 9.6 %
10264	CAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	LTE-TDD	9.23	± 9.6 %
10265	CAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	LTE-TDD	9.92	± 9.6 %
10266	CAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	LTE-TDD	10.07	±9.6 %
10267	CAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	LTE-TDD	9.30	± 9.6 %
10268	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	LTE-TDD	10.06	± 9.6 %
10269	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	LTE-TDD	10.13	± 9.6 %
10270	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	LTE-TDD		
				9.58	± 9.6 %
10274	CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	WCDMA	4.87	± 9.6 %
10275	CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	WCDMA	3.96	±9.6%
10277	CAA	PHS (QPSK)	PHS	11.81	± 9.6 %
10278	CAA	PHS (QPSK, BW 884MHz, Rolloff 0.5)	PHS	11.81	± 9.6 %
10279	ÇAA	PHS (QPSK, BW 884MHz, Rolloff 0.38)	PHS	12.18	±9.6%
10290	AAB	CDMA2000, RC1, SO55, Full Rate	CDMA2000	3.91	±9.6%
10291	AAB	CDMA2000, RC3, SO55, Full Rate	CDMA2000	3.46	± 9.6 %
10292	AAB	CDMA2000, RC3, SO33, Full Rate	CDMA2000	3.39	
					±9.6%
10293	AAB	CDMA2000, RC3, SO3, Full Rate	CDMA2000	3.50	±9.6%
10295	AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	CDMA2000	12.49	±9.6 %
10297	AAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	LTE-FDD	5.81	± 9.6 %
10298	AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	LTE-FDD	5.72	± 9.6 %
10299	AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	LTE-FDD	6.39	± 9.6 %
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10301 AAA IEEE Syn 10303 AAA IEEE 10304 AAA IEEE 10305 AAA IEEE Syn 10306 AAA IEEE Syn 10307 AAA IEEE Syn 10308 AAA IEEE 10309 AAA IEEE Syn 10310 AAA IEEE Syn 10311 AAD LTI 10313 AAA IDEE Syn 10314 AAA IDEE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu 10353 AAA Pu 10353 AAA Pu 103030 AAA IEEE 10352 AAA Pu 10353 AAA Pu 10353 AAA Pu 10353 AAA IEEE I0355 AAA Pu 10353 AAAA Pu 10353 AAA Pu 10353 AAAA Pu 10353 AAAA Pu 10353 AAAA Pu 10353 AAAA Pu 10355 AAAA Pu 10355 AAA Pu 10355 AAAA Pu 10355 AAA Pu 10355 AAAA Pu 10355 AAA Pu 10355 AAA	E-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)  EE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC)  EE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL mbols)  EE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)  EE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)  EE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)	LTE-FDD WIMAX LTE-FDD	12.52 11.86 15.24 14.67 14.49 14.46 14.58	±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 %
10302 AAA IEEE Syn 10303 AAA IEEE 10304 AAA IEEE 10305 AAA IEEE Syn 10306 AAA IEEE Syn 10307 AAA IEEE Syn 10308 AAA IEEE Syn 10309 AAA IEEE Syn 10310 AAA IEEE Syn 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu 10353 AAA Pu 10353 AAA Pu 10309 AAA Pu 10353 AAA Pu 10353 AAA Pu 10309 AAA IEEE Syn 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu	EE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL mbols)  EE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)  EE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)  EE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)	WIMAX	12.57 12.52 11.86 15.24 14.67 14.49 14.46 14.58	± 9.6 %  ± 9.6 %  ± 9.6 %  ± 9.6 %  ± 9.6 %  ± 9.6 %  ± 9.6 %
10303 AAA IEEE 10304 AAA IEEE 10305 AAA IEEE 10306 AAA IEEE 10307 AAA IEEE 10308 AAA IEEE 10309 AAA IEEE 10309 AAA IEEE 10310 AAA IEEE 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu 10353 AAA Pu 10304 IEEE 10352 AAA Pu 10353 AAA Pu	mbols)  EE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)  EE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)  EE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)	WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX	12.52 11.86 15.24 14.67 14.49 14.46 14.58	±9.6 % ±9.6 % ±9.6 % ±9.6 % ±9.6 %
10303 AAA IEEE 10304 AAA IEEE 10305 AAA IEEE SYF 10307 AAA IEEE SYF 10308 AAA IEEE SYF 10309 AAA IEEE SYF 10310 AAA IEEE SYF 10311 AAD LTI 10313 AAA IDEE 10314 AAA IDEE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA PU 10353 AAA PU 10353 AAA PU	EE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC) EE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC) EE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX	11.86 15.24 14.67 14.49 14.46 14.58	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
10304 AAA IEE 10305 AAA IEE 10306 AAA IEE syr 10307 AAA IEE 10308 AAA IEE 10309 AAA IEE 10309 AAA IEE 10310 AAA IEE 10311 AAD LT 10313 AAA IDE 10314 AAA IDE 10315 AAB IEE 10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	EE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC) EE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX	11.86 15.24 14.67 14.49 14.46 14.58	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
10305 AAA IEEE Syr 10306 AAA IEEE Syr 10307 AAA IEEE Syr 10308 AAA IEEE Syr 10309 AAA IEEE Syr 10310 AAA IEEE Syr 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu 10353 AAA Pu	EE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)	WIMAX WIMAX WIMAX WIMAX WIMAX WIMAX	15.24 14.67 14.49 14.46 14.58	± 9.6 % ± 9.6 % ± 9.6 % ± 9.6 %
Syr   10306   AAA   IEE   Syr   10307   AAA   IEE   Syr   10308   AAA   IEE   Syr   10309   AAA   IEE   Syr   10310   AAA   IEE   Syr   10311   AAD   LT   10313   AAA   IDE   10314   AAA   IDE   10315   AAB   IEE   10316   AAB   IEE   10317   AAC   IEE   10352   AAA   Pu   10353   AAA   Pu   10353   AAA   Pu	mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX WIMAX WIMAX	14.49 14.46 14.58	± 9.6 %
Syr	mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX WIMAX WIMAX	14.49 14.46 14.58	± 9.6 %
10307 AAA IEEE Syr 10308 AAA IEEE Syr 10309 AAA IEEE Syr 10310 AAA IEEE Syr 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu 10353 AAA Pu	EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols)  E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)  EN 1:3	WIMAX WIMAX WIMAX	14.46 14.58	± 9.6 %
Syr	mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) EE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX WIMAX WIMAX	14.46 14.58	± 9.6 %
10308 AAA IEE 10309 AAA IEE syr 10310 AAA IEE syr 10311 AAD LT 10313 AAA IDE 10314 AAA IDE 10315 AAB IEE 10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) EE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX	14.58	
10309 AAA IEEE syr 10310 AAA IEEE syr 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEEE 10316 AAB IEEE 10317 AAC IEEE 10352 AAA Pu 10353 AAA Pu	EE 802.16e WIMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 mbols) EE 802.16e WIMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WIMAX	14.58	
Syr   10310   AAA   IEE   Syr   10311   AAD   LT   10313   AAA   IDE   10314   AAA   IDE   10315   AAB   IEE   10316   AAB   IEE   10317   AAC   IEE   10352   AAA   Pu   10353   AAA   Pu   10353   AAA   Pu	mbols) EE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	WiMAX		±9,6%
10310 AAA IEE syr 10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEE 10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	EE 802.16e WIMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 mbols) E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3		14.57	
Syr   10311   AAD   LT    10313   AAA   IDE   10314   AAA   IDE   10315   AAB   IEE   10316   AAB   IEE   10317   AAC   IEE   10352   AAA   Pu   10353   AAA   Pu	mbols) E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3		14.57	± 9.6 %
10311 AAD LTI 10313 AAA IDE 10314 AAA IDE 10315 AAB IEE 10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	E-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) EN 1:3	I TE EDD		3.0 /
10313 AAA IDE 10314 AAA IDE 10315 AAB IEE 10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	EN 1:3	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	6.06	± 9.6 %
10314 AAA iDE 10315 AAB IEE 10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu		IDEN	10.51	± 9.6 %
10315         AAB         IEE           10316         AAB         IEE           10317         AAC         IEE           10352         AAA         Pu           10353         AAA         Pu	T N 1.0	iDEN	13.48	± 9.6 %
10316 AAB IEE 10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	EE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	WLAN	1.71	± 9.6 %
10317 AAC IEE 10352 AAA Pu 10353 AAA Pu	EE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	WLAN	8.36	± 9.6 %
10352 AAA Pu 10353 AAA Pu	EE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	WLAN	8.36	± 9.6 %
10353 AAA Pu	ulse Waveform (200Hz, 10%)	Generic	10.00	±9.6%
	ulse Waveform (200Hz, 20%)	Generic	6.99	± 9.6 %
	ulse Waveform (200Hz, 40%)	Generic	3.98	± 9.6 %
10355 AAA Pu	ulse Waveform (200Hz, 60%)	Generic	2.22	± 9.6 %
10356 AAA Pu	ulse Waveform (200Hz, 80%)	Generic	0.97	± 9.6 %
	PSK Waveform, 1 MHz	Generic	5.10	±9.6%
	PSK Waveform, 10 MHz	Generic	5.22	± 9.6 %
	4-QAM Waveform, 100 kHz	Generic	6.27	±96%
	1-QAM Waveform, 40 MHz	Generic	6.27	± 9.6 %
	EE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	WLAN	8.37	± 9.6 %
	EE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	WLAN	8.60 8.53	± 9.6 % ± 9.6 %
	EE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	WLAN CDMA2000	3.76	± 9.6 %
	DMA2000 (1xEV-DO, Rev. 0)	CDMA2000	3.77	±9.6 %
	DMA2000 (1xEV-DO, Rev. A) DMA2000, RC3, SO32, SCH0, Full Rate	CDMA2000	5.22	± 9.6 %
	TE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL	LTE-TDD	7.82	± 9.6 %
10410 AAF LI	ubframe=2,3,4,7,8,9, Subframe Conf=4)	-12 ,00	1.02	0.0 ,0
	/LAN CCDF, 64-QAM, 40MHz	Generic	8.54	± 9.6 %
	EE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	WLAN	1.54	± 9.6 %
10416 AAA IEI	EE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	WLAN	8.23	± 9.6 %
10417 AAB IEI	EE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	WLAN	8.23	± 9.6 %
10418 AAA IE	EE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle,	WLAN	8.14	± 9.6 %
Lo	ong preambule)			
	EE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle,	WLAN	8.19	± 9.6 %
	hort preambule)			
10422 AAB IE	EE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)	WLAN	8.32	± 9.6 %
	EE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM)	WLAN	8.47	±9.6 %
	EE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM)	WLAN	8.40	
	EE 802.11n (HT Greenfield, 15 Mbps, BPSK)	WLAN	8.41 8.45	± 9.6 % ± 9.6 %
	EE 802.11n (HT Greenfield, 90 Mbps, 16-QAM)	WLAN WLAN	8.45	± 9.6 %
10427 AAB IE	EE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)	LTE-FDD	8.28	± 9.6 %
10430 AAD LT	TE-FDD (OFDMA, 5 MHz, E-TM 3.1) TE-FDD (OFDMA, 10 MHz, E-TM 3.1)	LTE-FDD	8.38	± 9.6 %
	TE-FDD (OFDMA, 10 MHz, E-TM 3.1) TE-FDD (OFDMA, 15 MHz, E-TM 3.1)	LTE-FDD	8.34	± 9.6 %
	TE-FDD (OFDMA, 15 MHz, E-TM 3.1)	LTE-FDD	8.34	± 9.6 %
	V-CDMA (BS Test Model 1, 64 DPCH)	WCDMA	8.60	± 9.6 %
	TE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL	LTE-TDD	7.82	± 9.6 %
	Subframe=2,3,4,7,8,9)			
10435 AAF LT	TE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)	LTE-FDD	7.56	± 9.6 %
10435 AAF LT	TE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clippin 44%)	LTE-FDD	7.53	± 9.6 %
10435 AAF L1 St 10447 AAD L1			7 - 7 - 7	± 9.6 %
10435 AAF LT Su 10447 AAD LT 10448 AAD LT	TE-FDD (OFDMA, 15 MHz, E-TM 3.1, Cliping 44%)	LTE-FDD	7.51	± 9.6 %

10451	AAA	W-CDMA (BS Test Model 1, 64 DPCH, Clipping 44%)	WCDMA	7.50	+060/
10456	AAB	IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle)	WLAN	7.59 8.63	± 9.6 %
10457	AAA	UMTS-FDD (DC-HSDPA)	WCDMA	6.62	± 9.6 %
10458	AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	CDMA2000	6.55	± 9.6 %
10459	AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	CDMA2000	8.25	±9.6 %
10460	AAA	UMTS-FDD (WCDMA, AMR)	WCDMA	2.39	±9.6 %
10461	AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL	LTE-TDD	7.82	±9.6%
		Subframe=2,3,4,7,8,9)			
10462	AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL	LTE-TDD	8.30	±9.6%
		Subframe=2,3,4,7,8,9)			
10463	AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL	LTE-TDD	8.56	± 9.6 %
40404	A A D	Subframe=2,3,4,7,8,9)			
10464	AAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL	LTE-TDD	7.82	± 9.6 %
10465	AAB	Subframe=2,3,4,7,8,9)  LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL	LTE TOD	0.00	
10403	AAB	Subframe=2,3,4,7,8,9)	LTE-TDD	8.32	± 9.6 %
10466	AAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM, UL	LTE-TDD	8.57	± 9.6 %
10400	7770	Subframe=2,3,4,7,8,9)	LIETIDD	0.07	19.0 %
10467	AAE	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL	LTE-TDD	7.82	± 9.6 %
		Subframe=2,3,4,7,8,9)	2,2,00	1.02	20.0 %
10468	AAE	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL	LTE-TDD	8.32	± 9.6 %
		Subframe=2,3,4,7,8,9)		0,0,0	
10469	AAE	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM, UL	LTE-TDD	8.56	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10470	AAE	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL	LTE-TDD	7.82	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10471	AAE	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL	LTE-TDD	8.32	± 9.6 %
10.170		Subframe=2,3,4,7,8,9)			
10472	AAE	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL	LTE-TDD	8.57	± 9.6 %
10473	AAE	Subframe=2,3,4,7,8,9)	LTE TOO	7.00	1.000
10473	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10474	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL	LTE-TDD	8.32	± 9.6 %
10474	\ \\	Subframe=2,3,4,7,8,9)	L1E-100	0.32	19.0 %
10475	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL	LTE-TDD	8.57	± 9.6 %
10170	' ' ' '	Subframe=2,3,4,7,8,9)		0.01	20.070
10477	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL	LTE-TDD	8.32	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10478	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL	LTE-TDD	8.57	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10479	AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL	LTE-TDD	7.74	±9.6 %
	<u> </u>	Subframe=2,3,4,7,8,9)			
10480	AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL	LTE-TDD	8.18	± 9.6 %
10101		Subframe=2,3,4,7,8,9)			
10481	AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL	LTE-TDD	8.45	± 9.6 %
10482	AAB	Subframe=2,3,4,7,8,9)   LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL	LTE TOD	7 74	1060
10462	AAD	Subframe=2,3,4,7,8,9)	LTE-TDD	7.71	± 9.6 %
10483	AAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL	LTE-TDD	8.39	± 9.6 %
10700	1,22	Subframe=2,3,4,7,8,9)	L1L-100	0.03	± 3.0 /0
10484	AAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL	LTE-TDD	8.47	± 9.6 %
10404	7010	Subframe=2,3,4,7,8,9)		0.77	1 5.0 7
10485	AAE	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL	LTE-TDD	7.59	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10486	AAE	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL	LTE-TDD	8.38	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10487	AAE	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL	LTE-TDD	8.60	±9.6 %
	ļ	Subframe=2,3,4,7,8,9)			
10488	AAE	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL	LTE-TDD	7.70	± 9.6 %
40400	<del> </del>	Subframe=2,3,4,7,8,9)	1.75	<u> </u>	1 . 0 5 2
10489	AAE	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL	LTE-TDD	8.31	± 9.6 %
10400	AAE	Subframe=2,3,4,7,8,9)	LIETOD	0.54	1000
10490	AAE	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.54	±9.6%
10491	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL	LTE-TDD	7.74	± 9.6 %
10701	' ' ' '	Subframe=2,3,4,7,8,9)		'··' <b>-</b>	2.0.0 /0
	L	Cabhaille 2,0,7,1,0,0/	1	L	1

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				1 244 3	
10492	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	LTE-TDD	8.41	± 9.6 %
10493	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM, UL	LTE-TDD	8.55	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10494	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL	LTE-TDD	7.74	± 9.6 %
10495	AAF	Subframe=2,3,4,7,8,9) LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL	LTE-TDD	8.37	± 9.6 %
10495	AAF	Subframe=2,3,4,7,8,9)		0.07	0.0 /0
10496	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM, UL	LTE-TDD	8.54	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10497	AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL	LTE-TDD	7.67	± 9.6 %
10498	AAA	Subframe=2,3,4,7,8,9)  LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL	LTE-TDD	8.40	± 9.6 %
10400	/ " " "	Subframe=2,3,4,7,8,9)			
10499	AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM, UL	LTE-TDD	8.68	± 9.6 %
40500	445	Subframe=2,3,4,7,8,9)	LTE-TDD	7.67	± 9.6 %
10500	AAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	LIE-IDD	7.67	I 9.0 %
10501	AAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL	LTE-TDD	8.44	±9.6%
		Subframe=2,3,4,7,8,9)			
10502	AAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM, UL	LTE-TDD	8.52	± 9.6 %
10503	AAE	Subframe=2,3,4,7,8,9)  LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL	LTE-TDD	7.72	± 9.6 %
10303	\	Subframe=2.3.4.7.8.9)		12	0.0 /0
10504	AAE	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL	LTE-TDD	8.31	± 9.6 %
		Subframe=2,3,4,7,8,9)	1 70 700	0.54	1000
10505	AAE	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM, UL	LTE-TDD	8.54	± 9.6 %
10506	AAE	Subframe=2,3,4,7,8,9)   LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL	LTE-TDD	7.74	± 9.6 %
70000	/ 5 \ _	Subframe=2,3,4,7,8,9)			
10507	AAE	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL	LTE-TDD	8.36	± 9.6 %
40500		Subframe=2,3,4,7,8,9)  LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM, UL	LTE-TDD	8.55	±9.6%
10508	AAE	Subframe=2,3,4,7,8,9)	LIC-IDD	0.55	1.3.0 %
10509	AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL	LTE-TDD	7.99	± 9.6 %
		Subframe=2,3,4,7,8,9)		5.40	
10510	AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL	LTE-TDD	8.49	±9.6%
10511	AAE	Subframe=2,3,4,7,8,9)  LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM, UL	LTE-TDD	8.51	± 9.6 %
10071	/ " "	Subframe=2,3,4,7,8,9)			
10512	AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL	LTE-TDD	7.74	± 9.6 %
40540	A A E	Subframe=2,3,4,7,8,9)  LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL	LTE-TDD	8.42	± 9.6 %
10513	AAF	Subframe=2,3,4,7,8,9)	LIE-IDD	0.42	20.070
10514	AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM, UL	LTE-TDD	8.45	± 9.6 %
		Subframe=2,3,4,7,8,9)			
10515	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	WLAN	1.58	± 9.6 % ± 9.6 %
10516 10517	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 99pc duty cycle) IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 99pc duty cycle)	WLAN WLAN	1.57 1.58	± 9.6 %
10517	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	WLAN	8.23	± 9.6 %
10519	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 99pc duty cycle)	WLAN	8.39	± 9.6 %
10520	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 99pc duty cycle)	WLAN	8.12	± 9.6 %
10521	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 99pc duty cycle)	WLAN WLAN	7.97 8.45	± 9.6 % ± 9.6 %
10522 10523	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 99pc duty cycle) IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 99pc duty cycle)	WLAN	8.08	± 9.6 %
10523	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 99pc duty cycle)	WLAN	8.27	± 9.6 %
10525	AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	WLAN	8.36	± 9.6 %
10526	AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	WLAN	8.42	± 9.6 %
10527	AAB	IEEE 802.11ac WiFi (20MHz, MCS2, 99pc duty cycle)	WLAN WLAN	8.21 8.36	± 9.6 % ± 9.6 %
10528 10529	AAB AAB	IEEE 802.11ac WiFi (20MHz, MCS3, 99pc duty cycle) IEEE 802.11ac WiFi (20MHz, MCS4, 99pc duty cycle)	WLAN	8.36	± 9.6 %
10525	AAB	IEEE 802.11ac WiFi (20MHz, MCS6, 99pc duty cycle)	WLAN	8.43	± 9.6 %
10532	AAB	IEEE 802.11ac WiFi (20MHz, MCS7, 99pc duty cycle)	WLAN	8.29	± 9.6 %
10533	AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 99pc duty cycle)	WLAN	8.38	± 9.6 %
10534	AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	WLAN	8.45	± 9.6 %

10535	AAD	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	TAR AND	0.45	1000
10536	AAB AAB		WLAN	8.45	± 9.6 %
10537		IEEE 802.11ac WiFi (40MHz, MCS2, 99pc duty cycle)	WLAN	8.32	±9.6 %
10537	AAB	IEEE 802.11ac WiFi (40MHz, MCS3, 99pc duty cycle)	WLAN	8.44	±9.6%
10536	AAB AAB	IEEE 802.11ac WiFi (40MHz, MCS4, 99pc duty cycle)	WLAN	8.54	± 9.6 %
10540		IEEE 802.11ac WiFi (40MHz, MCS6, 99pc duty cycle)	WLAN	8.39	± 9.6 %
	AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 99pc duty cycle)	WLAN	8.46	± 9.6 %
10542	AAB	IEEE 802.11ac WiFi (40MHz, MCS8, 99pc duty cycle)	WLAN	8.65	± 9.6 %
10543	AAB	IEEE 802.11ac WiFi (40MHz, MCS9, 99pc duty cycle)	WLAN	8.65	± 9.6 %
10544	AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	WLAN	8.47	±9.6%
10545	AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	WLAN	8.55	±9.6%
10546	AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 99pc duty cycle)	WLAN	8.35	± 9.6 %
10547	AAB	IEEE 802.11ac WIFi (80MHz, MCS3, 99pc duty cycle)	WLAN	8.49	± 9.6 %
10548	AAB	IEEE 802.11ac WiFi (80MHz, MCS4, 99pc duty cycle)	WLAN	8.37	± 9.6 %
10550	AAB	IEEE 802.11ac WiFi (80MHz, MCS6, 99pc duty cycle)	WLAN	8.38	± 9.6 %
10551	AAB	IEEE 802.11ac WiFi (80MHz, MCS7, 99pc duty cycle)	WLAN	8.50	± 9.6 %
10552	AAB	IEEE 802.11ac WiFi (80MHz, MCS8, 99pc duty cycle)	WLAN	8.42	± 9.6 %
10553	AAB	IEEE 802.11ac WiFi (80MHz, MCS9, 99pc duty cycle)	WLAN	8.45	± 9.6 %
10554	AAC	IEEE 802.11ac WiFi (160MHz, MCS0, 99pc duty cycle)	WLAN	8.48	± 9.6 %
10555	AAC	IEEE 802.11ac WiFi (160MHz, MCS1, 99pc duty cycle)	WLAN	8.47	± 9.6 %
10556	AAC	IEEE 802.11ac WiFi (160MHz, MCS2, 99pc duty cycle)	WLAN	8.50	± 9.6 %
10557	AAC	IEEE 802.11ac WiFi (160MHz, MCS3, 99pc duty cycle)	WLAN	8.52	± 9.6 %
10558	AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 99pc duty cycle)	WLAN	8.61	± 9.6 %
10560	AAC	IEEE 802.11ac WiFi (160MHz, MCS6, 99pc duty cycle)	WLAN	8.73	± 9.6 %
10561	AAC	IEEE 802.11ac WiFi (160MHz, MCS7, 99pc duty cycle)	WLAN	8.56	± 9.6 %
10562	AAC	IEEE 802.11ac WiFi (160MHz, MCS8, 99pc duty cycle)	WLAN	8.69	± 9.6 %
10563	AAC	IEEE 802.11ac WiFi (160MHz, MCS9, 99pc duty cycle)	WLAN	8.77	± 9.6 %
10564	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty	WLAN	8.25	± 9.6 %
		cycle)			
10565	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 99pc duty cycle)	WLAN	8.45	± 9.6.%
10566	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 99pc duty cycle)	WLAN	8.13	±9.6%
10567	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 99pc duty cycle)	WLAN	8.00	± 9.6 %
10568	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 99pc duty cycle)	WLAN	8.37	± 9.6 %
10569	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 99pc duty	WLAN	8.10	± 9.6 %
10570	AAA	cycle) IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 99pc duty cycle)	WLAN	8.30	± 9.6 %
10571	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	WLAN	1.00	4069/
				1.99	± 9.6 %
10572	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	WLAN	1.99	±9.6 %
10573	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 90pc duty cycle) IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc duty cycle)	WLAN	1.98	± 9.6 %
10574 10575	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc duty cycle)	WLAN WLAN	1.98 8.59	± 9.6 % ± 9.6 %
		cycle)			
10576	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	WLAN	8.60	± 9.6 %
10577	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc duty cycle)	WLAN	8.70	± 9.6 %
10578	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc duty cycle)	WLAN	8.49	± 9.6 %
10579	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)	WLAN	8.36	± 9.6 %
10580	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)	WLAN	8.76	± 9.6 %
10581	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty	WLAN	8.35	± 9.6 %
10582	AAA	cycle) IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty	WLAN	8.67	± 9.6 %
10500	AAD	cycle)	\A/1 A &1	0.50	1060
10583	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	WLAN WLAN	8.59	±9.6 %
10584 10585	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)		8.60	±9.6 %
	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 90pc duty cycle)	WLAN	8.70	±9.6%
10586	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 90pc duty cycle)	WLAN	8.49	±9.6%
10587	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 90pc duty cycle)	WLAN	8.36	± 9.6 %