# Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.

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





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- 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

Client B.V. ADT (Auden)

Certificate No: D750V3-1013\_Aug20

# CALIBRATION CERTIFICATE

Object	D750V3 - SN:101	3	
	QA CAL-05.v11 Calibration Procee	dure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	August 13, 2020		
The measurements and the uncerta	inties with confidence pr	onal standards, which realize the physical uni robability are given on the following pages an y facility: environment temperature (22 $\pm$ 3)°C	d are part of the certificate.
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-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-19)	In house check: Oct-20
	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	Status della
Annual I	Kotio Dakovia	Technical Manager	mlle
Approved by:	Katja Pokovic	r ecrimicar manager	play
		n full without written approval of the laborator	Issued: August 14, 2020

Certificate No: D750V3-1013\_Aug20

## **Calibration Laboratory of**

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





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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
	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	V52.10.4	
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	42.4 ± 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	2.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.48 W/kg ± 17.0 % (k=2)
	1	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	1.40 W/kg

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω - 0.8 jΩ	
Return Loss	- 30.5 dB	

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.036 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: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1013

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz;  $\sigma$  = 0.91 S/m;  $\epsilon_r$  = 42.4;  $\rho$  = 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(9.97, 9.97, 9.97) @ 750 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

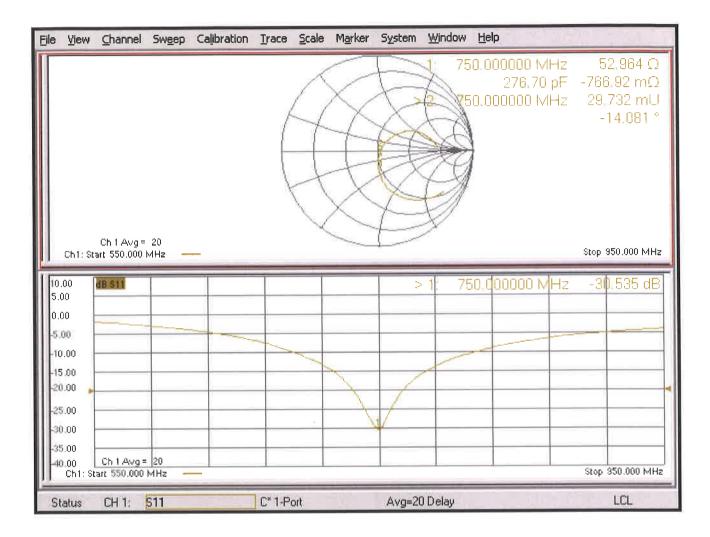
## Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 59.14 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 3.22 W/kg SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.4 W/kg Smallest distance from peaks to all points 3 dB below = 17 mm Ratio of SAR at M2 to SAR at M1 = 66.8% Maximum value of SAR (measured) = 2.83 W/kg



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

## Impedance Measurement Plot for Head TSL



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#### **B.V. ADT (Auden)** Client

Certificate No:	D835V2-4d121_A	ug20
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#### **CALIBRATION CERTIFICATE** D835V2 - SN:4d121 Object QA CAL-05.v11 Calibration procedure(s) Calibration Procedure for SAR Validation Sources between 0.7-3 GHz August 13, 2020 Calibration date: 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 # Scheduled Calibration **Primary Standards** Cal Date (Certificate No.) Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100/03101) Apr-21 Apr-21 Power sensor NRP-Z91 SN: 103244 01-Apr-20 (No. 217-03100) Power sensor NRP-Z91 SN: 103245 01-Apr-20 (No. 217-03101) Apr-21 Reference 20 dB Attenuator SN: BH9394 (20k) 31-Mar-20 (No. 217-03106) Apr-21 Type-N mismatch combination Apr-21 SN: 310982 / 06327 31-Mar-20 (No. 217-03104) Jun-21 Reference Probe EX3DV4 SN: 7349 29-Jun-20 (No. EX3-7349\_Jun20) DAE4 SN: 601 27-Dec-19 (No. DAE4-601\_Dec19) Dec-20 Scheduled Check Secondary Standards ID # Check Date (in house) SN: GB39512475 30-Oct-14 (in house check Feb-19) In house check: Oct-20 Power meter E4419B 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 In house check: Oct-20 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-19) Name Function Signature Laboratory Technician Jeffrey Katzman Calibrated by: Katja Pokovic **Technical Manager** Approved by: Issued: August 14, 2020 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

#### Certificate No: D835V2-4d121\_Aug20

Report No.: SF210105C01

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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%.

#### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.4	
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	42.2 ± 6 %	0.93 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	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.52 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	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.21 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	49.8 Ω - 3.4 jΩ
Return Loss	- 29.4 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.394 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
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## **DASY5 Validation Report for Head TSL**

Date: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d121

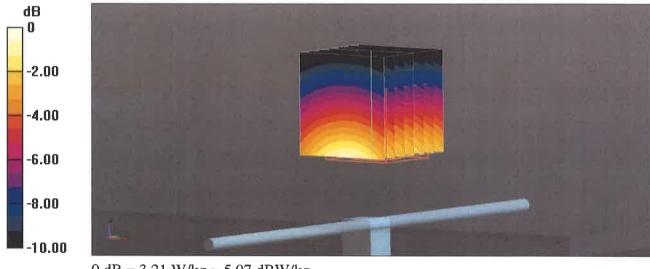
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma = 0.93$  S/m;  $\epsilon_r = 42.2$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

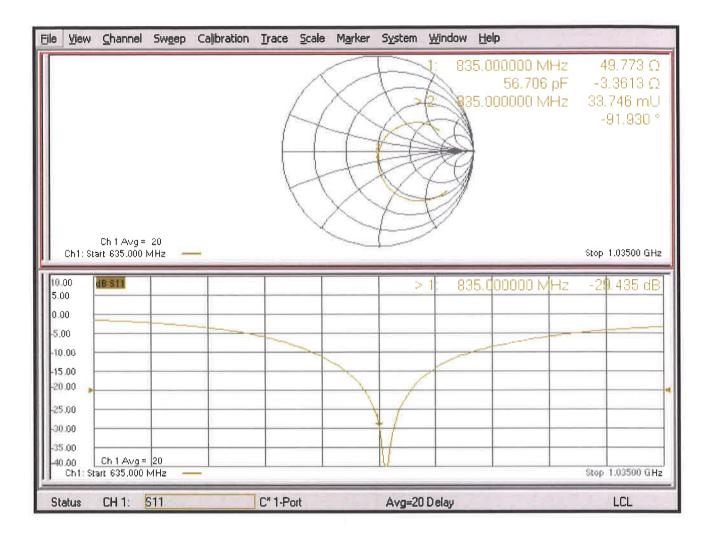
#### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 62.61 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 3.60 W/kg **SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.58 W/kg** Smallest distance from peaks to all points 3 dB below = 17 mm Ratio of SAR at M2 to SAR at M1 = 67.5% Maximum value of SAR (measured) = 3.21 W/kg



0 dB = 3.21 W/kg = 5.07 dBW/kg

#### Impedance Measurement Plot for Head TSL



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

B.V. ADT (Auden)

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#### Certificate No: D1750V2-1055\_Aug20

# **CALIBRATION CERTIFICATE**

Object	D1750V2 - SN:10		
	DITOUVE ON.IC	155	
Calibration procedure(s)	QA CAL-05.v11		
	<b>Calibration Proce</b>	dure for SAR Validation Source	es between 0.7-3 GHz
Calibration date:	August 14, 2020		
	<b>v</b> ,		
This calibration certificate documen	ts the traceability to natio	onal standards, which realize the physical ι	inits of measurements (SI)
		robability are given on the following pages a	
			and are part of the continuate.
All calibrations have been conducto	ad in the closed laborator	y facility: environment temperature (22 ± 3)	$^{\circ}$ C and humidity < 70%
	o in the closed laborator	y racinty, environment temperature ( $22 \pm 3$ )	/ ∪ anu numuny < /0%.
Calibration Equipment used (MRTE	oritical for calibration)		
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NBP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21 Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03100)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20
		27-Dec-19 (NO. DAL4-001_Dec19)	Dec-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-19)	In house check: Oct-20
, ,	4		
	Name	Function	(Signature )
Calibrated by:	Claudio Leubler	Laboratory Technician	
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Approved by:	Katja Pokovic	Technical Manager	01101
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			Issued: August 14, 2020
This calibration certificate shall not	be reproduced except in	full without written approval of the laborato	

Report No.: SF210105C01

## Calibration Laboratory of

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



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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	0 1
	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	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 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	40.4 ± 6 %	1.35 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	8.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.0 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	4.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.9 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	50.3 Ω + 0.8 jΩ
Return Loss	- 41.5 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.223 ns
Electroal Belay (one direction)	1.223 115

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

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

Date: 14.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1055

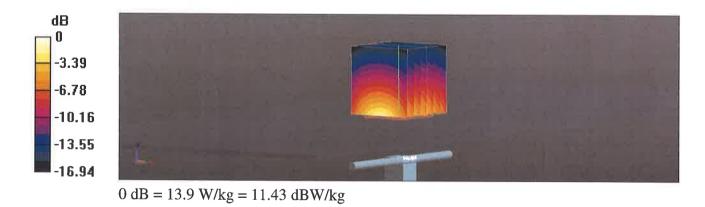
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma = 1.35$  S/m;  $\varepsilon_r = 40.4$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

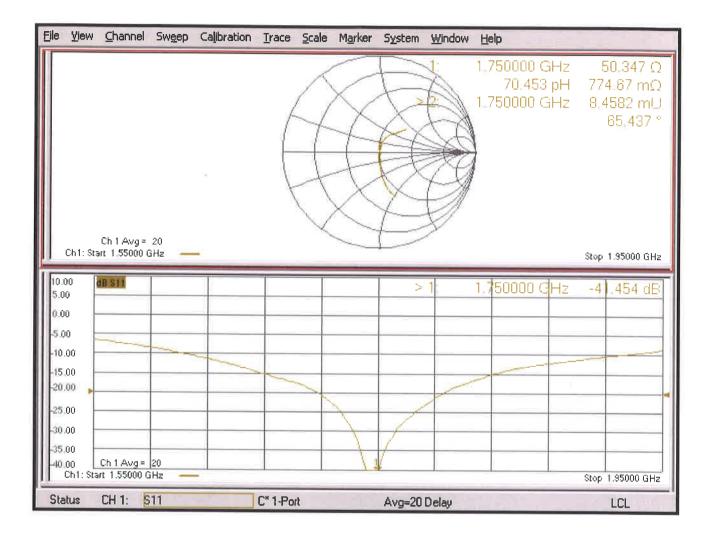
- Probe: EX3DV4 SN7349; ConvF(8.58, 8.58, 8.58) @ 1750 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 105.6 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 16.6 W/kg **SAR(1 g) = 8.89 W/kg; SAR(10 g) = 4.69 W/kg** Smallest distance from peaks to all points 3 dB below = 10 mm Ratio of SAR at M2 to SAR at M1 = 54% Maximum value of SAR (measured) = 13.9 W/kg



## Impedance Measurement Plot for Head TSL



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



Schweizerischer Kalibrierdienst

- S Service suisse d'étalonnage
- С Servizio svizzero di taratura
- 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 **B.V. ADT (Auden)**

Calibration procedure(s)   QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz     Calibration date:   January 22, 2021     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 onewer sensor NRP-291     Power sensor NRP-291   SN: 104778   01-Apr-20 (No. 217-03100)   Apr-21 onewer sensor NRP-291     SN: 103245   01-Apr-20 (No. 217-03100)   Apr-21 seference 20 dB Attenuator   SN: 810824 (206)     SN: 310882 (206327   31-Mar-20 (No. 217-03104)   Apr-21 seference 20 (No EX37034)   Apr-21 Apr-21     Secondary Standards   ID #   Check Date (In house)   Scheduled Check     Power sensor NP-291   SN: 601   02-Nov-20 (No. DAE4-601_Nov20)   Nov-21     Secondary Standards   ID #   Check Date (In house)   Scheduled Check     Power sensor HP 8481A   SN: US37282783   07-Oct-15 (In house check Oct-20) <td< th=""><th></th><th></th><th></th><th></th></td<>				
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz     Calibration date:   January 22, 2021     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 calibration Equipment used (M&TE critical for calibration)   Cal Date (Certificate No.)   Scheduled Calibration     Power meter NRP   SN: 104778   01-Apr-20 (No. 217-03100/03101)   Apr-21     Power sensor NRP-Z91   SN: 104778   01-Apr-20 (No. 217-03100)   Apr-21     Power sensor NRP-Z91   SN: 103244   01-Apr-20 (No. 217-03100)   Apr-21     Reference 20 Rb Attenuator   SN: 310982 / 06327   31-Mar-20 (No. 217-03101)   Apr-21     Reference Probe EX3DV4   SN: 104977   31-Mar-20 (No. 217-03104)   Apr-21     SN: 601   02-Nov-20 (No. 217-03104)   Apr-21   SN: 10982 / 06327   31-Mar-20 (No. 217-03104)   Apr-21     SN: 104778   30-Oct-14 (In house check Oct-20)   Nov-21   Secondary Standards   Dot # Check Date (In house)   Scheduled Check     Power sensor HP 8481A   SN: US37292783   30-Oct-14 (In house check Oct-20)   In house check: Oct-22	Dbject	D1900V2 - SN:50	1036	
Calibration date:   January 22, 2021     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 procedure(s)			
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 calibration Equipment used (M&TE critical for calibration)     Primary Standards   ID #   Cal Date (Certificate No.)   Scheduled Calibration     Power meter NRP   SN: 104778   01-Apr-20 (No. 217-03100/03101)   Apr-21     Power sensor NRP-Z91   SN: 103244   01-Apr-20 (No. 217-03100)   Apr-21     Power sensor NRP-Z91   SN: 103245   01-Apr-20 (No. 217-03100)   Apr-21     Power sensor NRP-Z91   SN: 103245   01-Apr-20 (No. 217-03100)   Apr-21     Power sensor NRP-Z91   SN: 103982 (Ook)   31-Mar-20 (No. 217-03104)   Apr-21     Reference 20 dB Attenuator   SN: 310982 (Os327   31-Mar-20 (No. 217-03104)   Apr-21     Style   SN: 601   02-Nov-20 (No. DAE4-601_Nov20)   Nov-21     Secondary Standards   ID #   Check Date (in house)   Scheduled Check     Power sensor HP 8481A   SN: US37292783   07-Oct-15 (in house check Oct-20)   In house check: Oct-22     Power sensor HP 8481A   SN: US41080477   31-Mar-14 (in house check Oct-20) </td <td></td> <td>Calibration Proce</td> <td>dure for SAH validation Sources</td> <td>s Detween U.7-3 GHZ</td>		Calibration Proce	dure for SAH validation Sources	s Detween U.7-3 GHZ
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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)     Scheduled Calibration)     Scheduled Calibration     Power meter NRP     SN: 104778   01-Apr-20 (No. 217-03100/03101)   Apr-21     Power sensor NRP-291   SN: 103244   01-Apr-20 (No. 217-03100)   Apr-21     Power sensor NRP-291   SN: 103245   01-Apr-20 (No. 217-03101)   Apr-21     Power sensor NRP-291   SN: 103245   01-Apr-20 (No. 217-03106)   Apr-21     Reference 20 dB Attenuator   SN: BH9394 (20k)   31-Mar-20 (No. 217-03106)   Apr-21     Type-N mismatch combination   SN: 310982 / 06327   31-Mar-20 (No. EX3-7349_Dec20)   Dec-21     DAE4   SN: 601   02-Nov-20 (No. DAE4-601_Nov20)   Nov-21     Secondary Standards   ID #   Check Date (in house)   Scheduled Check     Power sensor HP 8481A   SN: US37292783   07-Oct-15 (in house check Oct-20)   In house check: Oct-2	This calibration partificate documen	nts the traceshility to pati	onal standards, which realize the physical ur	hits of measurements (SI)
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Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4SN: 103245 SN: 31982 / 06327 SN: 31-Mar-20 (No. 217-03106)Apr-21 Apr-21 SN: 310982 / 06327 SN: 31-Mar-20 (No. 217-03104) SN: 310982 / 06327 SN: 7349 SN: 7349 SN: 601Apr-21 SN: 28-Dec-20 (No. EX3-7349_Dec20) Dec-21 SN: 601Dec-21 SN: 02-Nov-20 (No. DAE4-601_Nov20)Secondary StandardsID # Check Date (in house)Scheduled Check Scheduled CheckPower meter E4419B Power sensor HP 8481A SP generator R&S SMT-06 Metwork Analyzer Agilent E8358ASN: GB39512475 	Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
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Type-N mismatch combination Reference Probe EX3DV4 OAE4SN: 310982 / 06327 SN: 7349 SN: 7349 SN: 60131-Mar-20 (No. 217-03104) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)Apr-21 Dec-21 Nov-21Secondary StandardsID #Check Date (in house)Scheduled CheckSower meter E4419B Power sensor HP 8481A Power sensor HP 8481A SN: 100972SN: GB39512475 SN: 10097230-Oct-14 (in house check Oct-20) SN: 100972In house check: Oct-22 In house check Oct-20)In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22RF generator R&S SMT-06 Wetwork Analyzer Agilent E8358AName Jeffrey KatzmanFunction Laboratory TechnicianSignature Jeffrey	ower sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference Probe EX3DV4 bAE4SN: 7349 SN: 60128-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)Dec-21 Nov-21Recondary StandardsID # Check Date (in house)Scheduled CheckPower meter E4419B Power sensor HP 8481A Power sensor HP 8481ASN: GB39512475 SN: US37292783 SN: US37292783 SN: MY41092317 SN: 100972 SN: 100972 SN: 100972 SN: 100972 SN: US41080477 SN: US41080477In house check Oct-20 SN: US41080477 SI-Mar-14 (in house check Oct-20) In house check Oct-20 In house check: Oct-21Name Laboratory TechnicianSignature Signature	leference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
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Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358ASN: US37292783 SN: MY41092317 SN: MY41092317 SN: 100972 SN: 100972 SN: US41080477O7-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) SN: In house check Oct-20) In house check: Oct-22 In house check: Oct-21NameFunctionSignature In house check: Oct-21Defirey KatzmanLaboratory Technician	Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358ASN: MY41092317 SN: 100972 SN: 100972 SN: US4108047707-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21NameFunctionSignatureJeffrey KatzmanLaboratory Technician	ower meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06   SN: 100972   15-Jun-15 (in house check Oct-20)   In house check: Oct-22     Network Analyzer Agilent E8358A   SN: US41080477   15-Jun-15 (in house check Oct-20)   In house check: Oct-22     Name   Function   Signature     Laboratory Technician   Job	ower sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A   SN: US41080477   31-Mar-14 (in house check Oct-20)   In house check: Oct-21     Name   Function   Signature     Calibrated by:   Jeffrey Katzman   Laboratory Technician   Jeffrey	ower sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Name Function Signature   Calibrated by: Jeffrey Katzman Laboratory Technician	RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Calibrated by: Jeffrey Katzman Laboratory Technician	Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21
J. Foto		Name	Function	Signature
Technical Manager (1910)	Calibrated by:	Jeffrey Katzman	Laboratory Technician	J. type
Approved by: Katja Pokovic Technical Manager	Approved by:	Katja Pokovic	Technical Manager	alles

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

Certificate No: D1900V2-5d036\_Jan21

Report No.: SF210105C01

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## Certificate No: D1900V2-5d036\_Jan21

## **Calibration Laboratory of**

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





S

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

Accreditation No.: SCS 0108

**Glossary**: TSL tissue simulating liquid ConvF sensitivity in TSL / NORM x.v.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	V52.10.4
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	41.2 ± 6 %	1.39 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	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.4 W/kg ± 17.0 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.1 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	50.4 Ω + 5.3 jΩ
Return Loss	- 25.5 dB

## **General Antenna Parameters and Design**

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

Date: 22.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d036

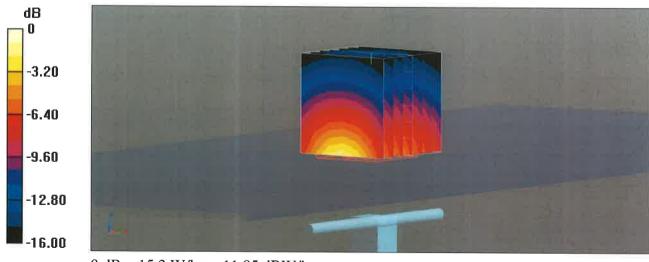
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.39 S/m;  $\epsilon_r$  = 41.2;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

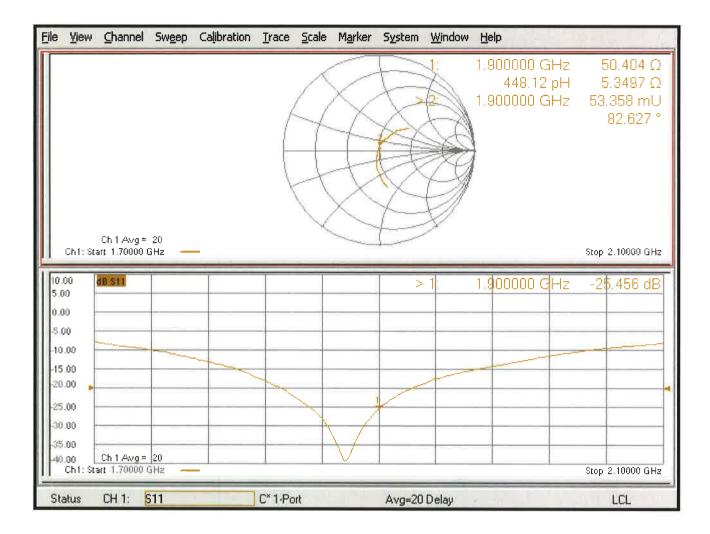
Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 109.8 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 18.4 W/kg **SAR(1 g) = 10.0 W/kg; SAR(10 g) = 5.23 W/kg** Smallest distance from peaks to all points 3 dB below = 9.8 mm Ratio of SAR at M2 to SAR at M1 = 55.3% Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Certificate No: D1900V2-5d036\_Jan21

## Impedance Measurement Plot for Head TSL



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S **Swiss Calibration Service** 

Accreditation No.: SCS 0108

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B.V. ADT (Auden) Client

Certificate No:	D2450V2-737_Aug20
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# **CALIBRATION CERTIFICATE**

Object	D2450V2 - SN:73	7	
Calibration procedure(s)	QA CAL-05.v11		
	<b>Calibration Proces</b>	dure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date:	August 13, 2020		
Cambration date.	14guot 10, 2020		
This collection actificate document	to the tracebility to petic	onal standards, which realize the physical u	nits of measurements (SI)
		obability are given on the following pages a	
i ne measurements and the uncerta	annies with confidence pr	obability are given on the following pages a	and are part of the continuate.
			C and burnidity , 70%
All calibrations have been conducted	ed in the closed laborator	y facility: environment temperature (22 $\pm$ 3)	~U and numidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)		
	1		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20
	24		
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-19)	In house check: Oct-20
			10 <b>-</b>
	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	Alat
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Approved by:	Katja Pokovic	Technical Manager	all 1
			an it
			Issued: August 14, 2020
1			

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

Certificate No: D2450V2-737\_Aug20

Report No.: SF210105C01

## **Calibration Laboratory of**

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





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#### **Glossarv:**

TSL	tissue simulating liquid
	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%.

Report No.: SF210105C01



#### **Measurement Conditions**

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

DASY5	V52.10.4
Advanced Extrapolation	
Modular Flat Phantom	
10 mm	with Spacer
dx, dy, dz = 5 mm	
2450 MHz ± 1 MHz	
	Advanced Extrapolation   Modular Flat Phantom   10 mm   dx, dy, dz = 5 mm

#### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	(1993),	2222.3

#### SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.6 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	6.12 W/kg

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.8 Ω + 4.7 jΩ	
Return Loss	- 23.9 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 by	SFEAG

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

Date: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:737

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz;  $\sigma = 1.84$  S/m;  $\epsilon_r = 38.9$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.74, 7.74, 7.74) @ 2450 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

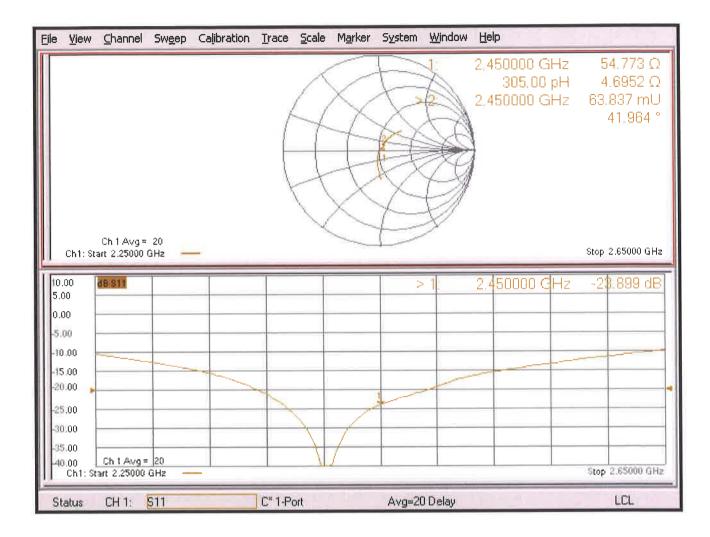
Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 114.4 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 25.6 W/kg **SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.12 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 51.2% Maximum value of SAR (measured) = 21.2 W/kg



0 dB = 21.2 W/kg = 13.27 dBW/kg

Certificate No: D2450V2-737\_Aug20

#### Impedance Measurement Plot for Head TSL



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#### Certificate No: D2600V2-1020\_Aug20

# **CALIBRATION CERTIFICATE**

B.V. ADT (Auden)

Client

Object	D2600V2 - SN:10	20	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	August 13, 2020		
The measurements and the uncerta	ainties with confidence pr ed in the closed laborator	onal standards, which realize the physical u obability are given on the following pages a y facility: environment temperature (22 ± 3)	nd are part of the certificate.
			Osh soluted Calibratian
Primary Standards	1D #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-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-19)	In house check: Oct-20
	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	J. Loton
			- 0
Approved by:	Katja Pokovic	Technical Manager	delly
This calibration certificate shall no	t be reproduced except ir	full without written approval of the laborate	Issued: August 14, 2020

Certificate No: D2600V2-1020\_Aug20

Report No.: SF210105C01

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Accreditation No.: SCS 0108

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

tissue simulating liquid
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	V52.10.4
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	38.3 ± 6 %	2.01 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	14.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.5 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	6.30 W/kg

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

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

Impedance, transformed to feed point	48.1 Ω - 5.4 jΩ	
Return Loss	- 24.7 dB	

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

Electrical Delay (one direction)	1.154 ns
Electrical Delay (one direction)	

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

	00510
Manufactured by	SPEAG

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

Date: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1020

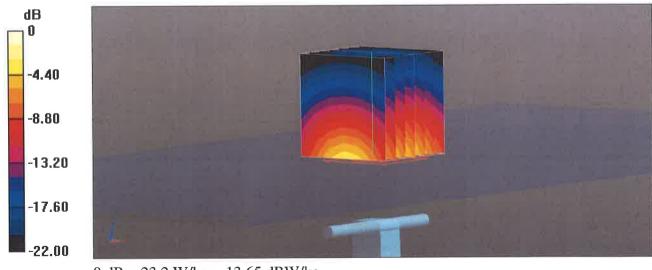
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz;  $\sigma$  = 2.01 S/m;  $\epsilon_r$  = 38.3;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.54, 7.54, 7.54) @ 2600 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

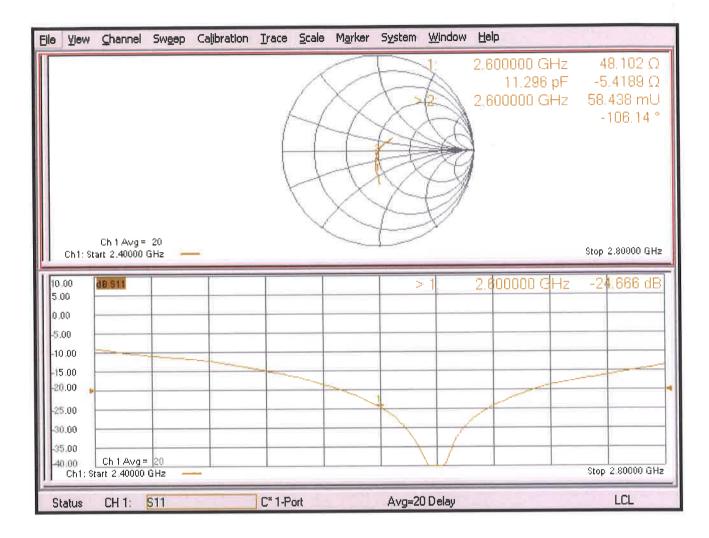
## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 117.5 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 28.1 W/kg SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.30 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 50.2% Maximum value of SAR (measured) = 23.2 W/kg



0 dB = 23.2 W/kg = 13.65 dBW/kg

## Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 0108

Certificate No: D5GHzV2-1019\_Mar21

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#### B.V. ADT (Auden) Client

alibration date: Ma	CAL-22.v6 libration Proce rch 19, 2021	edure for SAR Validation Sources	between 3-10 GHz
alibration date: Ma	libration Proce	edure for SAR Validation Sources	between 3-10 GHz
his calibration certificate documents the	rch 19, 2021		
his calibration certificate documents the			
he measurements and the uncertainties	•	ional standards, which realize the physical un	
	3 with confidence p	robability are given on the following pages an	id are part of the certificate.
Il calibrations have been conducted in t	he closed laborato	ry facility: environment temperature (22 $\pm$ 3)°	C and humidity < 70%.
alibration Equipment used (M&TE critic	al for calibration)		
rimary Standards	#	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP SN	: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
ower sensor NRP-Z91 SN	: 103244	01-Apr-20 (No. 217-03100)	Apr-21
ower sensor NRP-Z91 SN	: 103245	01-Apr-20 (No. 217-03101)	Apr-21
	: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
·	: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
	: 3503	30-Dec-20 (No. EX3-3503_Dec20)	Dec-21
AE4 SN	: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
econdary Standards	#	Check Date (in house)	Scheduled Check
ower meter E4419B SN	: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
ower sensor HP 8481A SN	: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
	: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
•	: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
letwork Analyzer Agilent E8358A SN	: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21
Na	me	Function	Signature
Calibrated by: Cla	udio Leubler	Laboratory Technician	
		and the second second second	VEL
Approved by: Kat	ja Pokovic	Technical Manager	mai
			WW (

Certificate No: D5GHzV2-1019\_Mar21

Report No.: SF210105C01

## **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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## Glossarv:

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%.

Report No.: SF210105C01



### **Measurement Conditions**

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

DASY5	V52.10.4
Advanced Extrapolation	
Modular Flat Phantom V5.0	
10 mm	with Spacer
dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
5250 MHz ± 1 MHz	
5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	
	Advanced ExtrapolationModular Flat Phantom V5.010 mmdx, dy = 4.0 mm, dz = 1.4 mm5250 MHz $\pm$ 1 MHz5600 MHz $\pm$ 1 MHz

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.51 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	8.13 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	23.0 W/kg ± 19.5 % (k=2)

## Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.86 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	8.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.4 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	23.3 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5750 MHz The following parameters and calculations were applied.

01	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	34.0 ± 6 %	5.01 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	88 <b>4</b> 5)	

## SAR result with Head TSL at 5750 MHz

Condition	
100 mW input power	8.02 W/kg
normalized to 1W	79.4 W/kg ± 19.9 % (k=2)
	100 mW input power

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 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	54.1 Ω - 6.4 jΩ
Return Loss	- 22.7 dB

## Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.6 Ω - 2.5 jΩ
Return Loss	- 22.6 dB

### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	57.9 Ω + 3.1 jΩ
Return Loss	- 22.1 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.203 ns
----------------------------------	----------

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

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

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

### Additional EUT Data

Manufactured by	SPEAG	
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## **DASY5 Validation Report for Head TSL**

Date: 19.03.2021

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1019

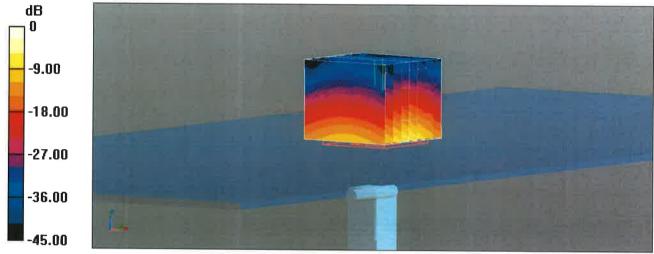
Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz;  $\sigma = 4.51$  S/m;  $\varepsilon_r = 34.7$ ;  $\rho = 1000$  kg/m<sup>3</sup> Medium parameters used: f = 5600 MHz;  $\sigma = 4.86$  S/m;  $\varepsilon_r = 34.2$ ;  $\rho = 1000$  kg/m<sup>3</sup> Medium parameters used: f = 5750 MHz;  $\sigma = 5.01$  S/m;  $\varepsilon_r = 34$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

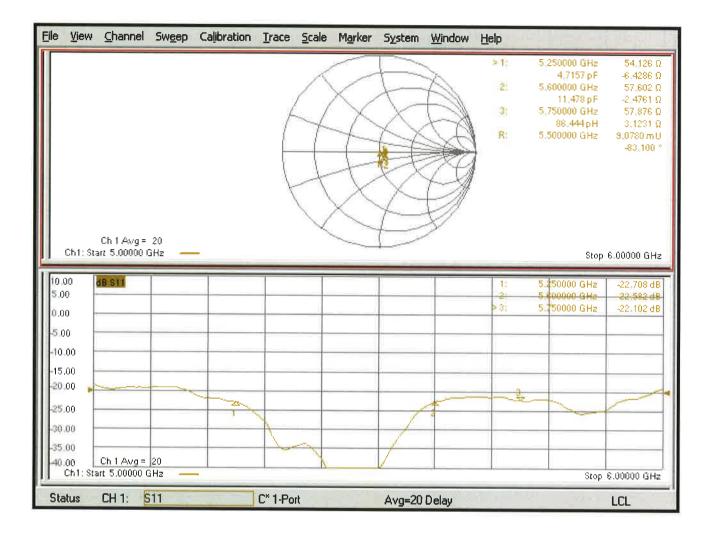
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 79.20 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 27.6 W/kg SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.32 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 70.7% Maximum value of SAR (measured) = 18.1 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 = 77.00 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 31.0 W/kg SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.36 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 66.9% Maximum value of SAR (measured) = 19.6 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 = 74.22 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 31.6 W/kg SAR(1 g) = 8.02 W/kg; SAR(10 g) = 2.27 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65% Maximum value of SAR (measured) = 19.2 W/kg



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

## Impedance Measurement Plot for Head TSL



#### **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

In house check: Oct-21

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

B.V. ADT (Auden) Client

**CALIBRATION CERTIFICATE** EX3DV4 - SN:3650 QA CAL-01.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes March 26, 2021 Calibration date: 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%. Scheduled Calibration ID Cal Date (Certificate No.) Primary Standards 01-Apr-20 (No. 217-03100/03101) Apr-21 Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100) Apr-21 SN: 103244 Power sensor NRP-Z91 Apr-21 01-Apr-20 (No. 217-03101) SN: 103245 Power sensor NRP-Z91 31-Mar-20 (No. 217-03106) Apr-21 Reference 20 dB Attenuator SN: CC2552 (20x) Dec-21 23-Dec-20 (No. DAE4-660 Dec20) SN: 660 DAF4 Dec-21 30-Dec-20 (No. ES3-3013 Dec20) SN: 3013 Reference Probe ES3DV2 Scheduled Check ID Check Date (in house) Secondary Standards In house check: Jun-22 SN: GB41293874 06-Apr-16 (in house check Jun-20) Power meter E4419B 06-Apr-16 (in house check Jun-20) In house check: Jun-22 SN: MY41498087 Power sensor E4412A In house check: Jun-22 06-Apr-16 (in house check Jun-20) SN: 000110210 Power sensor E4412A 04-Aug-99 (in house check Jun-20) In house check: Jun-22 RF generator HP 8648C SN: US3642U01700

latan Kastrati		
Jeton Kastrati	Laboratory Technician	fle
Katja Pokovic	Technical Manager	Ruf
		Issued: March 27, 2021
		Katja Pokovic Technical Manager

31-Mar-14 (in house check Oct-20)

Network Analyzer E8358A

Certificate No: EX3-3650 Mar21

Object

Calibration procedure(s)

Calibration Equipment used (M&TE critical for calibration)

SN: US41080477

## **Calibration Laboratory of**

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



Schweizerischer Kalibrierdienst S

- Service suisse d'étalonnage С
- Servizio svizzero di taratura
- S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

### Glossarv:

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 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),
1 Old 1 Zation 5	h = 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
- 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  $\leq 900$  MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E<sup>2</sup>-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 MH<sub>7</sub>.
- 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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Accreditation No.: SCS 0108

### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	0.40	0.41	0.41	± 10.1 %
DCP (mV) <sup>B</sup>	107.4	100.2	101.2	

#### **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	183.7	± 3.3 %	± 4.7 %
		Y	0.00	0.00	1.00		179.3		
		Z	0.00	0.00	1.00		186.2		
10352-	Pulse Waveform (200Hz, 10%)	X	2.58	65.68	10.54	10.00	60.0	± 3.5 %	± 9.6 %
AAA		Y	20.00	92.43	21.05		60.0		
		Z	20.00	91.86	21.59		60.0		
10353-	Pulse Waveform (200Hz, 20%)	X	1.95	66.59	9.90	6.99	80.0	± 2.2 %	± 9.6 %
AAA		Y	20.00	96.21	21.86	1	80.0		
		Z	20.00	93.31	20.96	1	80.0		
10354-	Pulse Waveform (200Hz, 40%)	X	2.11	70.97	10.58	3.98	95.0	± 1.1 %	± 9.6 %
AAA		Y	20.00	106.79	25.61	1	95.0		
		Z	20.00	97.89	21.69	1	95.0		
10355-	Pulse Waveform (200Hz, 60%)	X	20.00	89.92	15.28	2.22	120.0	± 1.1 %	± 9.6 %
AAA		Y	20.00	112.23	26.93	]	120.0		
		Z	20.00	104.25	23.40	1	120.0		
10387-	QPSK Waveform, 1 MHz	X	1.62	68.80	15.68	1.00	150.0	± 2.3 %	± 9.6 %
AAA		Y	1.87	66.92	15.80	]	150.0		
		Z	1.79	65.63	14.94	1	150.0		
10388-	QPSK Waveform, 10 MHz	X	2.07	68.21	15.96	0.00	150.0	± 1.0 %	± 9.6 %
AAA		Y	2.50	69.37	16.52	1	150.0	1	
		Z	2.33	67.81	15.58	1	150.0	1	
10396-	64-QAM Waveform, 100 kHz	X	2.28	68.41	17.80	3.01	150.0	± 0.7 %	± 9.6 %
AAA		Y	2.88	69.88	18.56		150.0	1	
		Z	2.94	69.67	18.30		150.0	1	
10399-	64-QAM Waveform, 40 MHz	X	3.28	66.72	15.60	0.00	150.0	± 0.7 %	± 9.6 %
AAA		Y	3.58	67.26	15.94		150.0		
		Z	3.48	66.53	15.45		150.0		
10414-	WLAN CCDF, 64-QAM, 40MHz	X	4.50	65.48	15.41	0.00	150.0	± 1.8 %	± 9.6 %
AAA		Y	4.95	65.63	15.57	]	150.0	]	
		Z	4.91	65.33	15.32	1	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%.

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

<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.

<sup>&</sup>lt;sup>B</sup> Numerical linearization parameter: uncertainty not required.

	C1	C2	α	T1	T2	Т3	T4	T5	Т6
	fF	fF	V <sup>-1</sup>	ms.V⁻²	ms.V⁻¹	ms	V <sup>-2</sup>	V <sup>-1</sup>	
Х	27.9	201.88	33.63	4.11	0.30	4.96	1.27	0.00	1.00
Y	52.3	386.53	34.95	11.58	0.00	5.05	0.67	0.30	1.00
Z	53.2	393.80	34.97	10.42	0.56	5.01	0.85	0.31	1.01

#### **Sensor Model Parameters**

### **Other Probe Parameters**

Triangular
158.3
enabled
disabled
337 mm
10 mm
9 mm
2.5 mm
1 mm
1 mm
1 mm
1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an Area Scan job.

T

#### Unc Depth <sup>G</sup> Conductivity Relative Alpha <sup>G</sup> (k=2) (mm) ConvF Z Permittivity<sup>F</sup> ConvF X ConvF Y f (MHz)<sup>C</sup> (S/m) ± 12.0 % 0.54 0.80 9.92 9.92 0.89 9.92 41.9 750 ± 12.0 % 0.83 0.48 9.83 9.83 9.83 0.90 41.5 835 ± 12.0 % 0.45 0.80 9.70 9.70 9.70 0.97 900 41.5 0.80 ± 12.0 % 0.45 8.94 8.94 1.20 8.94 40.5 1450 ± 12.0 % 0.35 0.86 8.61 8.61 8.61 1.31 1640 40.2 0.86 ± 12.0 % 8.54 8.54 0.33 8.54 1.37 1750 40.1 ± 12.0 % 8.17 0.35 0.86 8.17 8.17 1.40 1900 40.0 0.29 0.86 ± 12.0 % 8.05 8.05 1.40 8.05 40.0 2000 0.36 0.90 ± 12.0 % 7.96 7.96 7.96 1.67 2300 39.5 0.90 ± 12.0 % 7.77 0.39 7.77 1.80 7.77 39.2 2450 0.36 0.90 ± 12.0 % 7.57 7.57 1.96 7.57 39.0 2600 ± 13.1 % 0.30 1.30 7.00 7.00 2.71 7.00 38.2 3300 ± 13.1 % 1.30 0.25 6.80 6.80 6.80 2.91 3500 37.9 ± 13.1 % 1.30 6.75 6.75 0.30 6.75 3.12 3700 37.7 1.60 ± 13.1 % 6.39 0.40 6.39 6.39 3.32 3900 37.5 0.40 1.60 ± 13.1 % 6.22 3.53 6.22 6.22 37.2 4100 1.60 ± 13.1 % 6.25 0.40 6.25 3.63 6.25 37.1 4200 1.60 ± 13.1 % 0.40 6.13 6.13 3.84 6.13 36.9 4400 1.80 ± 13.1 % 6.07 0.40 6.07 6.07 4.04 36.7 4600 1.80 ± 13.1 % 0.45 6.04 6.04 6.04 4.25 36.4 4800 ± 13.1 % 1.80 0.40 5.75 5.75 5.75 4.40 4950 36.3 1.80 ± 13.1 % 0.40 5.29 5.29 5.29 4.71 5250 35.9 0.40 1.80 ± 13.1 % 4.80 4.80 4.80 5.07 5600 35.5 1.80 ± 13.1 % 5.10 0.40 5.10 5.10 5.22 5750 35.4

## Calibration Parameter Determined in Head Tissue Simulating Media

<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 at 10% if liquid compensation formula is applied to

<sup>F</sup> 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 ConvF uncertainty for indicated target tissue parameters.

the ConvF uncertainty for indicated target issue parameters. <sup>6</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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# Calibration Parameter Determined in Head Tissue Simulating Media

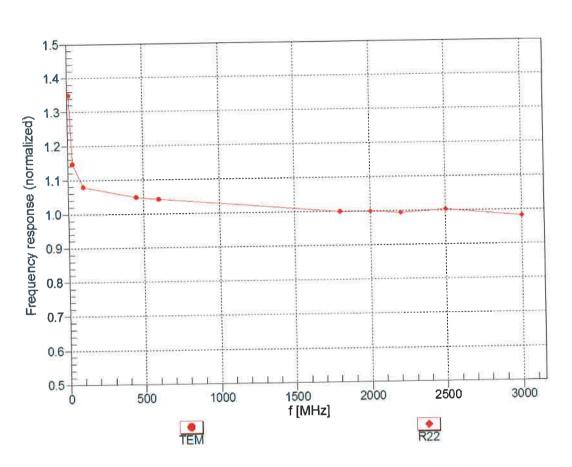
f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>®</sup> (mm)	Unc (k=2)
6500	34.5	6.07	5.70	5.70	5.70	0.20	2.50	± 18.6 %

<sup>c</sup> Frequency validity above 6GHz is ± 700 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

At frequencies 6-10 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. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters. <sup>6</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than  $\pm$  1% for frequencies below 3 GHz; below  $\pm$  2% for frequencies between 3-6 GHz; and below  $\pm$  4% for frequencies between 6-10 GHz at any distance larger than half the probe tip diameter from the boundary.

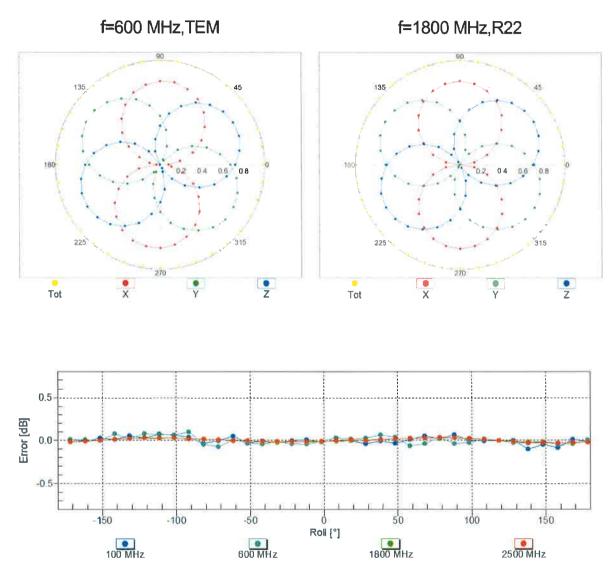
Certificate No: EX3-3650\_Mar21



## Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

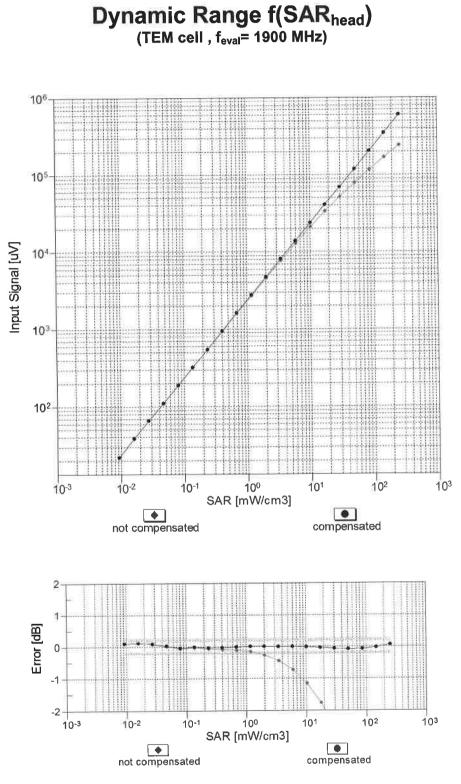
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

March 26, 2021

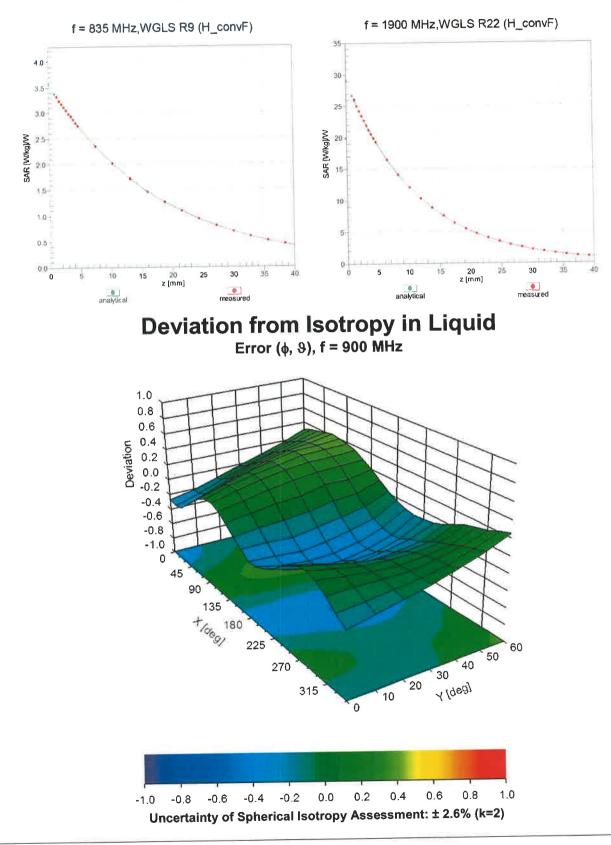


Receiving Pattern ( $\phi$ ),  $\vartheta = 0^{\circ}$ 

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



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



## **Conversion Factor Assessment**

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#### EX3DV4- SN:3650

## Appendix: Modulation Calibration Parameters

UID	Rev	Communication System Name	Group	PAR (dB)	Unc <sup>t</sup> (k=2)
)		CW	CW	0.00	± 4.7 %
0010	CAA	SAR Validation (Square, 100ms, 10ms)	Test	10.00	± 9.6 %
0011	CAB	UMTS-FDD (WCDMA)	WCDMA	2.91	± 9.6 %
0012	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	WLAN	1.87	± 9.6 %
0013	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	WLAN	9.46	± 9.6 %
0021	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 %
10020	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 %
10028		EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	GSM	7.78	± 9.6 %
10029	DAC	IEEE 802.15.1 Bluetooth (GFSK, DH1)	Bluetooth	5.30	± 9.6 %
10030	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	Bluetooth	1.87	± 9.6 °
	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	Bluetooth	1.16	± 9.6
10032	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	Bluetooth	7.74	± 9.6 °
10033	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	Bluetooth	4.53	± 9.6 °
10034	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	Bluetooth	3.83	± 9.6
10035	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	Bluetooth	8.01	± 9.6
10036	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	Bluetooth	4.77	± 9.6
10037	CAA		Bluetooth	4.10	± 9.6
10038	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	CDMA2000	4.57	± 9.6
10039	CAB	CDMA2000 (1xRTT, RC1)	AMPS	7.78	± 9.6
10042	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	AMPS	0.00	± 9.6
10044	CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	DECT	13.80	± 9.6
10048	CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	DECT	10.79	± 9.6
10049	CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	TD-SCDMA	11.01	± 9.6
10056	CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)		6.52	± 9.6
10058	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	GSM		± 9.6
10059	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	WLAN	2.12	
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	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	WLAN	8.68	± 9.6
10063	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	WLAN	8.63	± 9.6
10064	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	WLAN	9.09	± 9.6
10065	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	WLAN	9.00	± 9.6
10066	CAD	HERE AND ALL AVELE CUL- (OEDM 24 Mbos)	WLAN	9.38	± 9.6
10067	CAD	HERE DOD 44 IN MULTI & OUT (OFDM 26 Maps)	WLAN	10.12	± 9.6
10068	CAD	HERE ADD IN A MARELE ON A COEDMA 49 Mbps)	WLAN	10.24	± 9.6
10069	CAD	ITTE ODD 11 INITI 5 OH - (OFDM 54 Mbps)	WLAN	10.56	± 9.6
10071	CAB	I THE ARE ALL MUTTING A CITY (DECENTION ON MIDES)	WLAN	9.83	± 9.6
10072	CAB	HERE AND ALL MARTING A ONLY (DESS/OEDM 12 Mbps)	WLAN	9.62	± 9.6
10072		HERE GOD ALL MIT O A OUR (DESS/OEDM 18 Mbps)	WLAN	9.94	± 9.6
10074	CAB	THE BOAR OF THE CALLE (DECEMOEDM 24 Mbrs)	WLAN	10.30	± 9.6
10074	CAB	THE ADD AND THE OLD OF THE OPERATION SET AND THE OPERATION OF THE OPERATIO	WLAN	10.77	± 9.6
10075	CAB	A STATE OF A CHE (DESS/OEDM 48 Mbps)	WLAN	10.94	± 9.6
2.818 M.12	CAB	CONTRACT AND A CITY (DESS/OEDM 54 Mbps)	WLAN	11.00	± 9.6
10077	CAB	PRIMARA (1 DTT DO2)	CDMA2000	3.97	± 9.0
10081	CAB	TO ALL ADD TOD TODAL COM DIA DOPSK Fullrate)	AMPS	4.77	± 9.0
10082	CAB	THE ALL CLOCK THE ALL	GSM	6.56	± 9.
10090	DAC		WCDMA	3.98	± 9.0
10097	CAC	UMTS-FDD (HSDPA) UMTS-FDD (HSUPA, Subtest 2)	WCDMA	3.98	± 9.

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10099	CAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	GSM	9.55	± 9.6 %
10100	CAC	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	LTE-FDD	5.67	± 9.6 %
10100	CAC	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	LTE-FDD	6.42	± 9.6 %
10102	CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	LTE-FDD	6.60	± 9.6 %
10102		LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	LTE-TDD	9.29	± 9.6 %
10103	DAC	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	LTE-TDD	9.97	± 9.6 %
10104	CAE	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	LTE-TDD	10.01	± 9.6 %
10105	CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	LTE-FDD	5.80	± 9.6 %
10108	CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	LTE-FDD	6.43	± 9.6 %
	CAG	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	6.59	± 9.6 %
10112	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	LTE-FDD	6.62	± 9.6 %
10113	CAG	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	WLAN	8.10	± 9.6 %
10114	CAG	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)			± 9.6 %
10115	CAG	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	WLAN	8.46	
10116	CAG	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	WLAN	8.15	± 9.6 %
10117	CAG	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	WLAN	8.07	± 9.6 %
10118	CAD	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	WLAN	8.59	± 9.6 %
10119	CAD	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	WLAN	8.13	± 9.6 %
10140	CAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	LTE-FDD	6.49	± 9.6 %
10141	CAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	LTE-FDD	6.53	± 9.6 %
10142	CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10143	CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	LTE-FDD	6.35	± 9.6 %
10144	CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	LTE-FDD	6.65	± 9.6 %
10145	CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	LTE-FDD	5.76	± 9.6 %
10146	CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	LTE-FDD	6.41	± 9.6 %
10147	CAC	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	CAE	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	LTE-TDD	9.28	± 9.6 %
10152	CAE	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	LTE-TDD	9.92	± 9.6 %
10153	CAE	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	LTE-TDD	10.05	± 9.6 %
10154	CAF	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	LTE-FDD	5.75	± 9.6 %
10155	CAF	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	LTE-FDD	6.43	± 9.6 %
10156	CAF	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	LTE-FDD	5.79	± 9.6 %
10157	CAE	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	LTE-FDD	6.49	± 9.6 %
10158	CAE	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	LTE-FDD	6.62	± 9.6 %
10159	CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	LTE-FDD	6.56	± 9.6 %
10160	CAG	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	LTE-FDD	5.82	± 9.6 %
10160	CAG	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	LTE-FDD	6.43	± 9.6 %
10162	CAG	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	LTE-FDD	6.58	± 9.6 %
10166	_	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	LTE-FDD	5.46	± 9.6 %
10167	CAG	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	LTE-FDD	6.21	± 9.6 %
10167	CAG	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	LTE-FDD	6.79	± 9.6 %
10168	CAG	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	LTE-FDD	5.73	± 9.6 %
10169	CAG	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-FDD	6.52	± 9.6 %
-	CAG	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 10-QAM)	LTE-FDD	6.49	± 9.6 %
10171	CAE	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	LTE-TDD	9.21	± 9.6 %
10172	CAE	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10173	CAE	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-TDD	10.25	± 9.6 %
10174	CAF	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 04-QAM)	LTE-FDD	5.72	± 9.6 %
10175	CAF		LTE-FDD	6.52	± 9.6 %
10176	CAF	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	LTE-FDD	5.73	± 9.6 %
10177	CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	LTE-FDD	6.52	± 9.6 %
10178	CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)		6.52	± 9.6 %
10179	AAE	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	0.00	1 1 9.0 70

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