

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR23-SPF0001-A Page (405) of (488)	 
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Appendix A.5 Confined Loop Antennas Calibration certificate (CLA13_1019)

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



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Accreditation No.: **SCS 0108**

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Multilateral Agreement for the recognition of calibration certificates

Client **KCTL (Dymstec)**

Certificate No: **CLA13-1019_Jun22**

CALIBRATION CERTIFICATE

Object **CLA13 - SN: 1019**

Calibration procedure(s) **QA CAL-15.v9**
Calibration Procedure for SAR Validation Sources below 700 MHz

Calibration date: **June 03, 2022**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 3877	31-Dec-21 (No. EX3-3877_Dec21)	Dec-22
DAE4	SN: 654	26-Jan-22 (No. DAE4-654_Jan22)	Jan-23
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by: **Michael Weber** **Michael Weber**
Name: **Michael Weber** Function: **Laboratory Technician** Signature: **M. Weber**

Approved by: **Sven Kühn** **Sven Kühn**
Name: **Sven Kühn** Technical Manager: **Sven Kühn** Signature: **S. Kühn**

Issued: June 9, 2022

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Certificate No: CLA13-1019_Jun22

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Calibration Laboratory of
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

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Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	13 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	55.0	0.75 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	54.7 ± 6 %	0.74 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-----	-----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	1 W input power	0.570 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.575 W/kg ± 18.4 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.353 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.356 W/kg ± 18.0 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 5.9 j Ω
Return Loss	- 23.9 dB

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 03.06.2022

Test Laboratory: SPEAG, Zurich, Switzerland

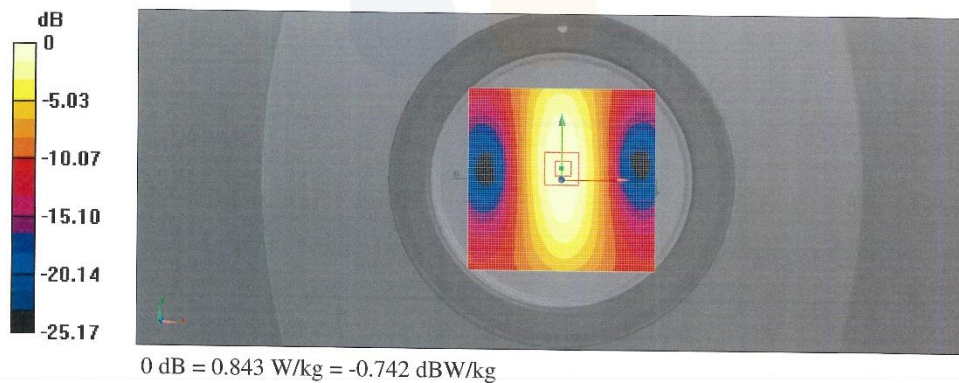
DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1019

Communication System: UID 0, CW (0); Frequency: 13 MHz
Medium parameters used: $f = 13$ MHz; $\sigma = 0.74$ S/m; $\epsilon_r = 54.7$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

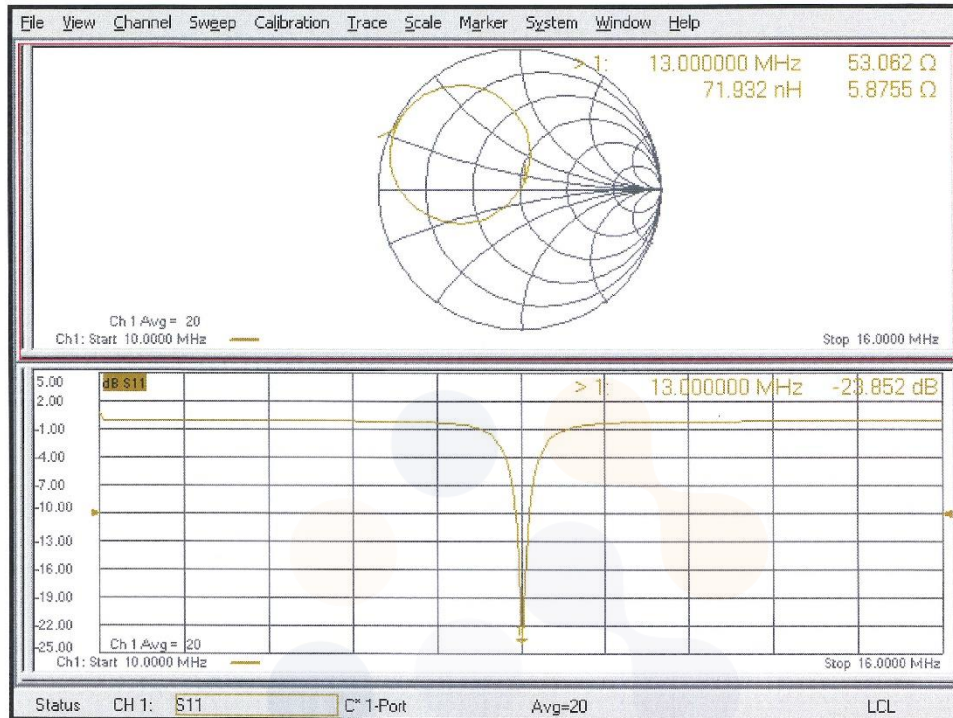
DASY Configuration:

- Probe: EX3DV4 - SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 31.71 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.16 W/kg
SAR(1 g) = 0.570 W/kg; SAR(10 g) = 0.353 W/kg
Smallest distance from peaks to all points 3 dB below = 19.9 mm
Ratio of SAR at M2 to SAR at M1 = 78.4%
Maximum value of SAR (measured) = 0.843 W/kg



Impedance Measurement Plot for Head TSL



Appendix A.6 Dipole Calibration certificate (D750V3_1183)

**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Client **Eurofins KCTL (Dymstec)**

Certificate No: **D750V3-1183_Sep22**

CALIBRATION CERTIFICATE

Object **D750V3 - SN:1183**

Calibration procedure(s) **QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **September 21, 2022**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3^\circ\text{C})$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104776	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: B19394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	31-Aug-22 (No. DAE4-601_Aug22)	Aug-23
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power meter E4419B	SN: 0839512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (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	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Jaton Kastrali	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

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Issued: September 23, 2022

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	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 $\pm$ 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 $\pm$ 0.2) °C	40.7 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.44 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.53 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω - 1.5 j Ω
Return Loss	- 27.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 21.09.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1183

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 40.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

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

Reference Value = 58.91 V/m; Power Drift = 0.00 dB

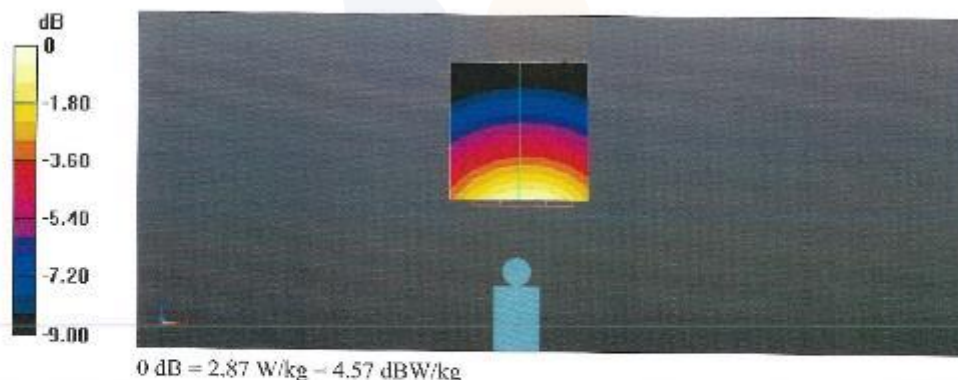
Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.40 W/kg

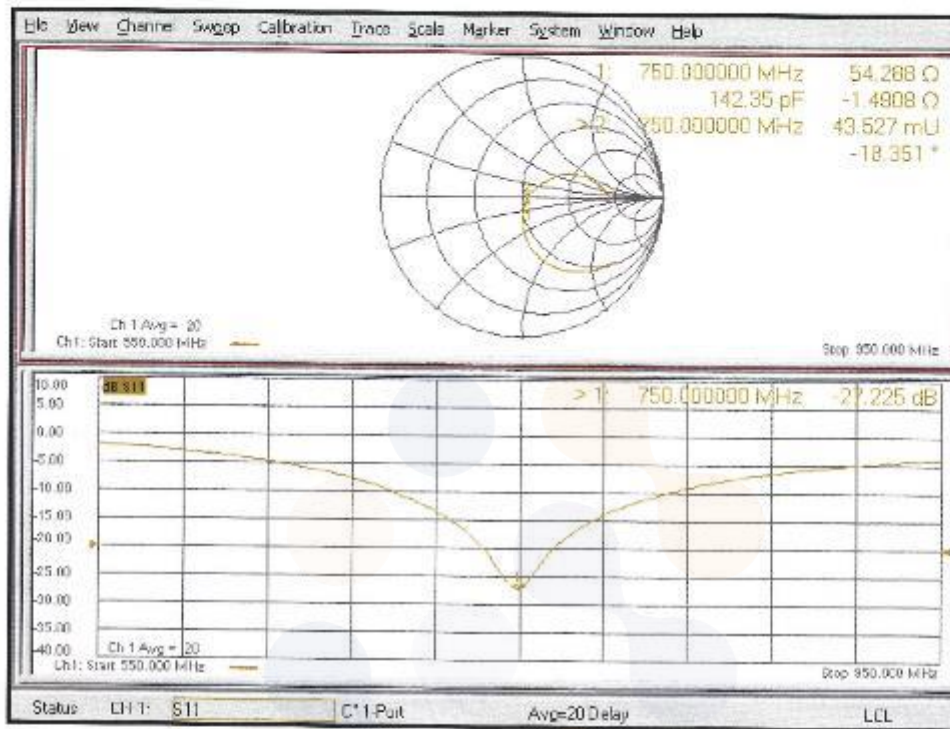
Smallest distance from peaks to all points 3 dB below = 18.9 mm

Ratio of SAR at M2 to SAR at M1 = 65.9%

Maximum value of SAR (measured) = 2.87 W/kg



Impedance Measurement Plot for Head TSL



Appendix A.7 Dipole Calibration certificate (D850V2_1006)

Calibration Laboratory of
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Accreditation No.: **SCS 0108**

Client: **KCTL (Dymstec)**

Certificate No.: **D850V2-1006_Apr22**

CALIBRATION CERTIFICATE

Object: **D850V2 - SN:1006**

Calibration procedure(s): **QA CAL-05.v11**
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: **April 26, 2022**

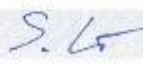
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: 0119394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 08327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAF4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: G839512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP B4B1A	SN: US37292785	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP B4B1A	SN: MY41093315	07-Oct-15 (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	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name Michael Weber	Function Laboratory Technician	Signature 
Approved by:	Sven Kühn	Deputy Manager	

Issued: April 28, 2022

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	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	850 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	0.92 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.1 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	10.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.64 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.54 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.2 Ω - 4.8 $\mu\Omega$
Return Loss	- 26.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.434 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 26.04.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 850 MHz; Type: D850V2; Serial: D850V2 - SN:1006

Communication System: UID 0 - CW; Frequency: 850 MHz

Medium parameters used: $f = 850$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 41.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.63, 9.63, 9.63) @ 850 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

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

Reference Value = 64.62 V/m; Power Drift = 0.02 dB

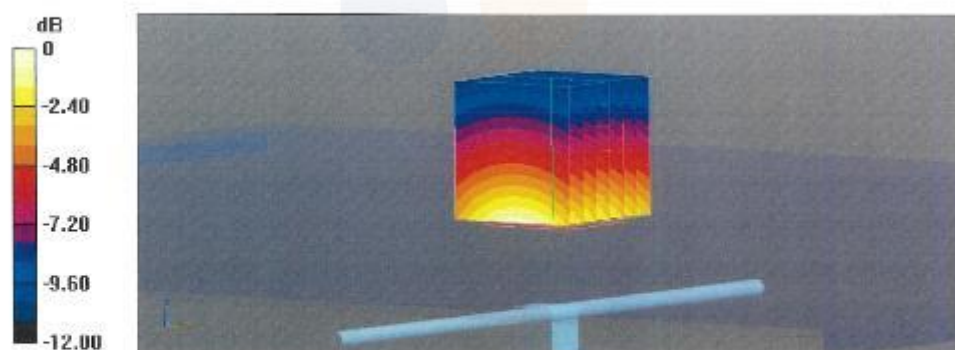
Peak SAR (extrapolated) = 3.83 W/kg

SAR(1 g) = 2.53 W/kg; SAR(10 g) = 1.64 W/kg

Smallest distance from peaks to all points 3 dB below = 16.5 mm

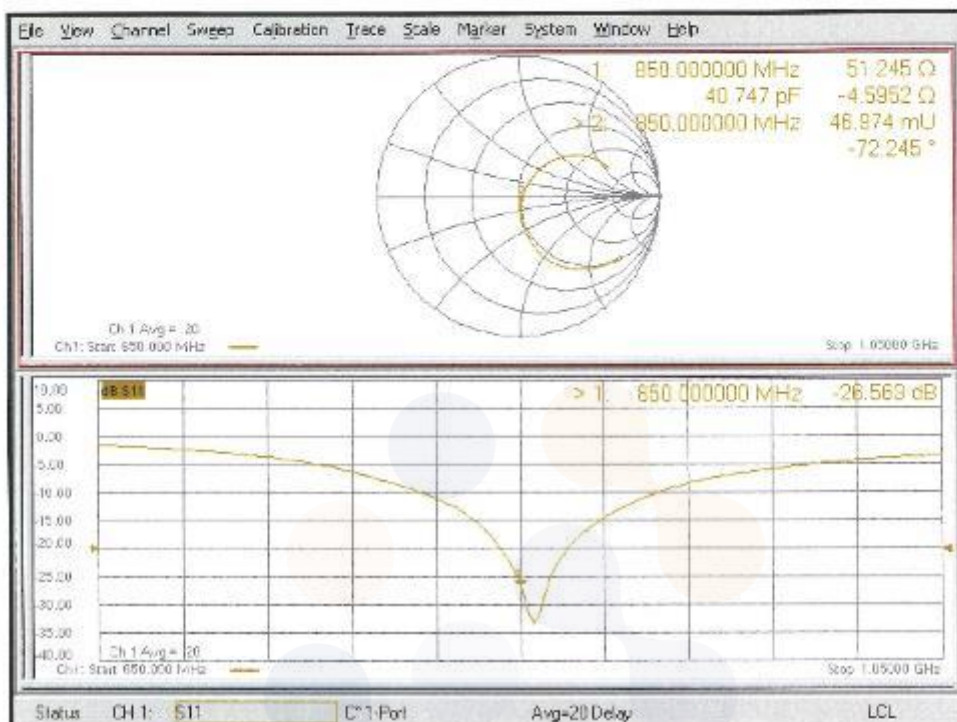
Ratio of SAR at M2 to SAR at M1 = 65.7%

Maximum value of SAR (measured) = 3.40 W/kg



0 dB = 3.40 W/kg = 5.32 dBW/kg

Impedance Measurement Plot for Head TSL



Appendix A.8 Dipole Calibration certificate (D1750V2_1072)

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client: **KCTL (Dymstec)**

Certificate No: **D1750V2-1072_Apr22**

CALIBRATION CERTIFICATE

Object: **D1750V2 - SN:1072**

Calibration procedure(s): **QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

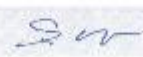
Calibration date: **April 27, 2022**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 108944	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: B19394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310952 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4119B	SN: G889512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292763	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-05	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41050477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name Joanna Leschaj	Function Laboratory Technician	Signature 
Approved by:	Name Sven Kühn	Deputy Manager	

Issued: April 28, 2022

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Certificate No: **D1750V2-1072_Apr22**

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	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 $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.4 $\pm$ 6 %	1.35 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.5 W/kg $\pm$ 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.3 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.6 Ω - 1.3 j Ω
Return Loss	- 36.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.216 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: 27.04.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1072

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.35$ S/m; $\epsilon_r = 39.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAF4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

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

Reference Value = 106.4 V/m; Power Drift = 0.04 dB

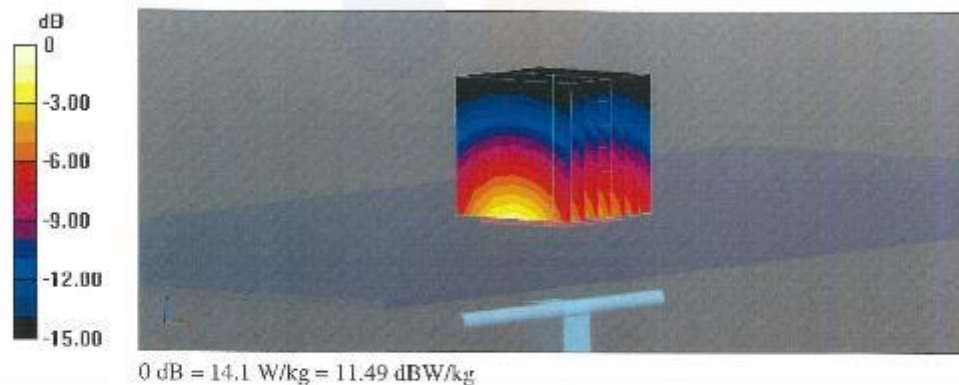
Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.08 W/kg; SAR(10 g) = 4.80 W/kg

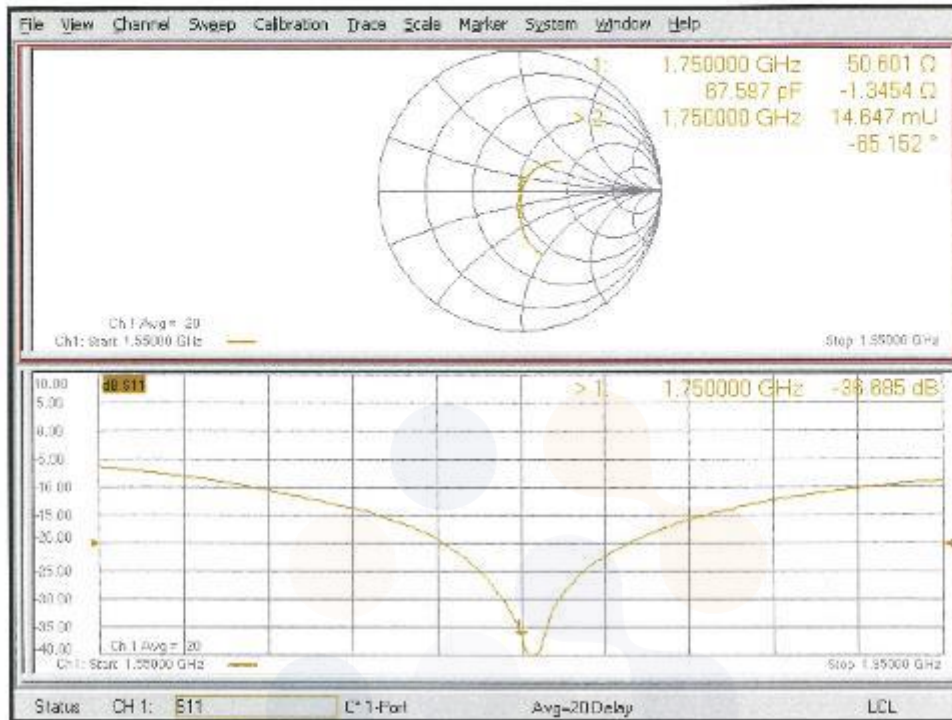
Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 54.3%

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



Impedance Measurement Plot for Head TSL



Appendix A.9 Dipole Calibration certificate (D1900V2_5d160)

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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Client **KCTL (Dymstec)**

Certificate No: **D1900V2-5d160_Apr22**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d160**

Calibration procedure(s) **QA CAL-05.v11**
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: **April 29, 2022**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal. Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104779	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103214	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: 3H9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310082 / 06327	04-Apr-22 (No. 217-03526)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419D	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41033315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100072	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent F8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by: **Jeffrey Katzman** Function: **Laboratory Technician**

Approved by: **Sven Kühn** Deputy Manager

Signature




Issued: May 4, 2022

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Certificate No: D1900V2-5d160_Apr22

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	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 $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.41 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	-----	-----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω + 8.3 j Ω
Return Loss	- 23.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 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: 29.04.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d160

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.41$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 31.12.2021
- Sensor Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 110.1 V/m; Power Drift = 0.04 dB

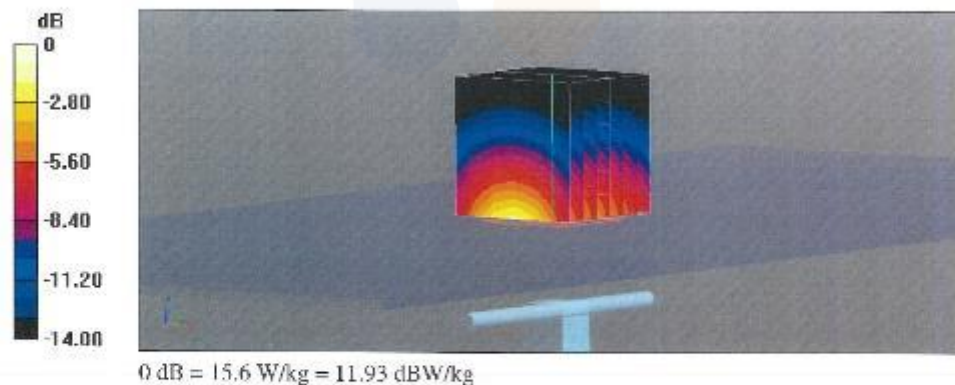
Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10.0 W/kg; SAR(10 g) = 5.22 W/kg

Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 54.3%

Maximum value of SAR (measured) = 15.6 W/kg



Impedance Measurement Plot for Head TSL



Appendix A.10 Dipole Calibration certificate (D2450V2_895)

**Calibration Laboratory of
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Accreditation No.: **SCS 0108**

Client: **Eurofins KCTL (Dymstec)**

Certificate No: **D2450V2-895_Jul22**

CALIBRATION CERTIFICATE

Object: **D2450V2 - SN.895**

Calibration procedure(s): **QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **July 15, 2022**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&E critical for calibration):

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH8391 (20K)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310882 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 801	02-May-22 (No. DAE4-801_May22)	May-23
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4119B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8461A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8461A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 1100372	15-Jun-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-22

Calibrated by:	Name: Aldona Georgianou	Function: Laboratory Technician	Signature: 
Approved by:	Name: Sven Kühn	Function: Technical Manager	Signature: 

Issued: July 26, 2022

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Certificate No: D2450V2-895_Jul22

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	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	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.9 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.3 W/kg $\pm$ 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$55.2 \Omega + 3.5 j\Omega$
Return Loss	-24.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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: 15.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:895

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 37.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

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

Reference Value = 114.7 V/m; Power Drift = 0.09 dB

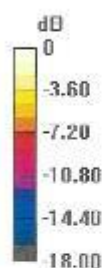
Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.22 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

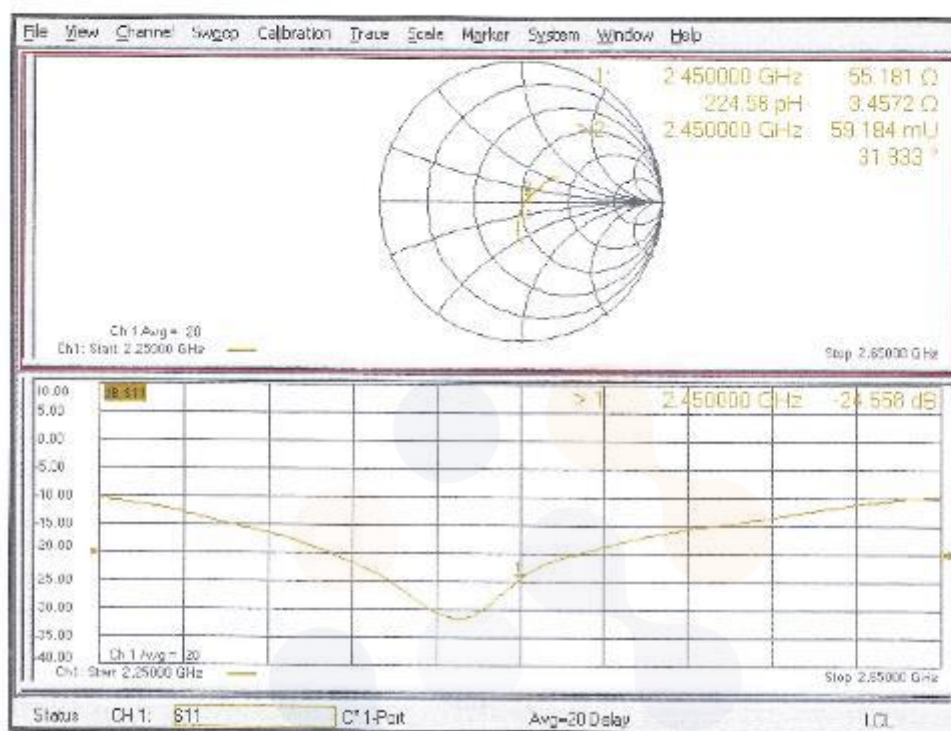
Ratio of SAR at M2 to SAR at M1 = 50.7%

Maximum value of SAR (measured) = 21.9 W/kg



0 dB = 21.9 W/kg = 13.41 dBW/kg

Impedance Measurement Plot for Head TSL



Appendix A.11 Dipole Calibration certificate (D2600V2_1050)

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Eurofins KCTL (Dymstec)**

Certificate No: **D2600V2-1050_Jul22**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1050**

Calibration procedure(s) **QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

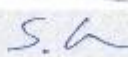
Calibration date: **July 15, 2022**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9364 (20k)	04-Apr-22 (No. 217-03524)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03526)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	02-May-22 (No. DAE4-601_May22)	May-23
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4418B	SN: GB29519475	30-Oct-14 (in house check Oct-20)	in house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	in house check: Oct-22
Power sensor HP 8481A	SN: MY41083315	07-Oct-15 (in house check Oct-20)	in house check: Oct-22
RF generator R&S SMT-08	SN: 100972	15-Jun-15 (in house check Oct-20)	in house check: Oct-22
Network Analyzer Agilent E8363A	SN: US41080477	31-Mar-14 (in house check Oct-20)	in house check: Oct-22

	Name	Function	Signature
Calibrated by:	Aldona Georgiadou	Laboratory Technician	
Approved by:	Sven Köhn	Deputy Manager	

Issued: July 26, 2022

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

Certificate No: D2600V2-1050_Jul22

Page 1 of 6

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	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 $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.3 $\pm$ 6 %	2.01 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.4 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8 Ω - 7.0 j Ω
Return Loss	- 23.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1,151 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
-----------------	-------

DASY5 Validation Report for Head TSL

Date: 15.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1050

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

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.01$ S/m; $\epsilon_r = 37.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 117.4 V/m; Power Drift = 0.09 dB

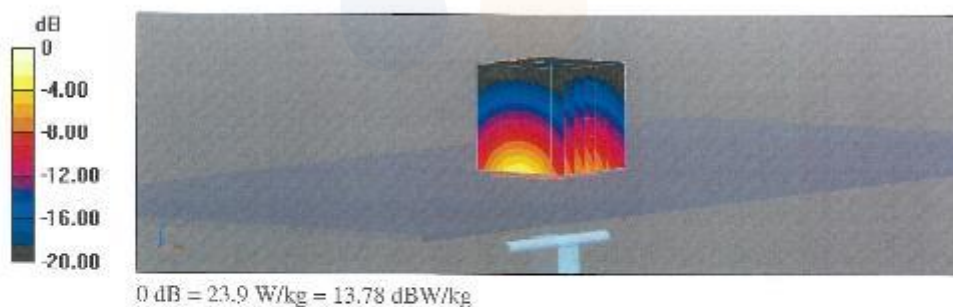
Peak SAR (extrapolated) = 28.9 W/kg

SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.45 W/kg

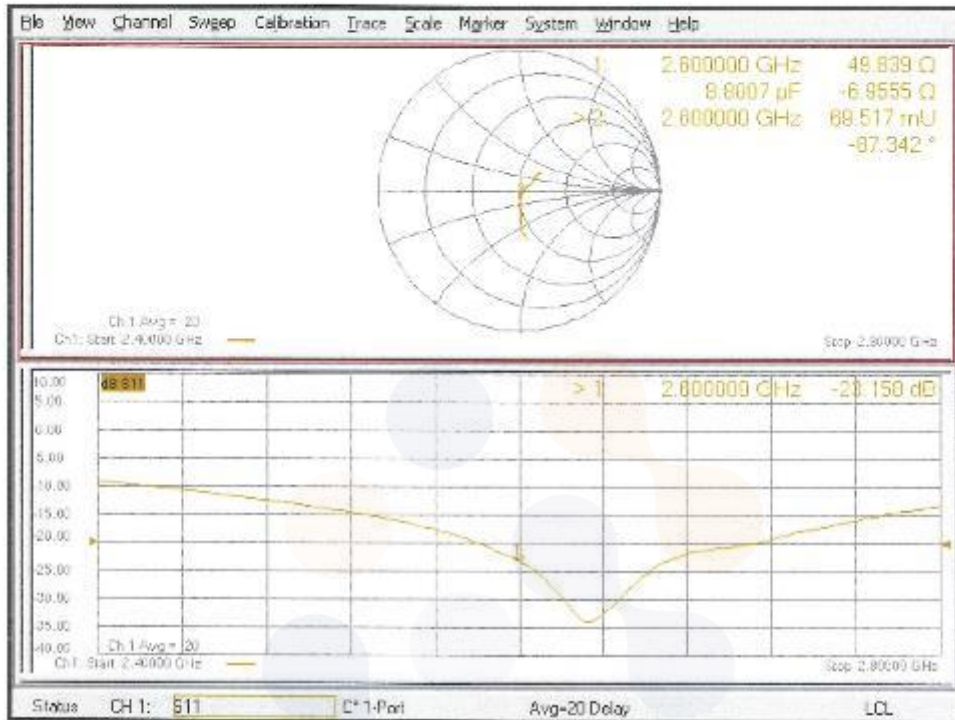
Smallest distance from peaks to all points 3 dB below = 8.5 mm

Ratio of SAR at M2 to SAR at M1 = 50.3%

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



Impedance Measurement Plot for Head TSL



Appendix A.12 Dipole Calibration certificate (D5GHzV2_1134)

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **KCTL (Dymstec)**

Certificate No: **D5GHzV2-1134_Jan22**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1134**

Calibration procedure(s) **QA CAL-22.v6
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **January 27, 2022**

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 (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 08327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	31-Dec-21 (No. EX3-3503_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB29512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292793	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (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 E8363A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Aldona Georgiadou	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: February 2, 2022

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:** This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.9 $\pm$ 6 %	4.52 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.4 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.2 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.4 $\pm$ 6 %	4.87 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.52 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.5 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 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	49.8 Ω - 8.8 j Ω
Return Loss	- 21.1 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.1 Ω - 2.8 j Ω
Return Loss	- 26.5 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.3 Ω - 5.2 j Ω
Return Loss	- 23.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 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: 27.01.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1134

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5250$ MHz; $\sigma = 4.52$ S/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³,
Medium parameters used: $f = 5600$ MHz; $\sigma = 4.87$ S/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³,
Medium parameters used: $f = 5800$ MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 34.1$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 78.11 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 8.20 W/kg; SAR(10 g) = 2.35 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 70.3%

Maximum value of SAR (measured) = 19.2 W/kg

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

Reference Value = 78.44 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 31.5 W/kg

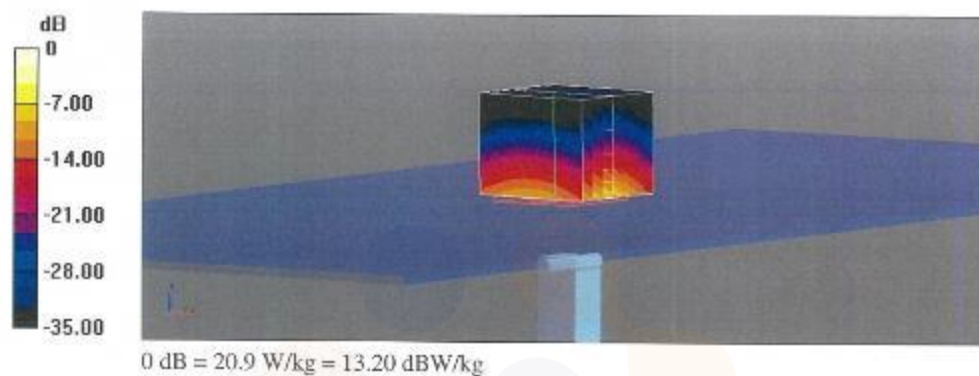
SAR(1 g) = 8.52 W/kg; SAR(10 g) = 2.41 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

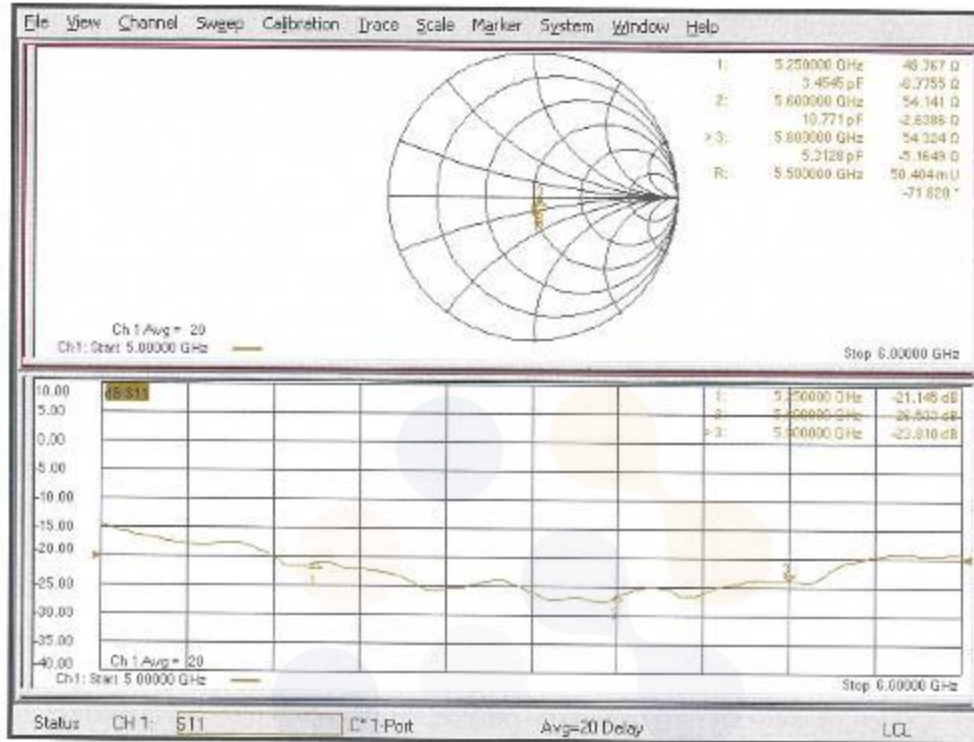
Ratio of SAR at M2 to SAR at M1 = 67.3%

Maximum value of SAR (measured) = 20.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 76.19 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.34 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 65.5%
Maximum value of SAR (measured) = 20.9 W/kg



Impedance Measurement Plot for Head TSL



Appendix B. SAR Tissue Specification

The brain mixtures consist of a viscous gel using hydrox-ethyl cellulose(HEC) gelling agent and saline solution. Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue.

Frequency (MHz)	750 ~ 835		1 750		1 900		2 450		5 200 ~ 5 800	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Ingredient	% by weight									
Water	40.29	51.97	53.00	68.00	55.00	70.50	72.00	73.00	65.52	80.00
Salt (NaCl)	1.38	0.93	0.40	0.20	0.35	0.30	0.10	0.10	0	0
Sugar	57.90	47.00	0	0	0	0	0	0	0	0
HEC	0.24	0	0	0	0	0	0	0	0	0
Bactericide	0.19	0.10	0	0	0	0	0	0	0	0
Triton X-100	0	0	0	0	0	0	20.00	0	17.24	0
DGBE	0	0	46.60	31.80	44.65	29.20	0	26.90	0	0
Diethylene glycol hexyl ether	0	0	0	0	0	0	7.90	0	17.24	0
Polysorbate (Tween) 80	0	0	0	0	0	0	0	0	0	20.00
Tissue parameter target by C. Gabriel and G. Harts grove.										
Salt: 99 % Pure Sodium Chloride					Sucrose: 98 % Pure Sucrose					
Water: De-ionized, 16 M resistivity					HEC: Hydroxyethyl Cellulose					
DGBE: 99 % Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy) ethanol]										
Triton X-100(ultra-pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether										

Appendix C. LTE CA RF Conducted Power

C.1 LTE Uplink Carrier Aggregation

LTE Inter-Band Uplink Carrier Aggregation –Interim Procedures

According to October 2018 TCB workshop, Uplink CA SAR test Guidance as follows;

- 1) If the single uplink 1 -g SAR values for each band are both less than 0.8 W/kg and the algebraic summation of the 1-g SAR values are less than 1.45 W/kg no additional measurements need to be performed.
- 2) If one of the single uplink 1 -g SAR values is greater than 0.8 W/kg, instead of algebraically summing the 1-g SAR values, sum up the SAR distributions, similar to the enlarged zoom scan (volume scan) procedures found in FCC KDB Publication 865664 D01.
- 3) If the algebraic sum of the 1-g SAR values is > 1.45 W/kg additional measurements may have to be made. Submit a KDB inquiry for additional guidance.

Combination	RF Exposure Condition	Antenna		Standalone SAR				UL CA [W/kg] (Worst Algebraic Summation)
		PCC	SCC	Maximum Tune-up Power (dBm)		Reported SAR (W/kg)		
				PCC	SCC	PCC	SCC	
CA_2A-4A	Head	Main 1	Sub 2	24.30	21.00	0.088	0.672	0.760
	Body-Worn	Main 1	Sub 2	24.30	21.00	0.410	0.146	0.556
	Hotspot	Main 1	Sub 2	19.30	21.00	0.624	0.407	1.031

C.2 LTE Downlink Carrier Aggregation

The tables below show the supported frequency bands of the device for DL Inter-band and DL Intra-band combinations.

Power measurements were performed on the channel with the highest maximum output power from Tune-up Procedure.

In applying the power measurement procedures of KDB 941225 D05A for DL CA to qualify for UL SAR test exclusion, power measurement is required only for the subset in each row with the largest combination of frequency bands and CCs

Index	2CC	Restriction	Completely Covered by Measurement Superset	Reverse
2CC #1	CA_2A-2A	N/A	No	N/A
2CC #2	CA_2C	N/A	No	N/A
2CC #3	CA_2A-4A	N/A	3CC #1	Yes
2CC #4	CA_2A-5A	N/A	3CC #1	Yes
2CC #5	CA_2A-12A	N/A	No	Yes
2CC #6	CA_2A-13A	N/A	3CC #2	Yes
2CC #7	CA_2A-17A	N/A	No	Yes
2CC #8	CA_2A-66A	N/A	No	Yes
2CC #9	CA_4A-4A	N/A	No	N/A
2CC #10	CA_4A-5A	N/A	3CC #1	Yes
2CC #11	CA_4A-12A	N/A	No	Yes
2CC #12	CA_4A-13A	N/A	3CC #2	Yes
2CC #13	CA_4A-17A	N/A	No	Yes
2CC #14	CA_5A-41A	B41 SCC Only	No	N/A
2CC #15	CA_5A-66A	N/A	3CC #3	Yes
2CC #16	CA_12A-66A	N/A	3CC #4	Yes
2CC #17	CA_26A-41A	B41 SCC Only	No	N/A
2CC #18	CA_41A-41A	N/A	No	N/A
2CC #19	CA_41C	N/A	No	N/A
2CC #20	CA_66A-66A	N/A	3CC #3	N/A
2CC #21	CA_66B	N/A	No	N/A
2CC #22	CA_66C	N/A	No	N/A

Index	3CC	Restriction	Completely Covered by Measurement Superset	Reverse
3CC #1	CA_2A-4A-5A	N/A	No	Yes
3CC #2	CA_2A-4A-13A	N/A	No	Yes
3CC #3	CA_5A-66A-66A	N/A	No	Yes
3CC #4	CA_12A-66A-66A	N/A	No	Yes

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Note: Only yellow highlight cells need power measurement according to LTE DL CA SAR test Exclusion in TCB workshop (April 2018).

In applying the power measurement procedures of KDB 941225 D05A for DL CA to qualify for UL SAR test exclusion, power measurement is required only for the CA configuration with the largest aggregated DL CA BW in each frequency band, independently for contiguous and non-contiguous CA; however, if the same frequency band is used for both contiguous and non-contiguous CA, power measurement was performed using the configuration with the largest aggregated BW and maximum output power among contiguous and non-contiguous CA.



C.2.1 Downlink Carrier Aggregation RF Conducted Powers

C.2.1.1 LTE Band 2 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-2A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B2	20	1100	1980.0	N/A				22.75	23.00
CA_2C	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B2	20	1098	1979.8	N/A				22.88	23.00
CA_2A-12A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B12	10	5095	737.5	N/A				22.89	23.00
CA_2A-17A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B17	10	5790	740.0	N/A				22.85	23.00
CA_2A-66A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B66	20	66786	2145.0	N/A				22.91	23.00
CA_2A-4A-5A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B4	20	2175	2132.5	LTE B5	10	2300	881.5	22.95	23.10
CA_2A-4A-13A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B4	20	2175	2132.5	LTE B13	10	2300	751.0	22.96	23.10

C.2.1.2 LTE Band 4 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_4A-4A	LTE B4	20	20050	1720.0	QPSK	1	49	2050	2120.0	LTE B4	20	2300	2145.0	N/A				23.45	23.60
CA_4A-12A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B12	10	5095	737.5	N/A				23.50	23.62
CA_4A-17A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B17	10	5790	740.0	N/A				23.51	23.62
CA_2A-4A-5A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B2	20	900	1960.0	LTE B5	10	2525	881.5	23.55	23.62
CA_2A-4A-13A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B2	20	900	1960.0	LTE B13	10	5230	751.0	23.54	23.62

C.2.1.3 LTE Band 5 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_5A-41A	LTE B5	10	20525	836.5	QPSK	1	25	2525	881.5	LTE B41	20	40620	2593.0	N/A				23.88	23.94
CA_2A-4A-5A	LTE B5	10	20525	836.5	QPSK	1	25	2525	881.5	LTE B2	20	900	1960.0	LTE B4	20	2175	2132.5	23.90	23.94
CA_5A-66A-66A	LTE B5	10	20525	836.5	QPSK	1	25	2525	881.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.85	23.94

C.2.1.4 LTE Band 12 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-12A	LTE B12	10	23095	707.5	QPSK	1	25	5095	737.5	LTE B2	20	900	1960.0	N/A				23.44	23.52
CA_12A-66A-66A	LTE B12	10	23095	707.5	QPSK	1	25	5095	737.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.46	23.52

C.2.1.5 LTE Band 13 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-4A-13A	LTE B13	10	23230	782.0	QPSK	1	25	5230	751.0	LTE B2	20	900	1960.0	LTE B4	20	2175	2132.5	23.41	23.47

C.2.1.6 LTE Band 17 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-17A	LTE B17	10	23790	710.0	QPSK	1	25	5790	740.0	LTE B2	10	900	1960.0	N/A				23.40	23.48
CA_4A-17A	LTE B17	10	23790	710.0	QPSK	1	25	5790	740.0	LTE B4	10	2050	2120.0	N/A				23.42	23.48

C.2.1.7 LTE Band 26 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_26A-41A	LTE B26	15	26865	831.5	QPSK	1	36	8865	876.5	LTE B41	20	40620	2593.0	N/A				23.39	23.50

C.2.1.8 LTE Band 41 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA-41A-41A	LTE B41	20	41490	2680.0	QPSK	1	49	41490	2680.0	LTE B41	20	39750	2506.0	N/A				22.46	22.60
CA-41C	LTE B41	20	41490	2680.0	QPSK	1	49	41490	2680.0	LTE B41	20	41292	2660.2	N/A				22.50	22.60

C.2.1.9 LTE Band 66 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-66A	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B2	20	900	1960.0	N/A				23.51	23.60
CA_66B	LTE B66	15	132047	1717.5	QPSK	1	36	66511	2117.5	LTE B66	5	66604	2126.8	N/A				23.41	23.47
CA_66C	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	66734	2139.8	N/A				23.51	23.60
CA_5A-66A-66A	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B5	10	2525	881.5	23.52	23.60
CA_12A-66A-66A	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B12	10	5095	737.5	23.48	23.60

C.3 LTE Downlink Carrier Aggregation with 4X4 MIMO

This device supports downlink 4x4 MIMO operations for some LTE bands.

Uplink transmission is limited to a single output stream. When carrier aggregation was applicable, the general test selection and setup procedures described in Appendix C.1 were applied.

According to LTE Test conditions in TCB workshop(May, 2017), SAR is excluded for LTE downlink 4x4 MIMO operation when uplink output with DL MIMO does not exceed highest uplink output power configuration without DL MIMO by more than a 1/4 dB. And for DL MIMO with carrier aggregation, the same SAR test exclusion procedure is considered.

Index	2CC	Restriction	Completely Covered by Measurement Superset	Reverse
2CC #1	CA_2A-[2A]	N/A	No	N/A
2CC #2	CA_[2A]-2A	N/A	No	N/A
2CC #3	CA_[2A]-[2A]	N/A	No	N/A
2CC #4	CA_2A-[4A]	N/A	3CC#1	Yes
2CC #5	CA_[2A]-4A	N/A	3CC#3	Yes
2CC #6	CA_[2A]-[4A]	N/A	3CC#4	Yes
2CC #7	CA_[2A]-5A	N/A	No	Yes
2CC #8	CA_[2A]-12A	N/A	No	Yes
2CC #9	CA_[2A]-66A	N/A	No	Yes
2CC #10	CA_4A-[4A]	N/A	No	N/A
2CC #11	CA_[4A]-4A	N/A	No	N/A
2CC #12	CA_[4A]-[4A]	N/A	No	N/A
2CC #13	CA_[4A]-5A	N/A	3CC#1	Yes
2CC #14	CA_[4A]-12A	N/A	No	Yes
2CC #15	CA_[4A]-13A	N/A	3CC#2	Yes
2CC #16	CA_[4A]-17A	N/A	No	Yes
2CC #17	CA_5A-[41A]	B41 SCC Only	No	No
2CC #18	CA_5A-[66A]	N/A	3CC#6	Yes
2CC #19	CA_12A-[66A]	N/A	3CC#9	Yes
2CC #20	CA_26A-[41A]	B41 SCC Only	No	No
2CC #21	CA_41A-[41A]	N/A	No	N/A
2CC #22	CA_[41A]-41A	N/A	No	N/A
2CC #23	CA_[41A]-[41A]	N/A	No	N/A
2CC #24	CA_[41C]	N/A	No	N/A
2CC #25	CA_66A-[66A]	N/A	3CC#5	N/A
2CC #26	CA_[66A]-66A	N/A	3CC#6	N/A
2CC #27	CA_[66A]-[66A]	N/A	3CC#7	N/A
2CC #28	CA_[66B]	N/A	No	N/A
2CC #29	CA_[66C]	N/A	No	N/A

Index	3CC	Restriction	Completely Covered by Measurement Superset	Reverse
3CC #1	CA_2A-[4A]-5A	N/A	No	Yes
3CC #2	CA_2A-[4A]-13A	N/A	No	Yes
3CC #3	CA_[2A]-4A-13A	N/A	No	Yes
3CC #4	CA_[2A]-[4A]-13A	N/A	No	Yes
3CC #5	CA_5A-66A-[66A]	N/A	No	Yes
3CC #6	CA_5A-[66A]-66A	N/A	No	Yes
3CC #7	CA_5A-[66A]-[66A]	N/A	No	Yes
3CC #8	CA_12A-66A-[66A]	N/A	No	Yes
3CC #9	CA_12A-[66A]-66A	N/A	No	Yes
3CC #10	CA_12A-[66A]-[66A]	N/A	No	Yes

Note: "[]" is 4X4 MIMO Configuration.



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C.3.1 Downlink Carrier Aggregation RF Conducted Powers With 4X4 MIMO

C.3.1.1 LTE 4X4 MIMO DL Standalone Powers

LTE Band	BW [MHz]	Ch.	Freq. [MHz]	Mod.	RB Size	RB Offset	4X4 DL MIMO Tx. Power (dBm)	Single Antenna Tx Power (dBm)
2	20	18900	1880.0	QPSK	1	49	22.88	23.00
4	20	20175	1732.5	QPSK	1	49	23.55	23.62
41	20	39750	2506.0	QPSK	1	0	22.54	22.68
66	20	132072	1720.0	QPSK	1	49	23.49	23.60

C.3.1.2 LTE Band 2 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-[2A]	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B2	20	1100	1980.0	N/A				22.81	23.00
CA_[2A]-2A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B2	20	1100	1980.0	N/A				22.89	23.00
CA_[2A]-[2A]	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B2	20	1100	1980.0	N/A				22.90	23.00
CA_[2A]-5A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B5	10	2525	881.5	N/A				22.85	23.00
CA_[2A]-12A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B12	10	5095	737.5	N/A				22.84	23.00
CA_[2A]-66A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B66	20	66786	2145.0	N/A				22.81	23.00
CA_2A-[4A]-5A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B4	20	2175	2132.5	LTE B5	10	2525	881.5	22.89	23.00
CA_2A-[4A]-13A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B4	20	2175	2132.5	LTE B13	10	5230	751.0	22.91	23.00
CA_[2A]-4A-13A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B4	20	2175	2132.5	LTE B13	10	5230	751.0	22.90	23.00
CA_[2A]-[4A]-13A	LTE B2	20	18900	1880.0	QPSK	1	49	900	1960.0	LTE B4	20	2175	2132.5	LTE B13	10	5230	751.0	22.91	23.00

C.3.1.3 LTE Band 4 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_4A-[4A]	LTE B4	20	20050	1720.0	QPSK	1	49	2050	2120.0	LTE B4	20	2300	2145.0	N/A				23.54	23.60
CA_[4A]-4A	LTE B4	20	20050	1720.0	QPSK	1	49	2050	2120.0	LTE B4	20	2300	2145.0	N/A				23.55	23.60
CA_[4A]-[4A]	LTE B4	20	20050	1720.0	QPSK	1	49	2050	2120.0	LTE B4	20	2300	2145.0	N/A				23.51	23.60
CA_[4A]-12A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B12	10	5095	737.5	N/A				23.50	23.62
CA_[4A]-17A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B17	10	5790	740.0	N/A				23.55	23.62
CA_2A-[4A]-5A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B2	20	900	1960.0	LTE B5	10	2525	881.5	23.58	23.62
CA_2A-4A-[13A]	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B2	20	900	1960.0	LTE B13	10	5230	751.0	23.54	23.62
CA_[2A]-4A-13A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B2	20	900	1960.0	LTE B13	10	5230	751.0	23.55	23.62
CA_[2A]-[4A]-13A	LTE B4	20	20175	1732.5	QPSK	1	49	2175	2132.5	LTE B2	20	900	1960.0	LTE B13	10	5230	751.0	23.57	23.62

C.3.1.4 LTE Band 5 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_5A-[41A]	LTE B5	10	20525	836.5	QPSK	1	0	2525	881.5	LTE B41	20	40620	2593.0	N/A				23.88	23.94
CA_2A-[4A]-5A	LTE B5	10	20525	836.5	QPSK	1	0	2525	881.5	LTE B2	20	900	1960.0	LTE B4	20	2175	2132.5	23.91	23.94
CA_5A-66A-[66A]	LTE B5	10	20525	836.5	QPSK	1	25	2525	881.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.90	23.94
CA_5A-[66A]-66A	LTE B5	10	20525	836.5	QPSK	1	25	2525	881.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.85	23.94
CA_5A-[66A]-[66A]	LTE B5	10	20525	836.5	QPSK	1	25	2525	881.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.87	23.94

C.3.1.5 LTE Band 12 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_[2A]-12A	LTE B12	10	23095	707.5	QPSK	1	25	5095	737.5	LTE B2	20	900	1960.0	N/A				23.44	23.52
CA_[4A]-12A	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B4	20	2175	2132.5	N/A				23.50	23.52
CA_12A-66A-[66A]	LTE B12	10	23095	707.5	QPSK	1	25	5095	737.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.41	23.52
CA_12A-[66A]-66A	LTE B12	10	23095	707.5	QPSK	1	25	5095	737.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.49	23.52
CA_12A-[66A]-[66A]	LTE B12	10	23095	707.5	QPSK	1	25	5095	737.5	LTE B66	20	66786	2145.0	LTE B66	20	67036	2170.0	23.47	23.52

C.3.1.6 LTE Band 13 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_2A-[4A]-13A	LTE B13	10	23230	782.0	QPSK	1	25	5230	751.0	LTE B2	20	900	1960.0	LTE B4	20	2175	2132.5	23.41	23.47
CA_[2A]-4A-13A	LTE B13	10	23230	782.0	QPSK	1	25	5230	751.0	LTE B2	20	900	1960.0	LTE B4	20	2175	2132.5	23.39	23.47
CA_[2A]-[4A]-13A	LTE B13	10	23230	782.0	QPSK	1	25	5230	751.0	LTE B2	20	900	1960.0	LTE B4	20	2175	2132.5	23.42	23.47

C.3.1.7 LTE Band 17 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_[4A]-17A	LTE B17	10	23790	710.0	QPSK	1	25	5790	740.0	LTE B4	10	2050	2120.0	N/A				23.40	23.48

C.3.1.8 LTE Band 26 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_26A-[41A]	LTE B26	15	26865	831.5	QPSK	1	36	8865	876.5	LTE B41	20	40620	2593.0	N/A				23.41	23.50

C.3.1.9 LTE Band 41 as PCC

Combination	PCC									SCC 1				SCC 2				SCC 3				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA-41A-[41A]	LTE B41	20	41490	2680.0	QPSK	1	49	41490	2680.0	LTE B41	20	39750	2506.0	N/A								22.42	22.60
CA-[41A]-41A	LTE B41	20	41490	2680.0	QPSK	1	49	41490	2680.0	LTE B41	20	39750	2506.0	N/A								22.50	22.60
CA-[41A]-[41A]	LTE B41	20	41490	2680.0	QPSK	1	49	41490	2680.0	LTE B41	20	39750	2506.0	N/A								22.49	22.60
CA-41C	LTE B41	20	41490	2680.0	QPSK	1	49	41490	2680.0	LTE B41	20	41292	2660.2	N/A								22.52	22.60

C.3.1.10 LTE Band 66 as PCC

Combination	PCC									SCC 1				SCC 2				Power	
	Band	BW [MHz]	(UL) Ch.	(UL) Freq. [MHz]	Mod.	(UL) RB Size	(UL) RB Offset	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	Band	BW [MHz]	(DL) Ch.	(DL) Freq. [MHz]	LTE Tx. Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_[66B]	LTE B66	15	132047	1717.5	QPSK	1	36	66511	2117.5	LTE B66	5	66604	2126.8	N/A				23.41	23.47
CA_[66C]	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	66734	2139.8	N/A				23.50	23.60
CA_5A-66A-[66A]	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B5	10	2525	881.5	23.51	23.60
CA_5A-[66A]-66A	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B5	10	2525	881.5	23.48	23.60
CA_5A-[66A]-[66A]	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B5	10	2525	881.5	23.54	23.60
CA_12A-66A-[66A]	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B12	10	5095	737.5	23.51	23.60
CA_12A-[66A]-66A	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B12	10	5095	737.5	23.49	23.60
CA_12A-[66A]-[66A]	LTE B66	20	132072	1720.0	QPSK	1	49	66536	2120.0	LTE B66	20	67036	2170.0	LTE B12	10	5095	737.5	23.53	23.60