Appendix A.4 Dipole Calibration certificate (D2450V2_1091)

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

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S Servizio svizzero di taratura
Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Client **Eurofins KCTL (Dymstec)**

Certificate No: **D2450V2-1091_Oct22**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:1091
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	October 14, 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: BH9394 (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: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Niels Kuster	Technical Manager	

Issued: October 14, 2022

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Certificate No: D2450V2-1091_Oct22 Page 1 of 6

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

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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:

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

Additional Documentation:

c) 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 ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.5 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 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 + 4.4 jΩ
Return Loss	- 26.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 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: 14.10.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1091

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 38.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

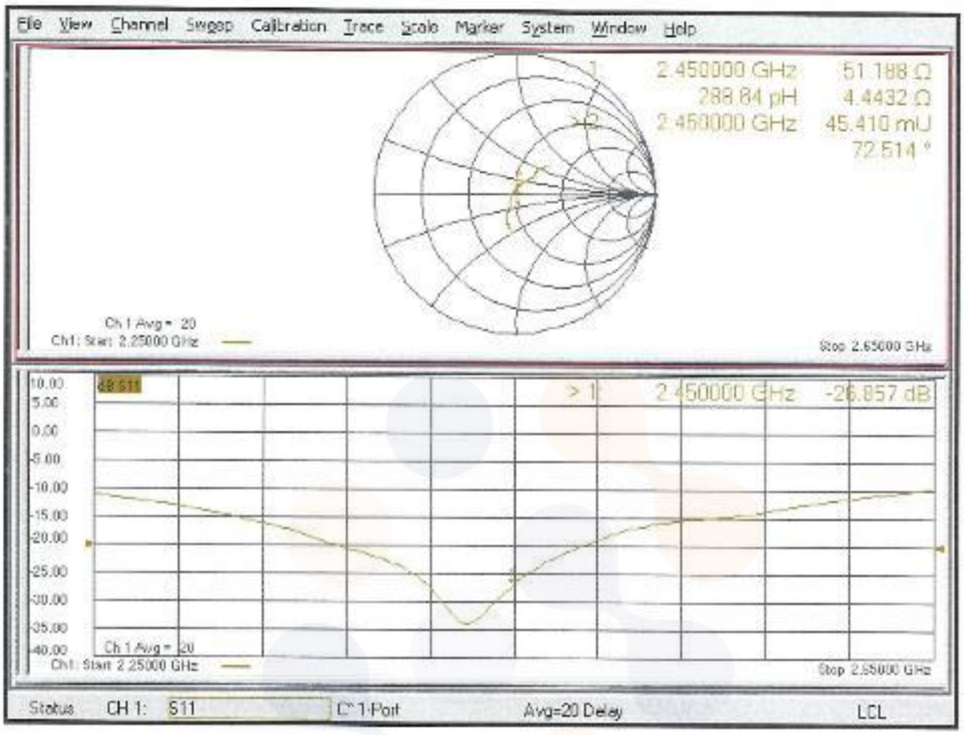
DASY52 Configuration:

- 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: 31.08.2022
- 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 = 116.8 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.16 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 49.5%
Maximum value of SAR (measured) = 22.1 W/kg

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

Impedance Measurement Plot for Head TSL



Appendix A.5 Dipole Calibration certificate (D5GHzV2_1293)

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

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S Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Client **Eurofins KCTL (Dymstec)**

Certificate No: **D5GHzV2-1293_Jan23**

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1293

Calibration procedure(s): QA CAL-22.v7
Calibration Procedure for SAR Validation Sources between 3-10 GHz

Calibration date: January 25, 2023

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: BH9394 (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: 3503	08-Mar-22 (No. EX3-3503_Mar22)	Mar-23
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: January 26, 2023

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

Certificate No: D5GHzV2-1293_Jan23 Page 1 of 9

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Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) 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 ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.6 ± 6 %	4.65 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.27 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	**23.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	5.15 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	5.18 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	8.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	47.3 Ω - 5.7 jΩ
Return Loss	- 23.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	51.4 Ω - 0.3 jΩ
Return Loss	- 37.1 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	50.5 Ω + 0.7 jΩ
Return Loss	- 41.5 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	49.8 Ω + 0.5 jΩ
Return Loss	- 45.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 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: 25.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1293

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5250 MHz; σ = 4.65 S/m; ε_r = 35.6; ρ = 1000 kg/m^3
Medium parameters used: f = 5600 MHz; σ = 5.03 S/m; ε_r = 35.4; ρ = 1000 kg/m^3
Medium parameters used: f = 5750 MHz; σ = 5.15 S/m; ε_r = 35.3; ρ = 1000 kg/m^3
Medium parameters used: f = 5800 MHz; σ = 5.18 S/m; ε_r = 35.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

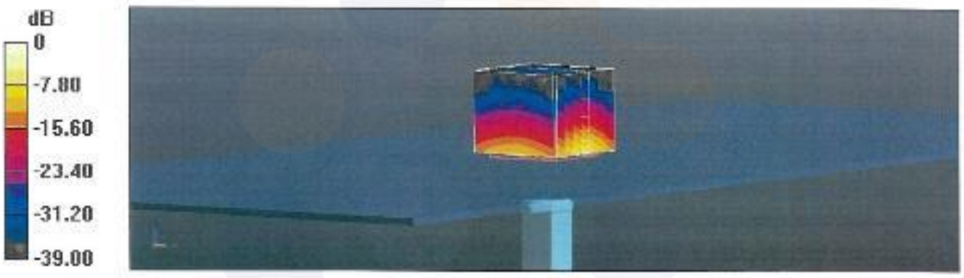
- Probe: EX3DV4 - SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: 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=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 76.11 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.30 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 70.4%
Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 75.66 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 8.27 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 = 67.9%
Maximum value of SAR (measured) = 19.5 W/kg

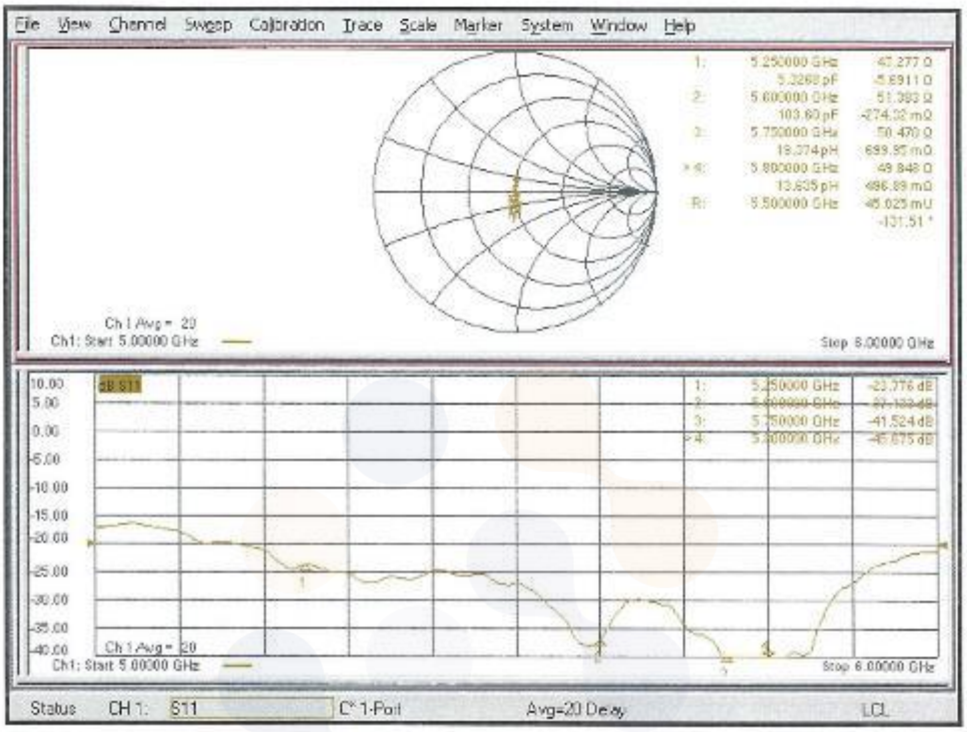
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.66 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.24 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 66.1%
Maximum value of SAR (measured) = 19.0 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 = 72.34 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 31.7 W/kg
SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.26 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 65.9%
Maximum value of SAR (measured) = 19.1 W/kg



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

Impedance Measurement Plot for Head TSL



Appendix B. SAR Tissue Specification

The brain mixtures consist of a viscous gel using hydrox-ethl cellullose(HEC) gelling agent and saline solution. Preservation with a bacteriacide 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 (㎒)	**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-tetramethybutyl)phenyl] ether

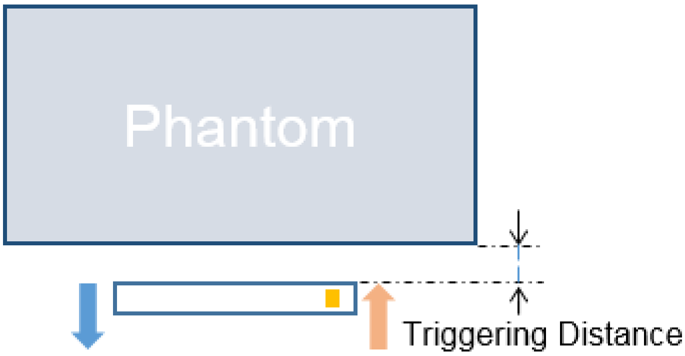
Appendix C. Power Reduction Verification

Proximity Sensor Triggering Distance (KDB 616217 §6.2)

Rear and Bottom of the DUT was placed directly below the flat phantom. The DUT was moved toward the phantom in accordance with the steps outlined in KDB 616217 §6.2 to determine the trigger distance for enabling power reduction. The DUT was moved away from the phantom to determine the trigger distance for resuming full power.

The DUT featured a visual indicator on its display that showed the status of the proximity sensor (Triggered or not triggered).This was used to determine the status of the sensor during the proximity sensor assessment as monitoring the output power directly was not practical without affecting the measurement.

It was confirmed separately that the output power was altered according to the proximity sensor status indication. This was achieved by observing the proximity sensor status at the same time as monitoring the conducted power contains both the full and reduced conducted power measurements.



LEGEND
Direction of DUT travel for determination of power reduction triggering point
Direction of DUT travel for determination of full power resumption triggering point

Resulting test positions for SAR mearsurementes

Tissue simulating liquid	Band	Trigger distance – Rear		
		Moving toward phantom	Moving from phantom	Worst case distance for SAR
2450 Head	Main	8mm	8mm	7mm
5000 Head		8mm	8mm	7mm
2450 Head	Aux	8mm	8mm	7mm
5000 Head		8mm	8mm	7mm

Proximity Sensor Triggering Distance Measurement Results – Rear Side (Main)

DUT Moving Toward (Trigger) to the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	13	12	11	10	9	8	7	6	5	4
2.4 GHz 802.11b	18.49	18.46	18.28	18.24	18.32	12.07	11.96	12.01	11.97	12.25
2.4 GHz 802.11g	17.50	17.48	17.54	17.59	17.49	11.90	11.93	11.86	11.88	11.71
2.4 GHz 802.11n 20MHz	17.88	17.90	17.82	17.83	17.83	11.99	11.83	11.87	12.10	11.90
2.4 GHz 802.11ax 20MHz	14.06	14.19	14.14	14.18	14.24	12.35	12.14	12.25	12.15	12.28
5 GHz 802.11a 20MHz	15.09	15.16	15.25	15.21	15.07	8.81	8.79	8.93	8.89	8.85
5 GHz 802.11n 20MHz	15.16	15.16	15.26	15.22	15.07	8.92	8.77	8.78	8.97	8.75
5 GHz 802.11n 40MHz	12.95	12.86	12.89	12.94	12.72	9.10	9.24	9.28	9.26	9.14
5 GHz 802.11ac 20MHz	12.96	12.86	12.92	12.88	12.83	8.65	8.73	8.80	8.80	8.80
5 GHz 802.11ac 40MHz	12.68	12.79	12.80	12.83	12.73	9.01	9.13	9.16	9.02	8.95
5 GHz 802.11ac 80MHz	12.80	12.80	12.99	12.76	12.89	8.92	8.97	9.08	8.99	9.02
5 GHz 802.11ac 160MHz	11.97	12.11	11.95	11.87	11.82	8.89	8.90	8.88	8.95	8.88
5 GHz 802.11ax 20MHz	13.41	13.40	13.35	13.24	13.30	8.89	8.78	8.73	8.89	8.71
5 GHz 802.11ax 40MHz	11.31	11.14	11.13	11.15	11.16	9.03	8.95	9.08	9.09	8.96
5 GHz 802.11ax 80MHz	12.17	12.00	12.18	12.14	11.99	9.04	9.15	9.18	9.01	9.06
5 GHz 802.11ax 160MHz	9.68	9.82	9.80	9.71	9.91	8.91	8.64	8.75	8.71	8.82

DUT Moving Away (Release) from the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	4	5	6	7	8	9	10	11	12	13
2.4 GHz 802.11b	12.23	12.08	12.12	12.08	12.22	18.31	18.51	18.49	18.21	18.45
2.4 GHz 802.11g	11.69	11.84	11.91	11.75	11.69	17.47	17.64	17.47	17.75	17.68
2.4 GHz 802.11n 20MHz	12.11	11.84	12.01	11.90	11.99	17.70	17.99	17.77	17.73	17.81
2.4 GHz 802.11ax 20MHz	12.09	12.08	12.21	12.35	12.30	14.18	14.08	14.06	14.19	14.32
5 GHz 802.11a 20MHz	8.96	8.79	8.94	8.69	8.72	15.05	15.16	15.00	15.20	15.19
5 GHz 802.11n 20MHz	8.81	8.94	8.97	8.84	8.96	15.26	15.08	15.12	15.28	15.09
5 GHz 802.11n 40MHz	9.38	9.26	9.38	9.38	9.30	12.80	12.76	12.75	12.79	13.00
5 GHz 802.11ac 20MHz	8.66	8.73	8.93	8.63	8.83	12.99	12.88	12.81	12.95	13.07
5 GHz 802.11ac 40MHz	9.07	9.18	9.03	9.18	8.99	12.92	12.93	12.75	12.92	12.70
5 GHz 802.11ac 80MHz	9.07	8.96	8.98	9.14	8.88	12.83	12.86	12.91	12.78	12.99
5 GHz 802.11ac 160MHz	8.87	8.94	9.01	8.94	8.91	11.88	11.84	12.01	11.99	11.90
5 GHz 802.11ax 20MHz	8.87	8.85	8.77	8.68	8.62	13.15	13.41	13.21	13.30	13.36
5 GHz 802.11ax 40MHz	9.07	9.12	8.97	9.17	9.14	11.16	11.20	11.25	11.32	11.30
5 GHz 802.11ax 80MHz	9.05	9.00	9.05	8.97	8.94	12.08	12.24	11.99	12.00	12.15
5 GHz 802.11ax 160MHz	8.63	8.80	8.70	8.63	8.64	9.90	9.89	9.80	9.78	9.69

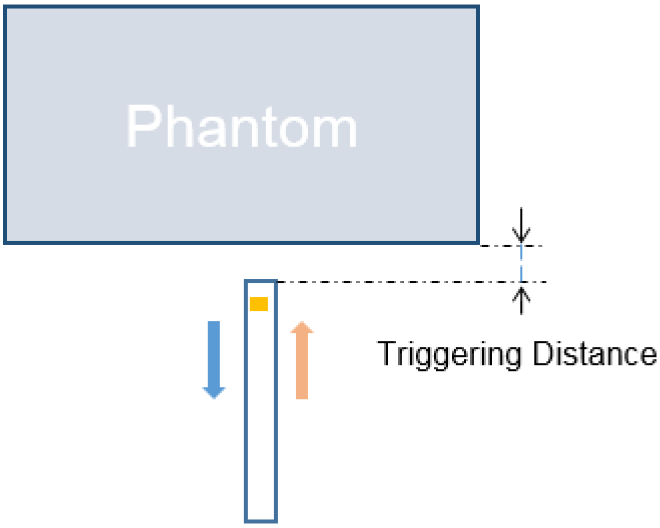
Proximity Sensor Triggering Distance Measurement Results – Rear Side (Aux)

DUT Moving Toward (Trigger) to the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	13	12	11	10	9	8	7	6	5	4
2.4 GHz 802.11b	18.66	18.63	18.62	18.69	18.59	11.96	11.77	11.93	11.90	11.93
2.4 GHz 802.11g	17.57	17.54	17.46	17.58	17.67	11.83	11.95	12.01	11.99	11.78
2.4 GHz 802.11n 20MHz	17.60	17.78	17.63	17.77	17.61	11.78	11.68	11.67	11.92	11.90
2.4 GHz 802.11ax 20MHz	13.75	13.71	13.74	13.91	13.91	11.83	11.77	11.85	11.67	11.96
5 GHz 802.11a 20MHz	14.87	14.69	14.66	14.82	14.69	8.76	8.72	8.87	8.66	8.66
5 GHz 802.11n 20MHz	14.81	14.90	14.96	14.82	14.89	8.90	8.76	8.79	8.72	8.75
5 GHz 802.11n 40MHz	12.81	12.85	12.62	12.60	12.73	8.71	8.74	8.85	8.80	8.65
5 GHz 802.11ac 20MHz	13.22	13.38	13.18	13.39	13.32	8.87	9.13	8.94	9.12	9.13
5 GHz 802.11ac 40MHz	13.33	13.21	13.20	13.15	13.15	9.10	8.97	9.18	9.22	9.18
5 GHz 802.11ac 80MHz	13.15	13.09	13.19	13.00	13.06	8.96	9.00	9.03	9.13	9.13
5 GHz 802.11ac 160MHz	11.71	11.96	11.96	11.95	11.96	9.21	9.24	9.11	9.19	9.13
5 GHz 802.11ax 20MHz	13.16	13.12	13.20	13.18	13.27	9.29	9.19	9.36	9.15	9.32
5 GHz 802.11ax 40MHz	10.85	10.74	10.69	10.68	10.80	8.65	8.87	8.75	8.77	8.72
5 GHz 802.11ax 80MHz	12.26	12.38	12.21	12.38	12.26	9.16	9.22	9.20	9.33	9.12
5 GHz 802.11ax 160MHz	9.72	9.90	9.73	9.81	9.75	8.96	9.07	8.79	8.92	8.88

DUT Moving Away (Release) from the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	4	5	6	7	8	9	10	11	12	13
2.4 GHz 802.11b	11.79	11.92	11.95	11.93	11.86	18.51	18.71	18.51	18.78	18.78
2.4 GHz 802.11g	11.79	11.87	11.85	11.99	11.98	17.47	17.52	17.58	17.41	17.65
2.4 GHz 802.11n 20MHz	11.87	11.70	11.92	11.89	11.84	17.71	17.58	17.66	17.63	17.81
2.4 GHz 802.11ax 20MHz	11.92	11.83	11.92	11.91	11.83	13.82	13.97	13.93	13.85	13.91
5 GHz 802.11a 20MHz	8.93	8.75	8.77	8.85	8.92	14.80	14.73	14.86	14.66	14.89
5 GHz 802.11n 20MHz	8.88	8.95	8.97	8.80	8.80	14.99	14.89	14.92	14.83	14.73
5 GHz 802.11n 40MHz	8.65	8.85	8.77	8.70	8.80	12.65	12.56	12.66	12.61	12.68
5 GHz 802.11ac 20MHz	9.14	8.92	8.94	8.92	8.90	13.23	13.12	13.37	13.31	13.33
5 GHz 802.11ac 40MHz	9.10	9.13	9.05	9.05	9.08	13.16	13.42	13.22	13.37	13.40
5 GHz 802.11ac 80MHz	9.12	8.93	8.98	8.89	9.02	12.95	13.04	13.07	13.02	13.06
5 GHz 802.11ac 160MHz	9.25	9.32	9.07	9.32	9.31	11.80	11.86	11.82	11.72	11.97
5 GHz 802.11ax 20MHz	9.27	9.24	9.14	9.22	9.36	13.15	13.06	13.31	13.21	13.07
5 GHz 802.11ax 40MHz	8.72	8.66	8.95	8.87	8.70	10.67	10.76	10.86	10.81	10.78
5 GHz 802.11ax 80MHz	9.25	9.20	9.32	9.28	9.37	12.30	12.26	12.28	12.17	12.14
5 GHz 802.11ax 160MHz	9.01	9.00	8.85	8.97	8.98	9.79	9.90	9.74	9.68	9.73



LEGEND
Direction of DUT travel for determination of power reduction triggering point
Direction of DUT travel for determination of full power resumption triggering point

Resulting test positions for SAR mearsurementes

Tissue simulating liquid	Band	Trigger distance – Bottom		
		Moving toward phantom	Moving from phantom	Worst case distance for SAR
2450 Head	Main	8mm	8mm	7mm
5000 Head		8mm	8mm	7mm
2450 Head	Aux	8mm	8mm	7mm
5000 Head		8mm	8mm	7mm

Proximity Sensor Triggering Distance Measurement Results – Bottom Side (Main)

DUT Moving Toward (Trigger) to the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	13	12	11	10	9	8	7	6	5	4
2.4 GHz 802.11b	18.40	18.42	18.41	18.27	18.23	12.21	12.20	12.23	12.15	12.21
2.4 GHz 802.11g	17.50	17.71	17.51	17.56	17.68	11.72	11.93	11.79	11.86	11.88
2.4 GHz 802.11n 20MHz	17.80	17.84	17.83	17.83	17.91	12.00	11.92	12.06	11.99	12.03
2.4 GHz 802.11ax 20MHz	14.26	14.22	14.19	14.19	14.02	12.20	12.29	12.09	12.34	12.30
5 GHz 802.11a 20MHz	15.28	15.15	15.25	15.22	15.11	8.74	8.93	8.79	8.96	8.92
5 GHz 802.11n 20MHz	15.24	15.09	15.14	15.13	15.27	8.93	8.97	8.93	8.84	8.73
5 GHz 802.11n 40MHz	12.74	12.79	12.84	12.96	12.91	9.39	9.34	9.14	9.27	9.12
5 GHz 802.11ac 20MHz	13.04	12.88	12.79	12.80	12.88	8.68	8.90	8.73	8.70	8.64
5 GHz 802.11ac 40MHz	12.81	12.69	12.83	12.78	12.91	9.03	9.04	9.18	9.01	9.07
5 GHz 802.11ac 80MHz	12.79	12.92	12.85	12.88	12.75	8.95	8.92	9.12	9.11	9.11
5 GHz 802.11ac 160MHz	11.81	12.03	11.91	11.82	12.04	9.13	9.12	9.00	8.95	9.16
5 GHz 802.11ax 20MHz	13.13	13.41	13.31	13.39	13.30	8.72	8.82	8.75	8.87	8.87
5 GHz 802.11ax 40MHz	11.07	11.14	11.07	11.32	11.20	9.05	9.10	8.98	8.95	9.10
5 GHz 802.11ax 80MHz	12.21	12.04	11.99	12.24	11.97	9.11	9.06	9.23	9.12	9.12
5 GHz 802.11ax 160MHz	9.97	9.71	9.87	9.72	9.88	8.90	8.93	8.81	8.77	8.79

DUT Moving Away (Release) from the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	4	5	6	7	8	9	10	11	12	13
2.4 GHz 802.11b	12.17	12.20	12.02	12.03	12.26	18.38	18.32	18.50	18.48	18.48
2.4 GHz 802.11g	11.75	11.92	11.90	11.81	11.70	17.71	17.54	17.60	17.60	17.65
2.4 GHz 802.11n 20MHz	11.88	11.90	12.09	11.85	12.13	17.95	17.85	17.92	17.82	17.99
2.4 GHz 802.11ax 20MHz	12.22	12.25	12.26	12.19	12.38	14.19	14.16	14.29	14.12	14.15
5 GHz 802.11a 20MHz	8.95	8.86	8.71	8.88	8.76	15.15	15.06	15.28	15.22	15.27
5 GHz 802.11n 20MHz	8.68	8.82	8.68	8.75	8.92	15.22	15.26	15.00	15.20	15.19
5 GHz 802.11n 40MHz	9.10	9.38	9.34	9.14	9.32	12.75	12.73	12.95	12.73	12.74
5 GHz 802.11ac 20MHz	8.88	8.82	8.77	8.79	8.78	12.82	12.88	12.78	12.87	12.85
5 GHz 802.11ac 40MHz	9.13	9.23	9.06	9.19	9.02	12.77	12.89	12.78	12.68	12.69
5 GHz 802.11ac 80MHz	9.00	9.10	9.14	8.89	9.07	12.84	12.76	12.77	13.01	13.00
5 GHz 802.11ac 160MHz	9.08	8.86	9.01	9.15	9.14	11.96	12.09	12.06	11.87	11.96
5 GHz 802.11ax 20MHz	8.72	8.83	8.67	8.73	8.90	13.40	13.24	13.21	13.13	13.35
5 GHz 802.11ax 40MHz	9.00	9.00	9.09	8.96	9.19	11.19	11.22	11.19	11.18	11.19
5 GHz 802.11ax 80MHz	9.19	9.01	9.05	9.15	9.09	12.24	12.22	12.20	12.10	12.03
5 GHz 802.11ax 160MHz	8.84	8.93	8.64	8.92	8.74	9.77	9.94	9.79	9.75	9.68

Proximity Sensor Triggering Distance Measurement Results – Bottom Side (Aux)

DUT Moving Toward (Trigger) to the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	13	12	11	10	9	8	7	6	5	4
2.4 GHz 802.11b	18.71	18.58	18.68	18.66	18.52	12.05	11.77	11.87	12.02	11.76
2.4 GHz 802.11g	17.44	17.45	17.65	17.46	17.47	11.79	11.74	12.02	12.00	11.82
2.4 GHz 802.11n 20MHz	17.59	17.57	17.82	17.65	17.68	11.91	11.90	11.68	11.83	11.83
2.4 GHz 802.11ax 20MHz	13.93	13.74	13.80	13.85	13.88	11.66	11.74	11.93	11.83	11.78
5 GHz 802.11a 20MHz	14.76	14.64	14.83	14.93	14.66	8.83	8.72	8.71	8.91	8.76
5 GHz 802.11n 20MHz	14.93	14.76	14.88	15.01	14.98	8.94	8.75	9.00	8.71	8.84
5 GHz 802.11n 40MHz	12.80	12.68	12.86	12.80	12.78	8.76	8.83	8.68	8.68	8.68
5 GHz 802.11ac 20MHz	13.31	13.14	13.34	13.11	13.16	9.06	8.89	8.90	9.04	9.14
5 GHz 802.11ac 40MHz	13.35	13.14	13.14	13.38	13.18	9.18	9.15	9.20	9.07	9.02
5 GHz 802.11ac 80MHz	13.20	13.06	13.18	12.93	13.08	8.90	9.10	9.03	9.18	8.98
5 GHz 802.11ac 160MHz	11.99	11.78	12.00	11.91	11.84	9.08	9.31	9.28	9.19	9.24
5 GHz 802.11ax 20MHz	13.35	13.31	13.21	13.07	13.19	9.38	9.28	9.39	9.15	9.36
5 GHz 802.11ax 40MHz	10.86	10.76	10.87	10.78	10.57	8.88	8.73	8.66	8.74	8.91
5 GHz 802.11ax 80MHz	12.15	12.27	12.40	12.17	12.19	9.21	9.19	9.32	9.22	9.17
5 GHz 802.11ax 160MHz	9.68	9.80	9.75	9.95	9.90	9.04	8.86	8.87	8.93	8.95

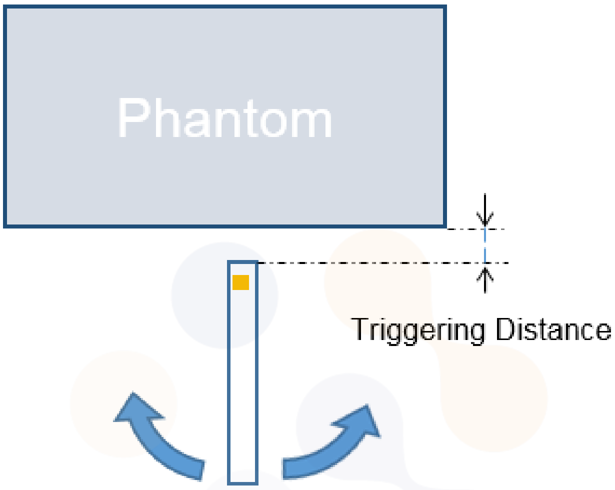
DUT Moving Away (Release) from the Phantom

Distance to DUT Output Power (dBm)										
Distance (mm)	4	5	6	7	8	9	10	11	12	13
2.4 GHz 802.11b	11.82	11.93	12.05	12.02	12.03	18.60	18.65	18.75	18.77	18.56
2.4 GHz 802.11g	11.81	11.75	11.87	12.00	11.99	17.64	17.60	17.42	17.44	17.48
2.4 GHz 802.11n 20MHz	11.88	11.91	11.63	11.76	11.87	17.85	17.62	17.55	17.63	17.79
2.4 GHz 802.11ax 20MHz	11.74	11.92	11.88	11.92	11.66	13.88	13.89	13.99	13.98	13.83
5 GHz 802.11a 20MHz	8.65	8.70	8.72	8.77	8.71	14.67	14.81	14.90	14.82	14.84
5 GHz 802.11n 20MHz	8.71	8.96	8.92	8.73	8.74	14.86	14.92	15.00	14.81	14.74
5 GHz 802.11n 40MHz	8.76	8.69	8.80	8.73	8.59	12.77	12.74	12.69	12.67	12.69
5 GHz 802.11ac 20MHz	9.12	8.90	9.04	9.02	9.11	13.16	13.29	13.31	13.15	13.11
5 GHz 802.11ac 40MHz	9.08	9.03	9.16	9.11	8.95	13.26	13.31	13.24	13.31	13.19
5 GHz 802.11ac 80MHz	9.10	9.07	9.07	8.98	8.97	13.06	13.14	13.15	13.18	12.95
5 GHz 802.11ac 160MHz	9.23	9.11	9.08	9.21	9.19	11.77	11.80	12.00	11.79	11.92
5 GHz 802.11ax 20MHz	9.22	9.20	9.28	9.13	9.25	13.21	13.09	13.08	13.20	13.27
5 GHz 802.11ax 40MHz	8.77	8.95	8.65	8.83	8.85	10.64	10.72	10.82	10.57	10.62
5 GHz 802.11ax 80MHz	9.35	9.41	9.21	9.29	9.17	12.20	12.31	12.12	12.11	12.32
5 GHz 802.11ax 160MHz	9.01	8.99	8.94	8.81	8.97	9.84	9.81	9.92	9.87	9.69

Proximity Sensor Tilt Angle Assessment (KDB 616217 §6.4)

The DUT was positioned directly below the flat phantom at the minimum measured trigger distance with Bottom parallel to the base of the flat phantom for each band.

The EUT was rotated about Bottom for angles up to +/- 45°. If the output power increased during the rotation the DUT was moved 1mm toward the phantom and the rotation repeated.
This procedure was repeated until the power remained reduced for all angles up to +/- 45°.



Proximity sensor tilt angle assessment KDB 616217 §6.4

Summary of Tilt Angle Influence to Proximity Sensor Triggering (Bottom)

Band [MHz]	Minimum trigger distance measured according to KDB 616217 §6.2	Minimum distance at which power reduction was maintained over +/-45°	Power reduction status										
			-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
2450 (Main)	8 mm	8 mm	On	On	On	On	On	On	On	On	On	On	On
2450 (Aux)	8 mm	8 mm	On	On	On	On	On	On	On	On	On	On	On
5000 (Main)	8 mm	8 mm	On	On	On	On	On	On	On	On	On	On	On
5000 (Aux)	8 mm	8 mm	On	On	On	On	On	On	On	On	On	On	On