

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	6.24 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.51 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)
Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	48.7 Ω - 5.5 $j\Omega$
Return Loss	- 24.9 dB

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	48.6 Ω - 4.0 $j\Omega$
Return Loss	- 27.5 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	47.7 Ω - 3.3 $j\Omega$
Return Loss	- 27.7 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.9 Ω - 3.9 $j\Omega$
Return Loss	- 28.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.2 Ω + 0.3 $j\Omega$
Return Loss	- 27.9 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	51.7 Ω - 0.8 $j\Omega$
Return Loss	- 34.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.1 Ω - 2.4 $j\Omega$
Return Loss	- 30.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	48.9 Ω - 5.6 $j\Omega$
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	48.0 Ω - 2.2 $j\Omega$
Return Loss	- 30.4 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.3 Ω - 3.0 $j\Omega$
Return Loss	- 29.1 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.2 Ω - 2.2 $j\Omega$
Return Loss	- 33.1 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	55.5 Ω + 1.0 $j\Omega$
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	52.3 Ω + 0.8 $j\Omega$
Return Loss	- 32.3 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	52.9 Ω - 1.8 $j\Omega$
Return Loss	- 29.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
----------------------------------	----------

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

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

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

Additional EUT Data

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

DASY5 Validation Report for Head TSL

Date: 22.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1060

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.46 \text{ S/m}$; $\epsilon_r = 35.5$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5250 \text{ MHz}$; $\sigma = 4.51 \text{ S/m}$; $\epsilon_r = 35.5$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 4.56 \text{ S/m}$; $\epsilon_r = 35.4$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 4.76 \text{ S/m}$; $\epsilon_r = 35.1$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 4.86 \text{ S/m}$; $\epsilon_r = 35$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5750 \text{ MHz}$; $\sigma = 5.02 \text{ S/m}$; $\epsilon_r = 34.8$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.07 \text{ S/m}$; $\epsilon_r = 34.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.64, 5.64, 5.64) @ 5200 MHz, ConvF(5.4, 5.4, 5.4) @ 5250 MHz, ConvF(5.39, 5.39, 5.39) @ 5300 MHz, ConvF(5.1, 5.1, 5.1) @ 5500 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz, ConvF(4.96, 4.96, 4.96) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.16 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 28.1 W/kg

SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 17.8 W/kg

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 = 74.71 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.33 W/kg

Maximum value of SAR (measured) = 17.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 75.07 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 28.8 W/kg

SAR(1 g) = 8.23 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.21 V/m; Power Drift = 0.7 dB

Peak SAR (extrapolated) = 32.1 W/kg

SAR(1 g) = 8.51 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 19.6 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 = 75.03 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 31.0 W/kg

SAR(1 g) = 8.49 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 19.4 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 = 71.89 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

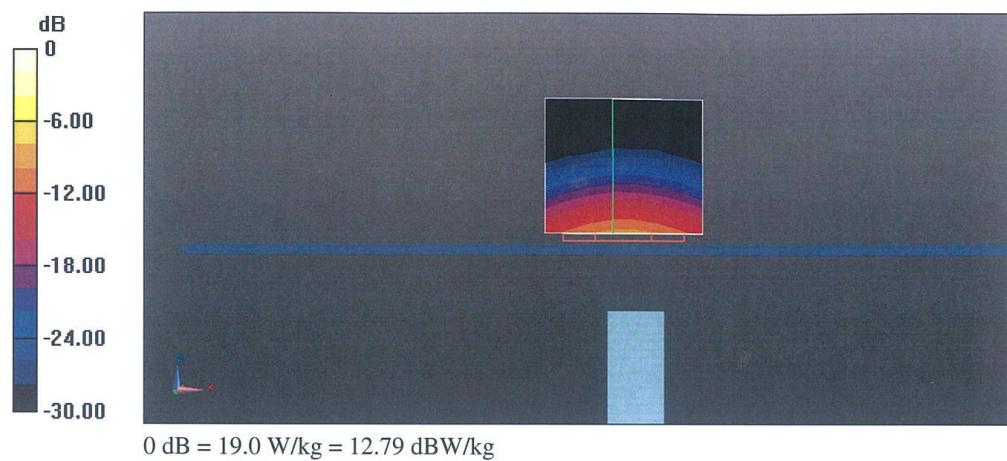
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.69 V/m; Power Drift = 0.09 dB

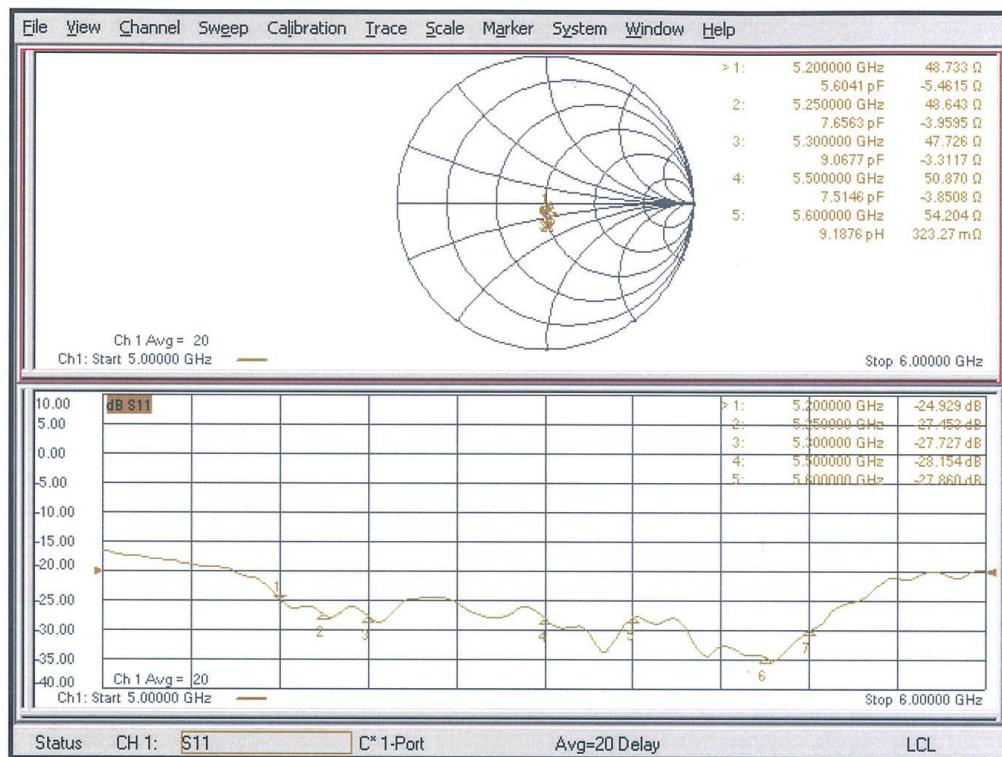
Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.30 W/kg

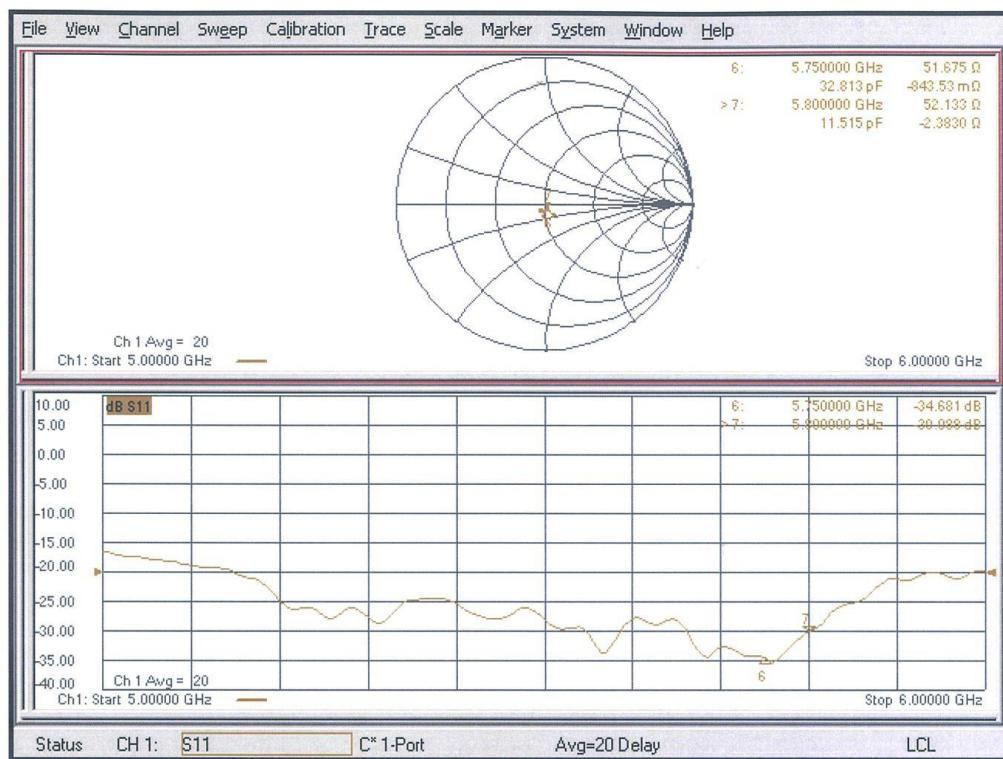
Maximum value of SAR (measured) = 19.0 W/kg



Impedance Measurement Plot for Head TSL (5200, 5250, 5300, 5500, 5600 MHz)



Impedance Measurement Plot for Head TSL (5750, 5800 MHz)



DASY5 Validation Report for Body TSL

Date: 22.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1060

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 5.43 \text{ S/m}$; $\epsilon_r = 47.3$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5250 \text{ MHz}$; $\sigma = 5.49 \text{ S/m}$; $\epsilon_r = 47.2$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 5.56 \text{ S/m}$; $\epsilon_r = 47.1$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 5.83 \text{ S/m}$; $\epsilon_r = 46.7$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.97 \text{ S/m}$; $\epsilon_r = 46.6$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5750 \text{ MHz}$; $\sigma = 6.17 \text{ S/m}$; $\epsilon_r = 46.3$; $\rho = 1000 \text{ kg/m}^3$,Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 6.24 \text{ S/m}$; $\epsilon_r = 46.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14) @ 5200 MHz, ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(5.25, 5.25, 5.25) @ 5300 MHz, ConvF(4.79, 4.79, 4.79) @ 5500 MHz, ConvF(4.74, 4.74, 4.74) @ 5600 MHz, ConvF(4.62, 4.62, 4.62) @ 5750 MHz, ConvF(4.62, 4.62, 4.62) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 68.89 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 17.2 W/kg

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

Reference Value = 69.26 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 29.2 W/kg

SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 17.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 68.18 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 29.0 W/kg

SAR(1 g) = 7.52 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 17.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.45 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 32.7 W/kg

SAR(1 g) = 8 W/kg; SAR(10 g) = 2.23 W/kg

Maximum value of SAR (measured) = 19.1 W/kg

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

Reference Value = 68.13 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

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

Reference Value = 67.49 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.18 W/kg

Maximum value of SAR (measured) = 19.0 W/kg

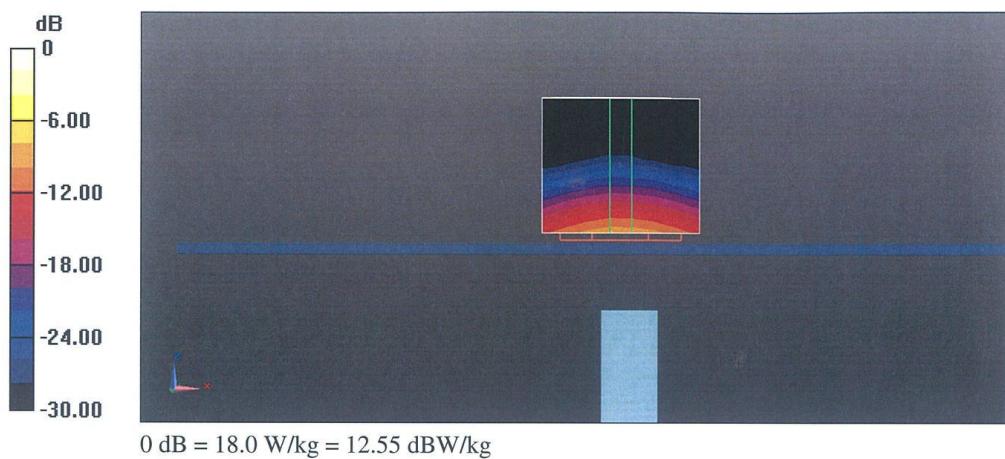
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.59 V/m; Power Drift = 0.01 dB

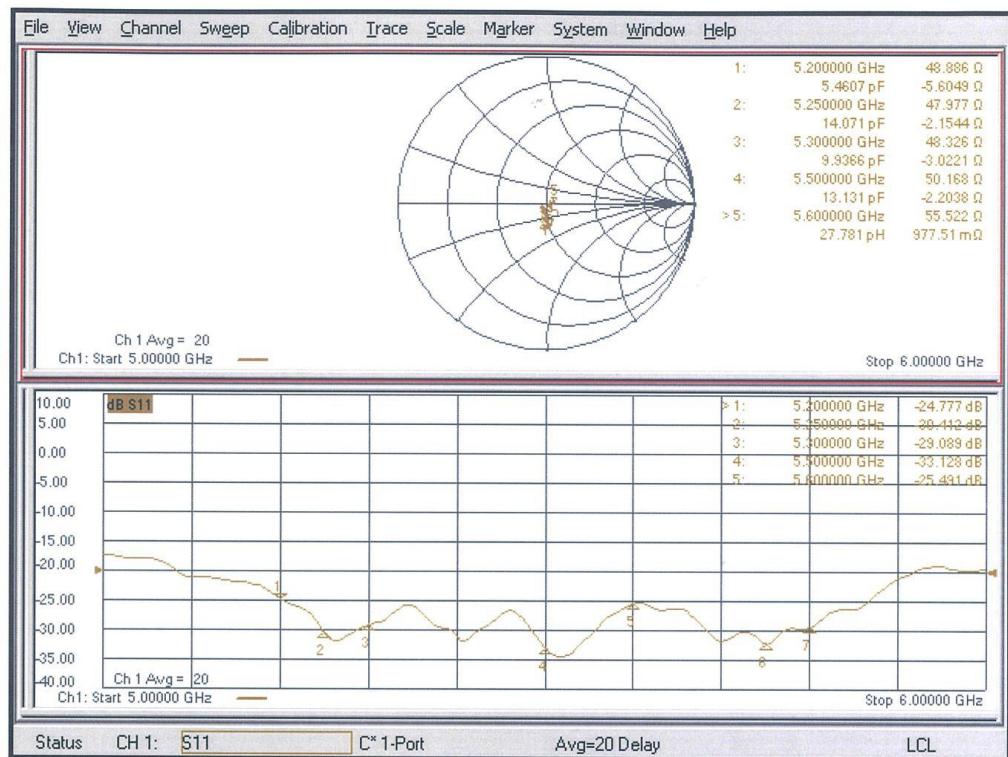
Peak SAR (extrapolated) = 32.0 W/kg

SAR(1 g) = 7.51 W/kg; SAR(10 g) = 2.09 W/kg

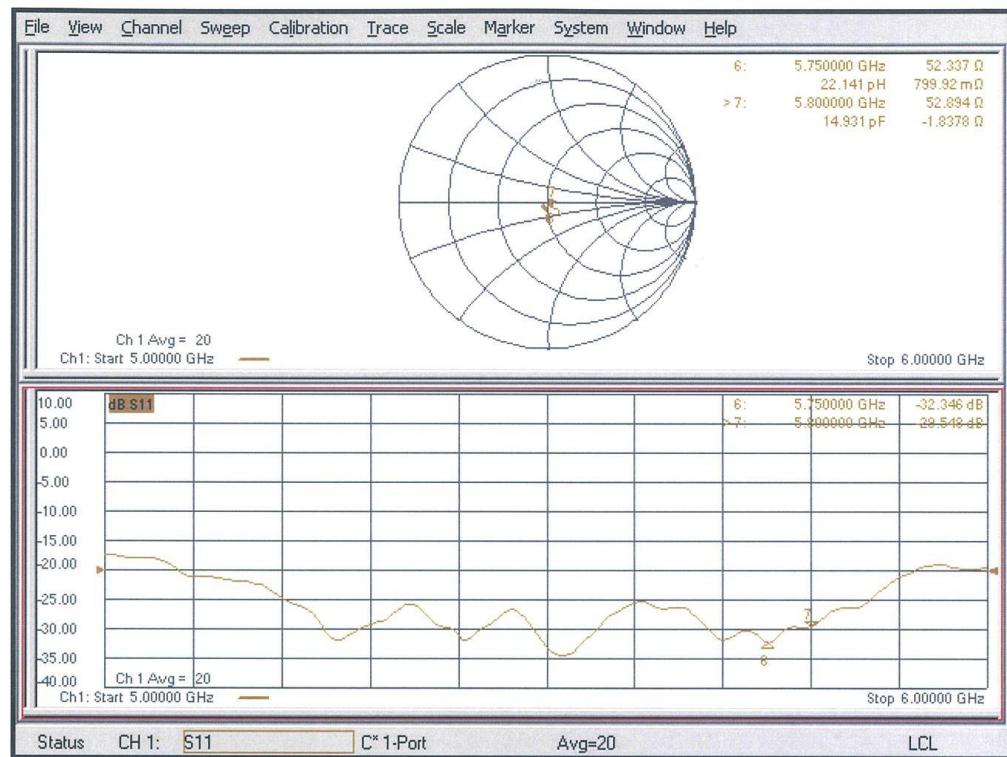
Maximum value of SAR (measured) = 18.0 W/kg



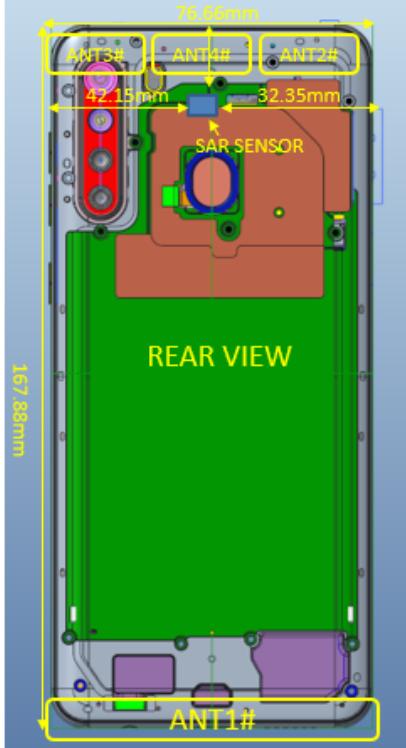
Impedance Measurement Plot for Body TSL (5200, 5250, 5300, 5500, 5600 MHz)



Impedance Measurement Plot for Body TSL (5750, 5800 MHz)



ANNEX I Sensor Triggering Data Summary



Antenna	Band	Maximum power Level (dBm) (Body)	Maximum power Level (dBm) (Head)
3# Wifi Antenna	11B/G/N	17	14
4# Wifi Antenna	11A/N/AC	18	13

Antenna	Trigger Position	Trigger Distance (mm)
1# Main Antenna	Rear	22
	Bottom	22
	Front	16
3#&4# WIFI Antenna	Rear	18
	Top	16
	Front	14

According to the above description, this device was tested by the manufacturer to determine the SAR sensor triggering distances for the rear, left edge and top edge of the device. The measured power state within ± 5 mm of the triggering points (or until touching the phantom) is included for rear and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1mm less than the smallest distance from the device and SAR phantom with the device at maximum output power without power reduction.

We tested the power and got the different proximity sensor triggering distances for rear, left edge and top edge. But the manufacturer has declared 22mm (rear/bottom) / 16mm (front) are the most conservative triggering distance for main antenna. Therefore base on the most conservative triggering distances as above, additional SAR measurements were required at 21mm (rear/bottom) / 15mm (front) for main antenna.

We tested the power and got the different proximity sensor triggering distances for rear, left edge and top edge. But the manufacturer has declared 18mm (rear) / 14mm (front) /16mm (top) are the most conservative triggering distance for main antenna. Therefore base on the most conservative

triggering distances as above, additional SAR measurements were required at 17mm (rear) / 13mm (front) / 15mm (top) for wifi antenna.

Rear/Bottom of main antenna

Moving device toward the phantom:

The power state											
Distance [mm]	27	26	25	24	23	22	21	20	19	18	17
Main antenna	Normal	Normal	Normal	Normal	Normal	Low	Low	Low	Low	Low	Low

Moving device away from the phantom:

The power state											
Distance [mm]	17	18	19	20	21	22	23	24	25	26	27
Main antenna	Low	Low	Low	Low	Low	Low	Normal	Normal	Normal	Normal	Normal

Front Edge of main antenna

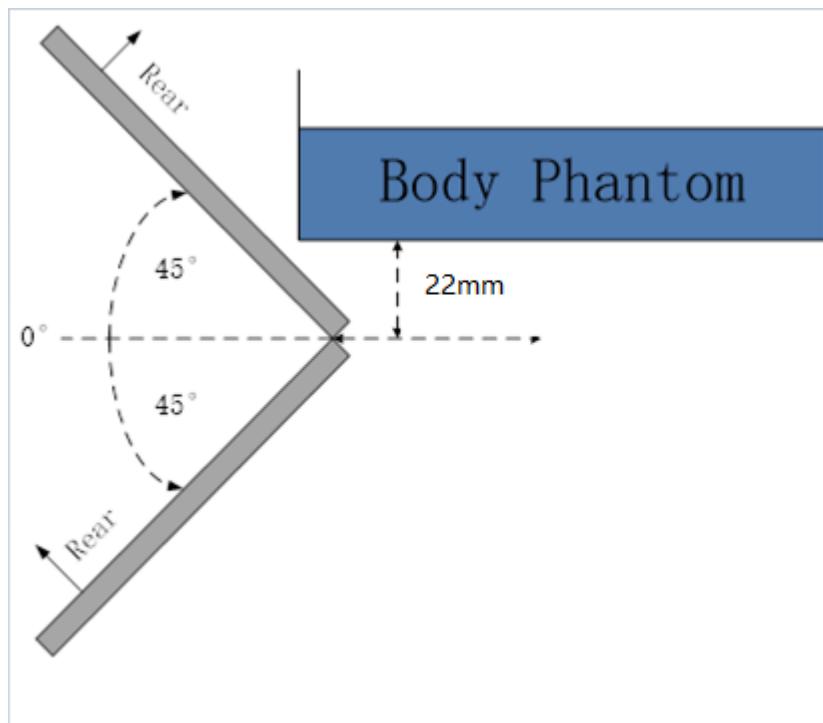
Moving device toward the phantom:

The power state											
Distance [mm]	21	20	19	18	17	16	15	14	13	12	11
Main antenna	Normal	Normal	Normal	Normal	Normal	Low	Low	Low	Low	Low	Low

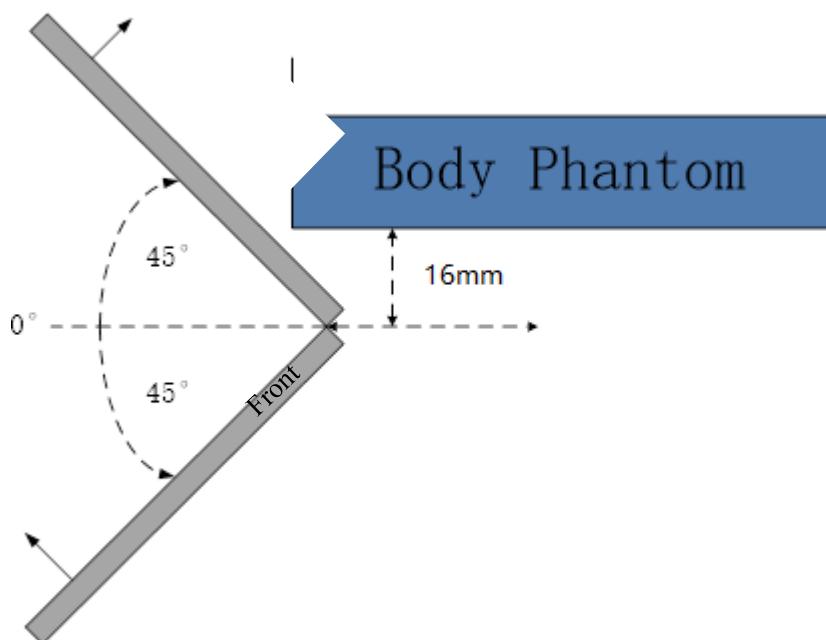
Moving device away from the phantom:

The power state											
Distance [mm]	11	12	13	14	15	16	17	18	19	20	21
Main antenna	Low	Low	Low	Low	Low	Low	Normal	Normal	Normal	Normal	Normal

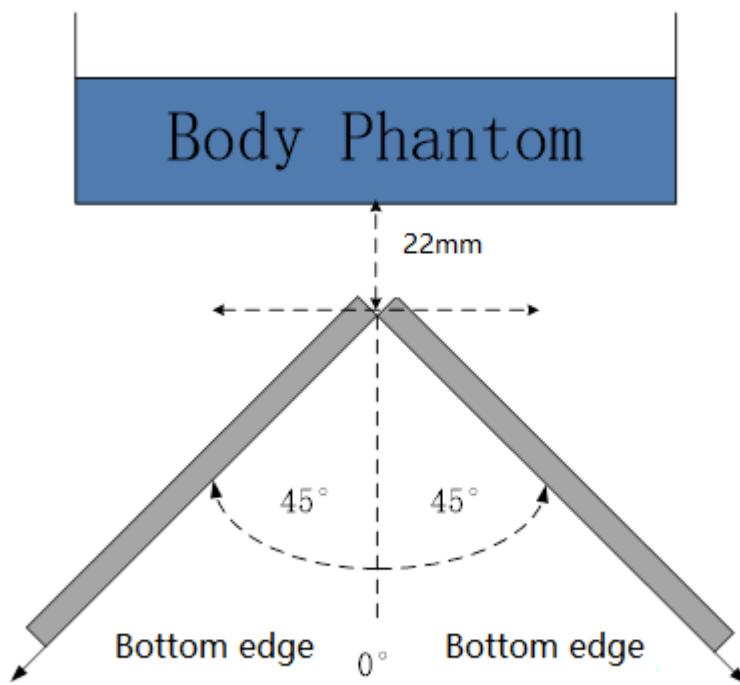
The influence of table tilt angles to proximity sensor triggering is determined by positioning each edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance by rotating the device around the edge next to the phantom in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ or more from the vertical position at 0° .



The Rear evaluation



The Front edge evaluation



The bottom edge evaluation

Rear of wifi antenna

Moving device toward the phantom:

Distance [mm]	The power state										
	23	22	21	20	19	18	17	16	15	14	13
Wifi antenna	Normal	Normal	Normal	Normal	Normal	Low	Low	Low	Low	Low	Low

Moving device away from the phantom:

Distance [mm]	The power state										
	13	14	15	16	17	18	19	20	21	22	23
Wifi antenna	Low	Low	Low	Low	Low	Low	Normal	Normal	Normal	Normal	Normal

Front Edge of wifi antenna

Moving device toward the phantom:

Distance [mm]	The power state										
	19	18	17	16	15	14	13	12	11	10	9
Wifi antenna	Normal	Normal	Normal	Normal	Normal	Low	Low	Low	Low	Low	Low

Moving device away from the phantom:

Distance [mm]	The power state										
	9	10	11	12	13	14	15	16	17	18	19
Wifi antenna	Low	Low	Low	Low	Low	Low	Normal	Normal	Normal	Normal	Normal

Top Edge of wifi antenna

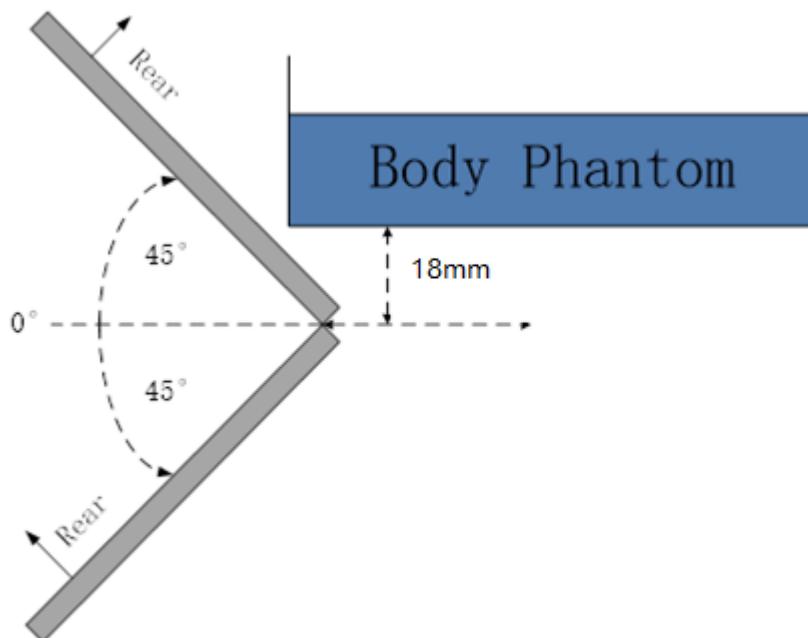
Moving device toward the phantom:

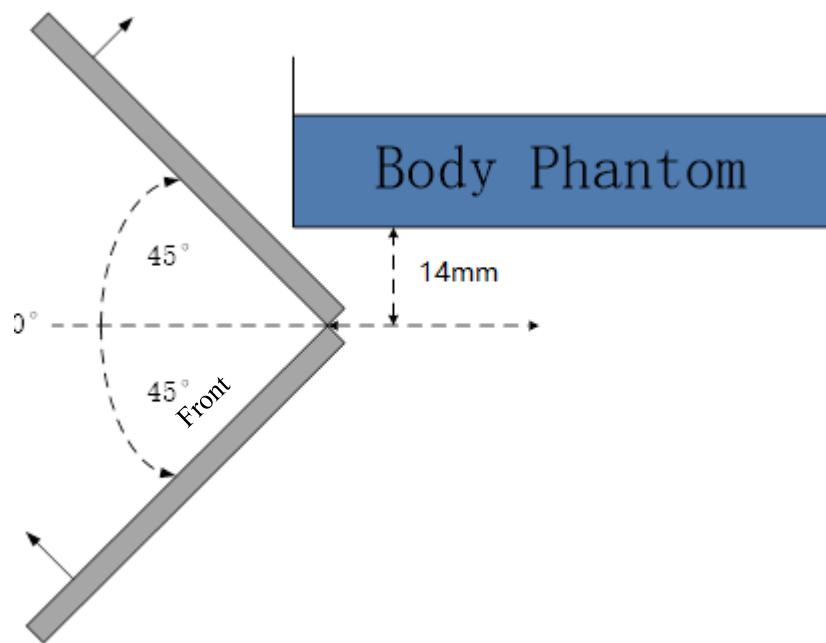
Distance [mm]	The power state										
	21	20	19	18	17	16	15	14	13	12	11
Wifi antenna	Normal	Normal	Normal	Normal	Normal	Low	Low	Low	Low	Low	Low

Moving device away from the phantom:

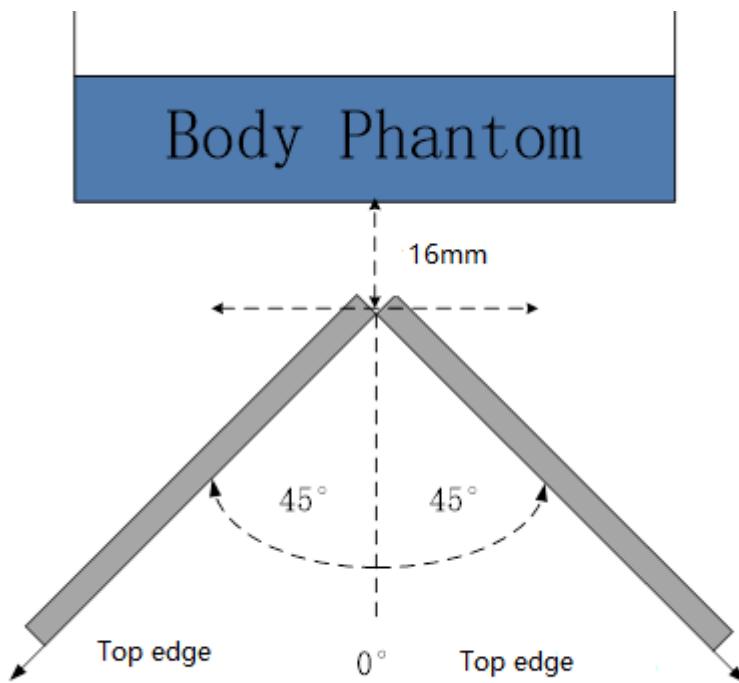
Distance [mm]	The power state										
	11	12	13	14	15	16	17	18	19	20	21
Wifi antenna	Low	Low	Low	Low	Low	Low	Normal	Normal	Normal	Normal	Normal

The influence of table tilt angles to proximity sensor triggering is determined by positioning each edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance by rotating the device around the edge next to the phantom in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ or more from the vertical position at 0° .


The Rear evaluation



The Front edge evaluation



The Top edge evaluation

Based on the above evaluation, we come to the conclusion that the sensor triggering is not released and normal maximum output power is not restored within the $\pm 45^\circ$ range at the smallest sensor triggering test distance declared by manufacturer.

ANNEX J Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT

Beijing
China

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Electromagnetic Compatibility & Telecommunications

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2019-09-26 through 2020-09-30

Effective Dates



For the National Voluntary Laboratory Accreditation Program