RE510-18-104778-1-A Ed. 0

# SAR TEST REPORT

Partial tests – Fast SAR method

## According to the standard:

EN 62209-2: 2010

## Equipment under test:

Wavestopper
BlackXSilver

## Company:

SPARTAN

DISTRIBUTION: Mr. MENARD-CALENGE

Company: SPARTAN

Number of pages: 19 including 2 appendixes

| Ed. | Date | Modified page(s) | Quality Approval<br>Name- Fonction Visa |
|---|---|---|---|
| 0 | 29-Nov-18 | Creation | COEURET<br>Technical Director |

*Duplication of this test report is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.*
*This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole production of the tested sample.*

| | |
|---|---|
| EQUIPMENT UNDER TEST: | WAVESTOPPER |
| Reference: | BlackXSilver |
| Serial Number: | 20181011/3/1 |
| Transmitter: | Mobile phone NOKIA model LUMIA 635 |
| IMEI number: | IMEI 1:353632068670697 |
| MANUFACTURER: | SPARTAN |
| APPLICANT: | |
| Company: | SPARTAN |
| Address: | 105 RUE JULES FERRY<br>BAGNOLET ( 93)<br>FRANCE |
| Contact person: | Mr . A. MENARD-CALENGE |
| Person(s) present(s) during the test: | - |
| DATE(S) OF TEST(S): | November 15 and 16, 2018 |
| TEST SITE: | EMITECH<br>Parc d'Activités de Lanserre<br>21 rue de la Fuye<br>49610 Juigne sur Loire<br>France |
| TEST OPERATOR:<br>REPORT WRITTEN BY | G.HYAUMET Visa: |

# SUMMARY

## 1. INTRODUCTION

In this test report, Specific Absorption Rate (SAR) measurements on the mobile phone NOKIA model LUMIA 635 – RM975 combined with the WAVESTOPPER model BlackXSilver are presented.

The measurements were made according to the EN62209-2. Full SAR testing according to the referenced standards was not required by the applicant; measurements were conducted according to the test plan defined by the applicant and described in the § 6

## 2. REFERENCE DOCUMENTS

| Reference | Document title | Date |
|---|---|---|
| EN 62209-2 | Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: procedure to determine the specific absorption rate (SAR) for mobile wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz). | 2010 |

## 3. PRESENTATION OF EQUIPMENT FOR TESTING PURPOSES

EUT (Equipment Under Test) is a sample of a fabric. Provided size 50x50cm
EUT is shown above.

Mobile phone:


Label on phone:

## 4. TEST CONDITIONS

The mobile phone is controlled during test using platform n° 1 (BTS simulator) referenced in appendix 1 of this test report. The maximum output power was not measured.

The output power and frequency are controlled using a base station simulator. The mobile phone is set to transmit at its highest output peak power level.

The battery is fully charged before the measurements

The SAR test was performed for each test positions at the centre frequency of the tested operating band.

| | |
|---|---|
| Standard: | E-UTRA band 7 |
| Crest factor: | 1 |
| Modulation: | GFSK – Bandwidth 5MHz- 25 Ressource blocks low position |
| Traffic Channel: | 21100 (2535MHz) |
| Maximum output power: (Standard value, not measured) | 23dBm |

## 5. MEASUREMENT RESULTS

Fast SAR evaluation has been conducted in agreement with the applicant. See the method in §6. Full SAR measurements have not been requested by the applicant.

Measurement results (SAR values averaged over a mass of 10g:

| Test Position | SAR 10g (W/kg)<br>Channel 21100 2535 MHz | Attenuation (%) |
|---|---|---|
| Rear side of mobile – 0 mm from phantom | 2.770 | Reference value |
| Rear side of mobile – 0 mm from WAVESTOPPER | 0.012 | 99.6 |

The tested phone could contain an antenna diversity technology, as MIMO or MISO. The control of the antenna's scheme has not been provided by the applicant. Thus, the radiated performances of the phone are dependent on the test set-up; an antenna diversity control could lead to different results from those reported in this test report

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s).

OPINIONS AND INTERPRETATIONS

The results of this report do not imply an assessment of the conformity of the whole requirements of the applicable standard(s).

Fast SAR method: uncertainties not evaluated.

Transceiving performances (radiated power and sensitivity) of the mobile phone, combined with the sample of the fabric, could be affected and have not been evaluated.

## 6. MEASUREMENT SYSTEM DESCRIPTION

The automated near-field scanning system Dosimetric Assessment System DASY4 from Schmid & Partner Engineering AG was used. The measurement is performed using platform n° 2 referenced in appendix 1 of this report. The system consists of a computer controlled, high precision robotics system, robot controller, extreme near-field probes and the phantom containing the liquid. The six axis robot precisely positions the probe at the points of maximum electromagnetic field. A device holder made of low-loss dielectric material is used to maintain the test position of the equipment under test against the phantom.

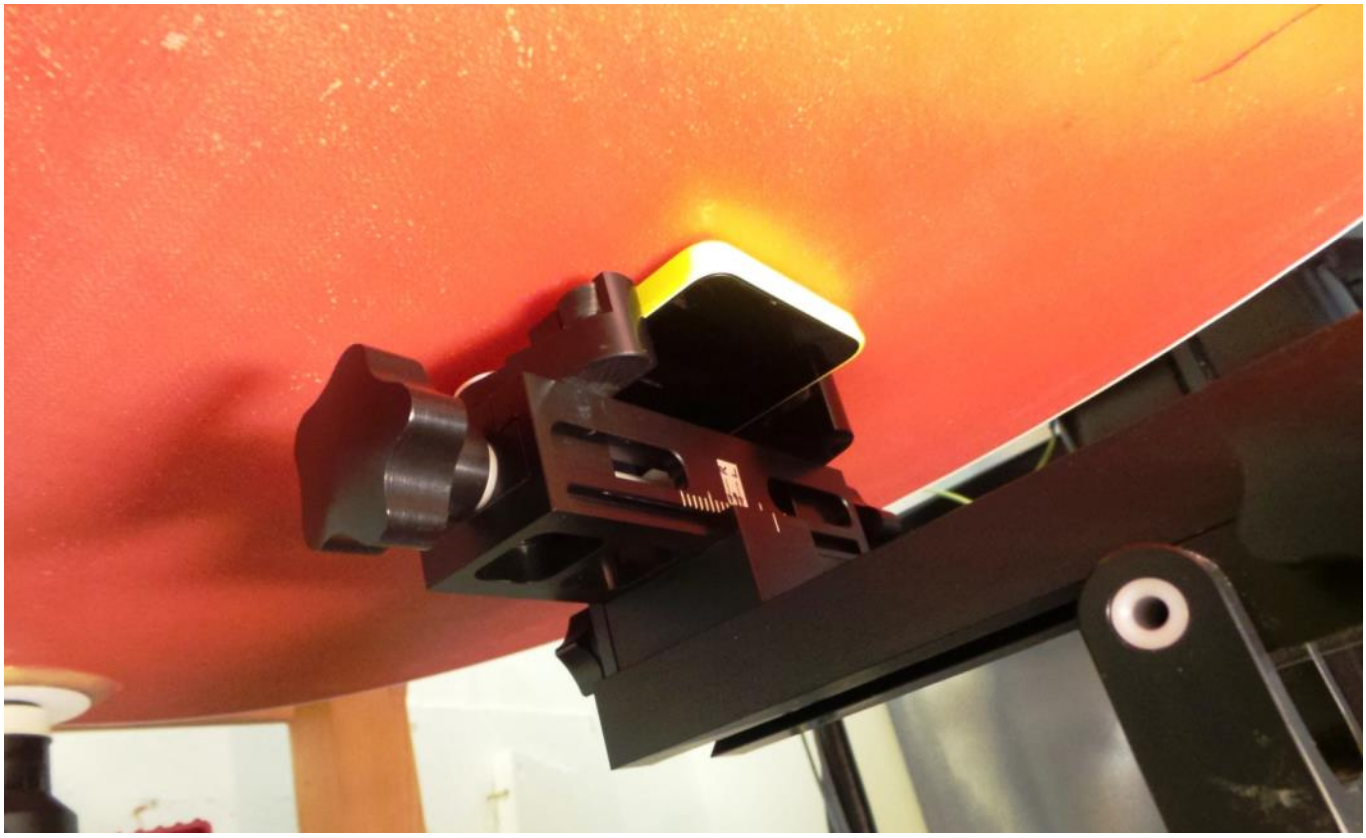

Fast SAR method: The number of measured points has decreased:

- Area scan with a grid spacing 15mm
- Zoom scan size 30 x 30 x 28 mm with a grid step 10x10x7 mm

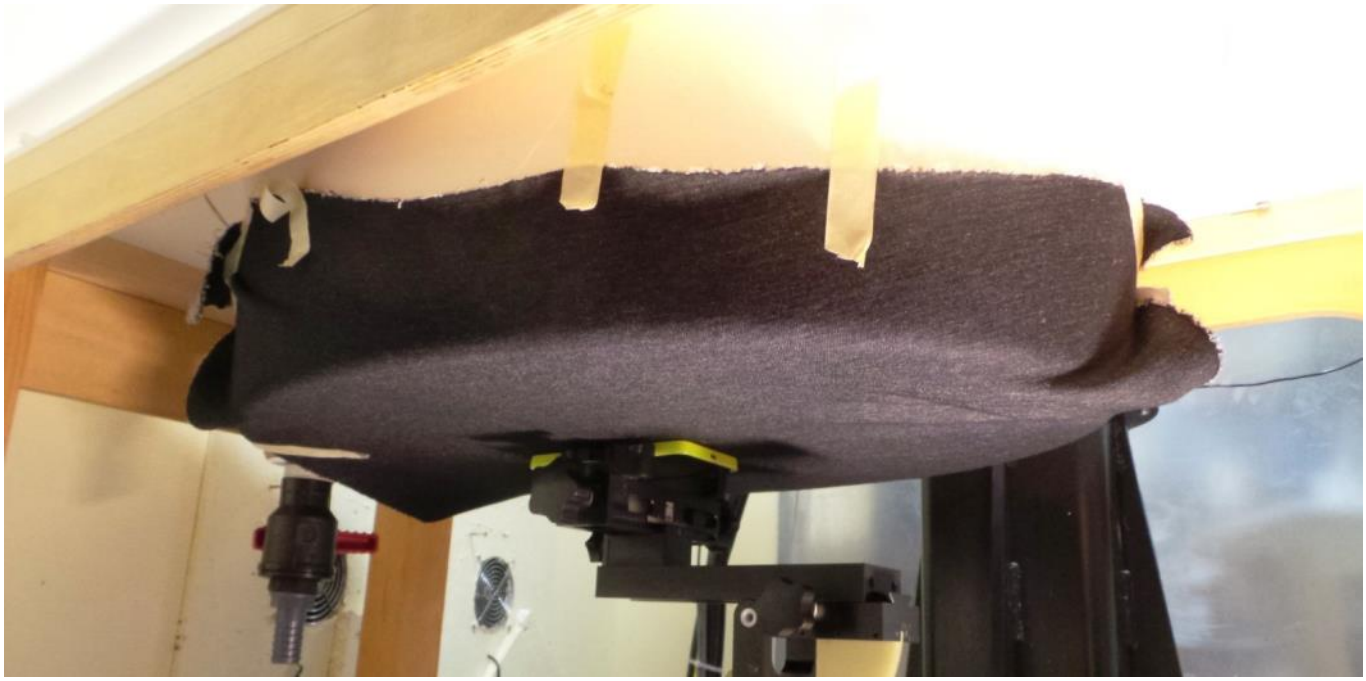
## 7. PHOTOGRAPHIES OF THE EUT

The photographies of the tested setups are shown above:

Mobile



Mobile and EUT:



## 8. LIQUID MEASUREMENT

The measurement is performed using platform n° 3 referenced in Appendix 1 of this report. The following ingredients (in % by weight) are theoretical and given for information.

2600 MHz liquid: Diethylenglykol-monobutylether 7.99 %
De-ionised water 71.88 %
Triton X-100 19.97%
NaCl salt 0.16 %

The phantom shall be filled with tissue-equivalent liquid to a depth of at least 15cm.

The dielectric parameters of the liquid were controlled prior to assessment (contact probe method). Dielectric properties measured:

| Date | Frequency (MHz) | $\varepsilon_r$ (F/m) Target value | $\varepsilon_r$ (F/m) Measured value | $\sigma$ (S/m) Target value | $\sigma$ (S/m) Measured value | Liquid temperature (°C) | Ambient temperature (°C) |
|---|---|---|---|---|---|---|---|
| Nov 15, 2018 | 2500 | 39.1 ± 10% | 35.6 | 1.86 ± 10 % | 1.98 | 24.5 | 22 |
| | 2510 | 39.1 ± 10 % | 35.5 | 1.87 ± 10 % | 1.99 | | |
| | 2535 | 39.1 ± 10 % | 35.4 | 1.89 ± 10 % | 2.02 | | |
| | 2560 | 39.1 ± 10 % | 35.3 | 1.92 ± 10 % | 2.05 | | |
| | 2565 | 39.0 ± 10 % | 35.3 | 1.93 ± 10 % | 2.06 | | |
| | 2600 | 39.0 ± 10 % | 35.1 | 1.96 ± 10 % | 2.10 | | |

## 9. SYSTEM CHECK

The measurement is performed using platform n° 4 referenced in appendix 1 of this report.

Prior to the SAR assessment, the validation dipole were used to check whether the system was operating within its specification of ± 10 %.

Measurement conditions: flat section of the ELI4 phantom filled with liquids simulating tissue. The validation dipole input power was 250mW.

Measurement results: The results are hereafter below and shown above.

Fast SAR evaluation has been conducted.

| Date | Frequency (MHz) | SAR 10g (W/kg) Target value | SAR 10g (W/kg) Measured value |
|---|---|---|---|
| Nov 15, 2018 | 2600 | 6.15 | 6.25 |

DUT: Dipole 2600 MHz

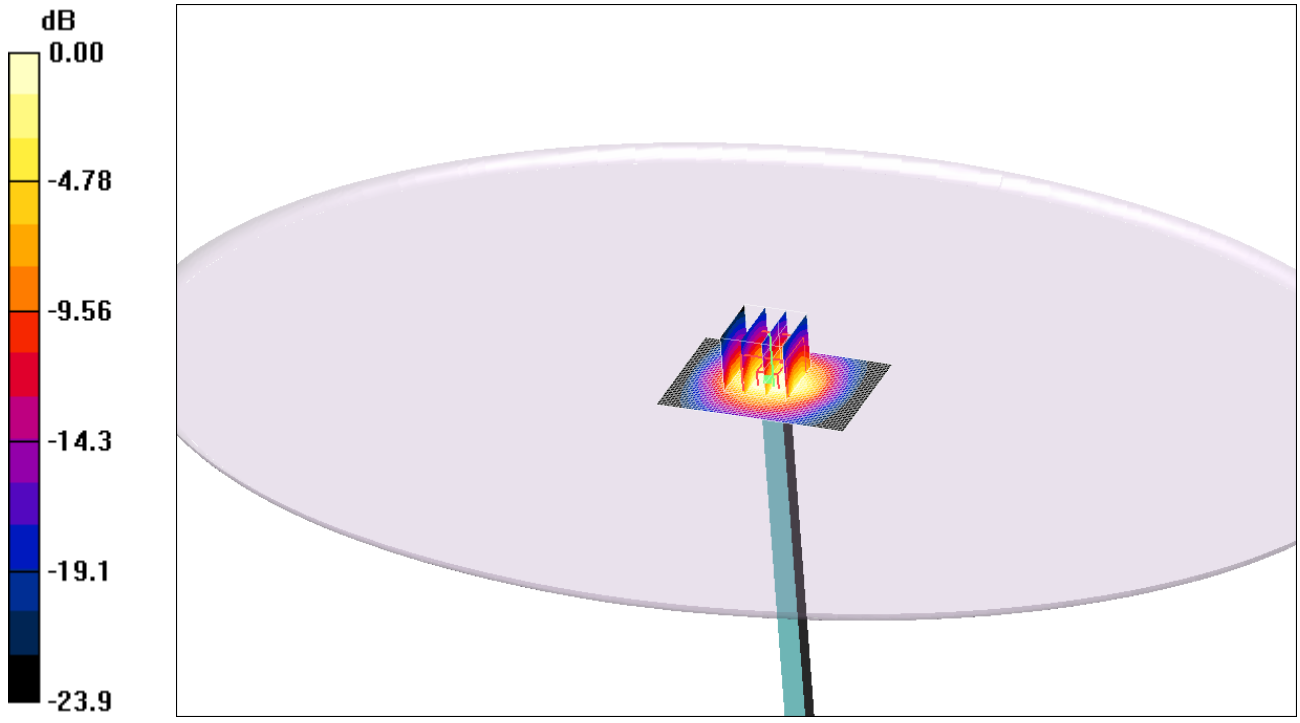
Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma$ = 2.09024 mho/m, $\varepsilon_r$ = 35.4049; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

Program Notes: Ambient temperature = 22 deg C Liquid temperature = 24.5 deg C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.6, 4.6, 4.6); Calibrated: 8/27/2018
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2018
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

**Position 5mm, Low channel/Area Scan (41x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 20.3 mW/g

**Position 5mm, Low channel/Zoom Scan (7x7x7) (4x4x5)/Cube 0:** Measurement grid: dx=10mm, dy=10mm, dz=7mm
Reference Value = 36.0 V/m; Power Drift = -0.018 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 14.3 mW/g; SAR(10 g) = 6.25 mW/g
Maximum value of SAR (measured) = 17.0 mW/g




0 dB = 17.0mW/g

## 10.GRAPHICAL REPRESENTATIONS OF THE SCANS

The graphical representations of the scans are shown above, measured on Nov 16, 2018:

DUT: NOKIA Lumia 635

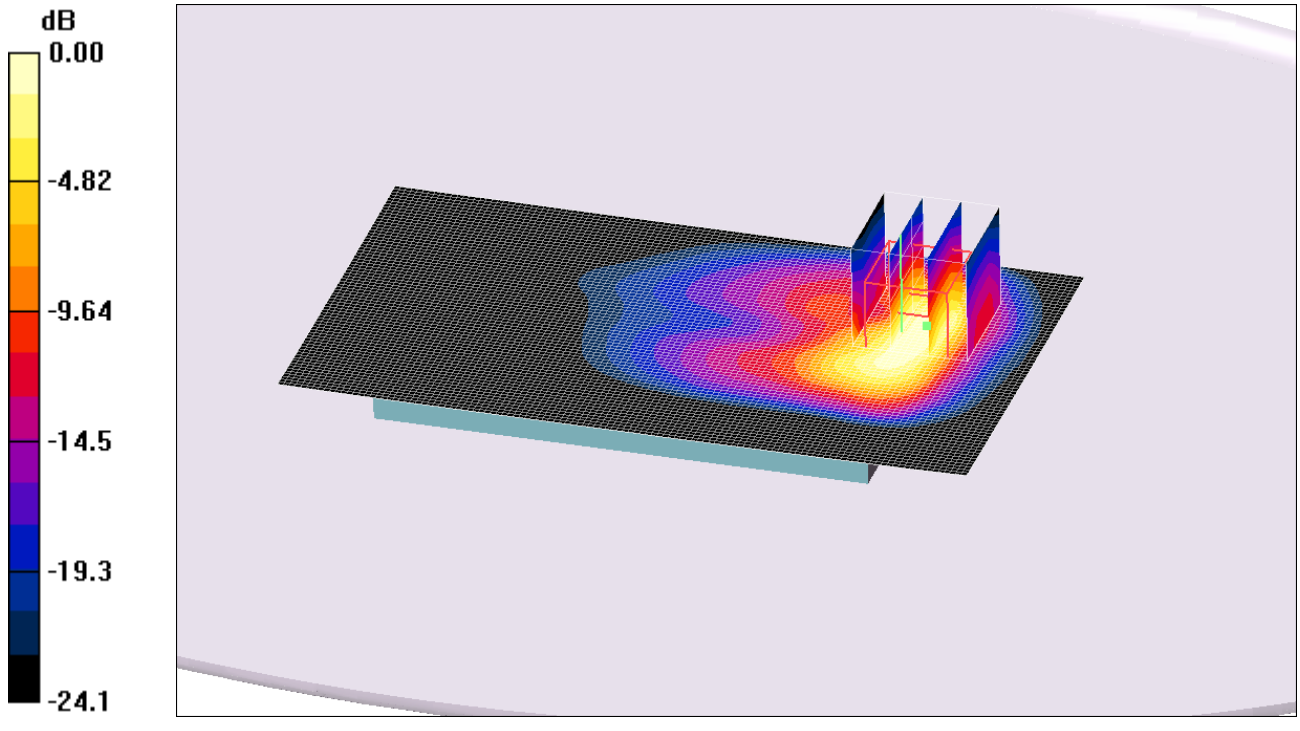
Communication System: LTE Band 7 BW5MHz; Frequency: 2535 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma$ = 2.01628 mho/m, $\varepsilon_r$ = 35.6991; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

Program Notes: Ambient temperature = 22 ° C Liquid temperature = 24.5 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.6, 4.6, 4.6); Calibrated: 8/27/2018
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2018
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

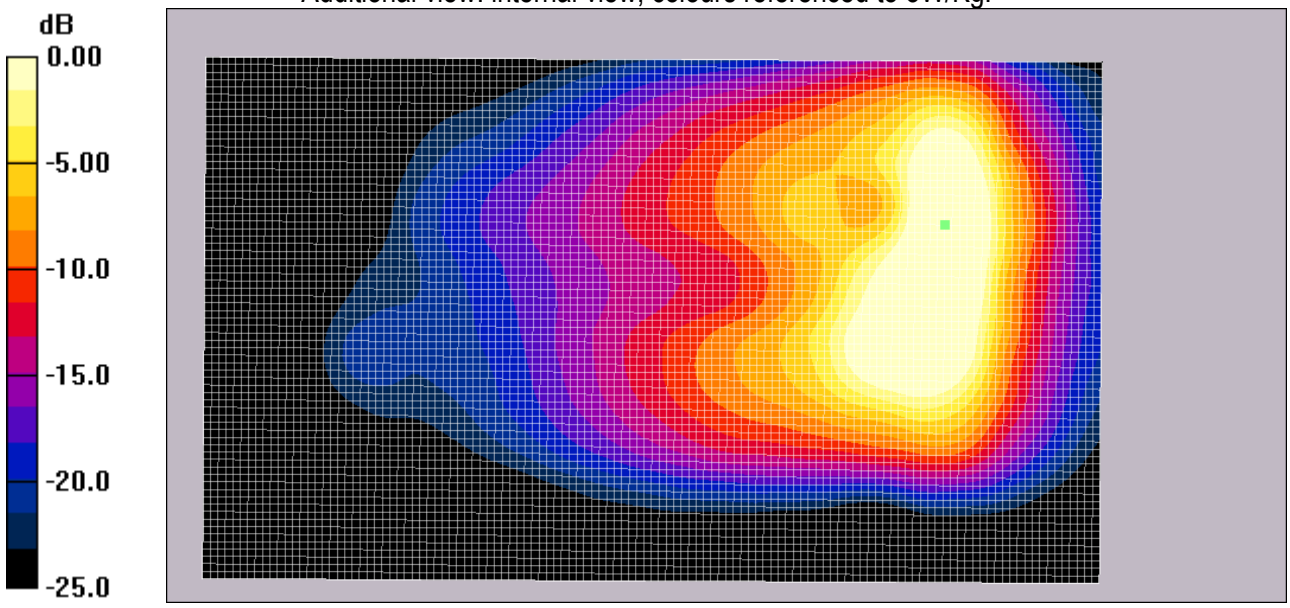
**Position 5mm, Low channel/Area Scan (71x121x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 9.68 mW/g

**Position 5mm, Low channel/Zoom Scan (7x7x7) (4x4x5)/Cube 0:** Measurement grid: dx=10mm, dy=10mm, dz=7mm
Reference Value = 19.3 V/m; Power Drift = 0.020 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 7.12 mW/g; SAR(10 g) = 2.77 mW/g
Maximum value of SAR (measured) = 8.74 mW/g




0 dB = 8.74mW/g

Additional view: internal view, colours referenced to 3W/Kg:



DUT: NOKIA Lumia 635 and fabric sample

Communication System: LTE Band 7 BW5MHz; Frequency: 2535 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma$ = 2.01628 mho/m, $\varepsilon_r$ = 35.6991; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

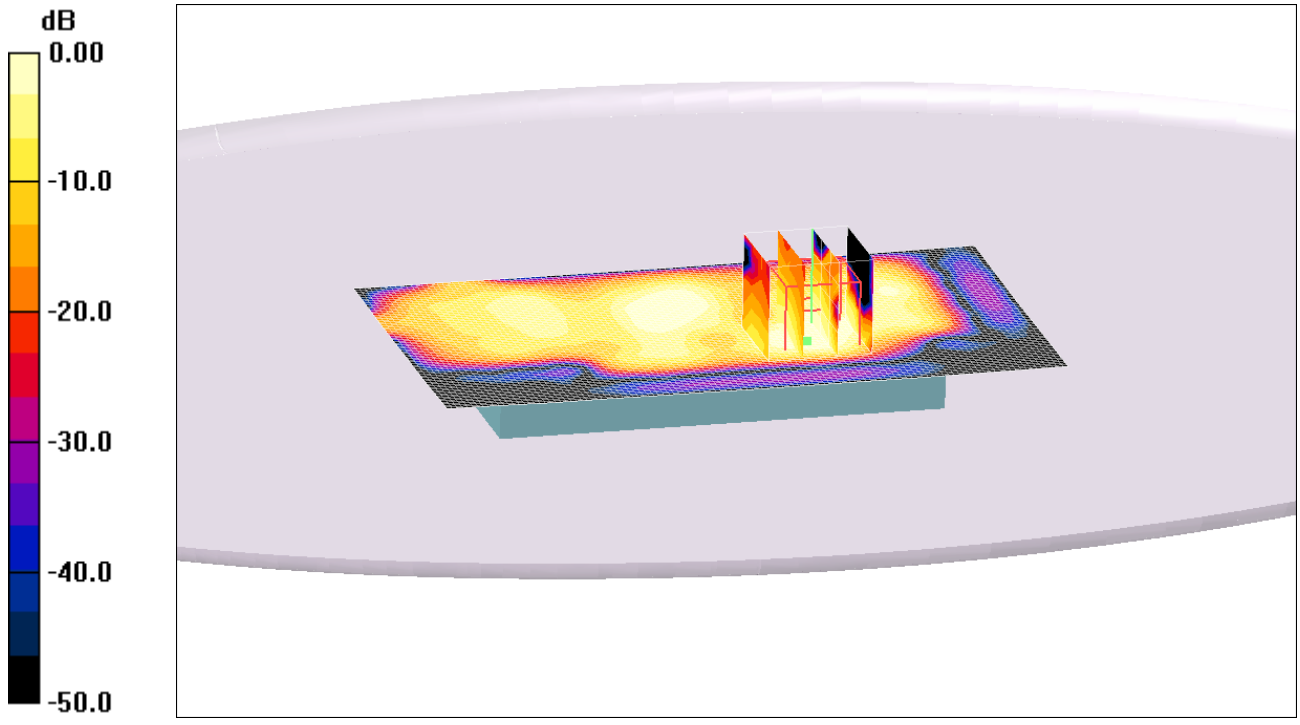
Program Notes: Ambient temperature = 22 deg C Liquid temperature = 24.5 deg C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.6, 4.6, 4.6); Calibrated: 8/27/2018
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2018
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

**Position 5mm, Low channel/Area Scan (71x121x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.043 mW/g

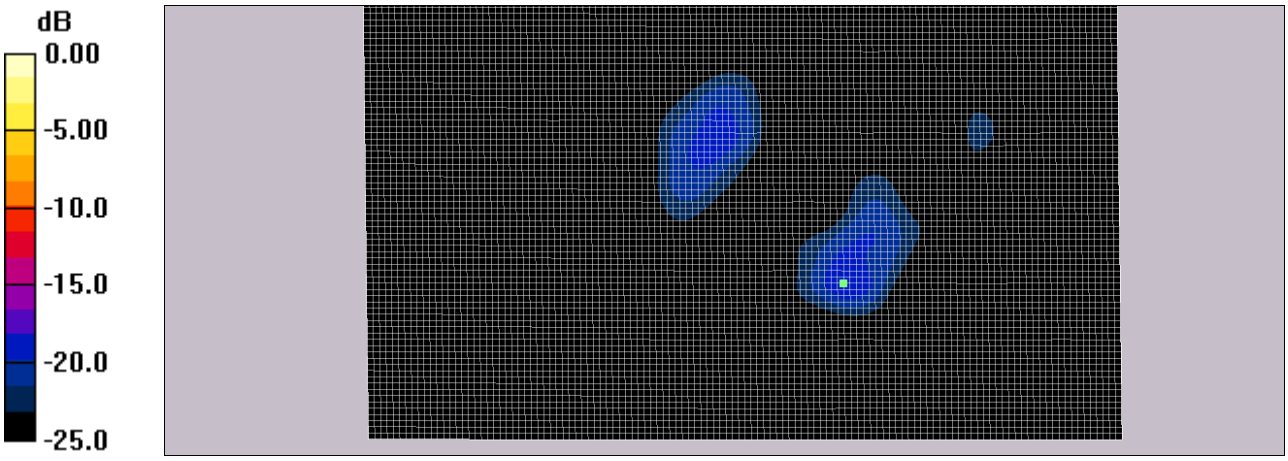
**Position 5mm, Low channel/Zoom Scan (7x7x7) (4x4x5)/Cube 0:** Measurement grid: dx=10mm, dy=10mm, dz=7mm
Reference Value = 3.42 V/m; Power Drift = 0.074 dB
Peak SAR (extrapolated) = 0.075 W/kg
SAR(1 g) = 0.028 mW/g; SAR(10 g) = 0.012 mW/g

Maximum averaged SAR over 10 g is located on the boundary of the measurement cube. This cube might not incorporate the absolute averaged SAR. a refinement of the Area Scan measurement has to be considered.
Maximum value of SAR (measured) = 0.032 mW/g




0 dB = 0.032mW/g

Additional view: internal head view, colors referenced to 3W/Kg:




□□□ End of report, 2 appendixes to be forwarded □□□

# APPENDIX1: TEST EQUIPMENTS

| Platform ID N° | Platform | Equipment | Type | Manufacturer | Internal Number | Software Version |
|---|---|---|---|---|---|---|
| 1 | BTS Simulator | CMW500 | 4G Radio tester | Rohde-Schwarz | 7041 | |
| | | | | | | |
| 2 | DASY4 | DASY4 | Software | Speag | 7321 | V4.5 Build 19 |
| | | ES3DV3 | E-Field Probe | Speag | 9485 | |
| | | DAE3 | Data acquisition | Speag | 7192 | |
| | | ELI4 | Phantom | Speag | 7324 | |
| 3 | Liquid Measure | HP85070C | Software | Hewlett-Packard | - | C1.01 |
| | | HP8753C | Network analyzer | Hewlett-Packard | 1402 | |
| | | HP85047A | S-Parameter test set | Hewlett-Packard | 9777 | |
| | | HP85070C | Dielectric probe | Hewlett-Packard | 7218 | |
| | | 922 | Thermometer | Testo | 6980 | |
| 4 | System Validation | | | | | |
| | | SMR20 | Signal generator | Rohde-Schwarz | 8730 | |
| | | ZHL42 | Amplifier | Mini-circuits | 7209 | |
| | | NRVS | Power meter | Rohde-Schwarz | 7212 | |
| | | NRV-Z31 | Probe power meter | Rohde-Schwarz | 7211 | |
| | | NRVD | Power meter | Rohde-Schwarz | 7035 | |
| | | NRV-Z1 | Probe power meter | Rohde-Schwarz | 7034 | |
| | | 86205A | Coupler | Hewlett-Packard | 7754 | |
| | | R411810124<br>R411806124 | Attenuator | Radiall | 7315 | |
| | | 33-3-34 | Attenuator | Weinschel Engineering | 7213 | |
| | | SID2600 | Dipole 2600MHz | MVG | 7337 | |
| | | 253023-01 | 2m coaxial cable | Hytem | 7419 | |

# APPENDIX 2 : MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s) .
The expanded uncertainty with a confidence interval of 95 % shall not exceed 30 % for averaged SAR values in the range from 0.4 to 10 W/kg.

EN 62209-2 : full SAR measurement

| Source of uncertainty | Tolerance/ uncertainty (%) | Divisor | Ci 1g | Ci 10g | 1g Standard Uncertainty (%) | 10g Standard Uncertainty (%) |
|---|---|---|---|---|---|---|
| Measurement System | | | | | | |
| Probe Calibration | 6,7 | 1,000 | 1 | 1 | 6,7 | 6,7 |
| Probe calibration drift | 7,0 | 3,464 | 1 | 1 | 2,0 | 2,0 |
| Axial Isotropy | 4,7 | 1,732 | 1 | 1 | 2,7 | 2,7 |
| Hemispherical Isotropy | 9,6 | 1,732 | 1 | 1 | 5,5 | 5,5 |
| Linearity | 4,7 | 1,732 | 1 | 1 | 2,7 | 2,7 |
| Probe modulation response | 2,4 | 1,732 | 1 | 1 | 1,4 | 1,4 |
| Detection Limits | 1,0 | 1,732 | 1 | 1 | 0,6 | 0,6 |
| Boundary Effect | 1,0 | 1,732 | 1 | 1 | 0,6 | 0,6 |
| Readout Electronics | 0,3 | 1,000 | 1 | 1 | 0,3 | 0,3 |
| Response Time | 0,8 | 1,732 | 1 | 1 | 0,5 | 0,5 |
| Integration Time | 2,6 | 1,732 | 1 | 1 | 1,5 | 1,5 |
| RF Ambient Conditions- Noise | 3,0 | 1,732 | 1 | 1 | 1,7 | 1,7 |
| RF Ambient Conditions-Reflections | 3,0 | 1,732 | 1 | 1 | 1,7 | 1,7 |
| Probe Positioner Mechanical Restrictions | 0,4 | 1,732 | 1 | 1 | 0,2 | 0,2 |
| Probe Positioning with respect to Phantom Shell | 2,9 | 1,732 | 1 | 1 | 1,7 | 1,7 |
| Post-Processing | 2,0 | 1,732 | 1 | 1 | 1,2 | 1,2 |
| Test Sample Related | | | | | | |
| Device Holder Uncertainty | 3,6 | 1,000 | 1 | 1 | 3,6 | 3,6 |
| Test Sample Positioning | 2,9 | 1,000 | 1 | 1 | 2,9 | 2,9 |
| *Power scaling* | 0,0 | 1,732 | *1* | *1* | 0,0 | 0,0 |
| Drift of Output Power (measured SAR drift) | 5,0 | 1,732 | 1 | 1 | 2,9 | 2,9 |
| Phantom and Set-Up | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 7,5 | 1,732 | 1 | 1 | 4,3 | 4,3 |
| Algorithm for correcting SAR for deviations in permittivity and conductivity | 1,9 | 1,000 | 1 | 0,84 | 1,9 | 1,6 |
| Liquid Conductivity (Measurement) | 2,5 | 1,000 | 0,78 | 0,71 | 2,0 | 1,8 |
| Liquid Permittivity (Measurement) | 2,5 | 1,000 | 0,23 | 0,26 | 0,6 | 0,7 |
| Liquid Permittivity – temperature uncertainty | 1,9 | 1,732 | 0,78 | 0,71 | 0,9 | 0,8 |
| Liquid Conductivity – temperature uncertainty | 2,8 | 1,732 | 0,23 | 0,26 | 0,4 | 0,4 |
| Combined standard uncertainty | | | | | 12,8 | 12,7 |
| Expanded uncertainty (95%confidence interval) | | | | | 25,7 | 25,5 |