

## Appendixes List

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Appendix A</b> | A.1 Probe Calibration certificate (EX3DV4_7541)<br>A.2 Probe Calibration certificate (EX3DV4_3928)<br>A.3 Probe Calibration certificate (EX3DV4_3697)<br>A.4 Dipole Calibration certificate (D750V3_1183)<br>A.5 Dipole Calibration certificate (D850V2_1006)<br>A.6 Dipole Calibration certificate (D1750V2_1072)<br>A.7 Dipole Calibration certificate (D1900V2_5d160)<br>A.8 Dipole Calibration certificate (D2450V2_895)<br>A.9 Dipole Calibration certificate (D2600V2_1050)<br>A.10 Dipole Calibration certificate (D5 GHz V2_1134)<br>A.11 Justification for Extended SAR Dipole Calibrations |
| <b>Appendix B</b> | SAR Tissue Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Appendix C</b> | Downlink LTE CA RF Conducted Power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Appendix D</b> | Antenna Location & Distance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Appendix E</b> | EUT Photo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Appendix F</b> | Test Setup Photo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Appendix G</b> | Power Reduction Verification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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Report No.:  
KR19-SPF0032-A  
Page (175) of (308)



## Appendix A. Calibration certificate Appendix A.1 Probe Calibration certificate (EX3DV4\_7541)

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



S Schweizerischer Kalibrierdienst  
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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 **KCTL (Dymstec)**

Certificate No: **EX3-7541\_Jul19**

### CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7541**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7  
Calibration procedure for dosimetric E-field probes**

Calibration date **July 22, 2019**

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       | 03-Apr-19 (No. 217-02892/02893)   | Apr-20                 |
| Power sensor NRP-Z91       | SN: 103244       | 03-Apr-19 (No. 217-02892)         | Apr-20                 |
| Power sensor NRP-Z01       | SN: 103245       | 03-Apr-19 (No. 217-02893)         | Apr-20                 |
| Reference 20 dB Attenuator | SN: 55277 (20x)  | 04-Apr-19 (No. 217-02894)         | Apr-20                 |
| DAE4                       | SN: 660          | 19-Dec-18 (No. DAE4-660, Dec18)   | Dec-19                 |
| Reference Probe ES3DV2     | SN: 3013         | 31-Dec-18 (No. ES3-3013, Dec18)   | Dec-19                 |
| Secondary Standards        | ID               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B         | SN: 0841293874   | 06-Apr-18 (in house check Jun-18) | in house check: Jun-20 |
| Power sensor E4412A        | SN: MY41468087   | 06-Apr-18 (in house check Jun-18) | in house check: Jun-20 |
| Power sensor E4412A        | SN: 000110210    | 06-Apr-18 (in house check Jun-18) | in house check: Jun-20 |
| RF generator HP 8648C      | SN: US3642J01700 | 04-Aug-09 (in house check Jun-18) | in house check: Jun-20 |
| Network Analyzer E8358A    | SN: US41080477   | 31-Mar-14 (in house check Oct-18) | in house check: Oct-19 |

|                                                                                                                 |                              |                                   |                       |
|-----------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------------|-----------------------|
| Calibrated by:                                                                                                  | Name<br><b>Leif Kyriak</b>   | Function<br>Laboratory Technician | Signature<br>         |
| Approved by:                                                                                                    | Name<br><b>Roger Pokorny</b> | Technical Manager                 |                       |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. |                              |                                   | Issued: July 22, 2019 |

Certificate No: EX3-7541\_Jul19

Page 1 of 19

**Calibration Laboratory of  
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**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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

Accreditation No.: SCS 0108

#### Glossary:

|                       |                                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                   | liquid simulating liquid                                                                                                                                  |
| NORM <sub>x,y,z</sub> | sensitivity in free space                                                                                                                                 |
| ConvF                 | sensitivity in TSL / NORM <sub>x,y,z</sub>                                                                                                                |
| DCP                   | diode compression point                                                                                                                                   |
| CF                    | crest factor (1/duty_cycle) of the RF signal                                                                                                              |
| A, B, C, D            | modulation dependent linearization parameters                                                                                                             |
| Polarization $\alpha$ | $\alpha$ rotation around probe axis                                                                                                                       |
| Polarization $\beta$  | $\beta$ rotation around an axis that is in the plane normal to probe axis ( $\alpha$ ) (measurement center),<br>i.e., $\beta = 0$ is normal to probe axis |
| Connector Angle       | information used in DASY system to align probe sensor X to the robot coordinate system                                                                    |

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 885664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>: Assessed for E-field polarization  $\beta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in fat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a fat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

EX3DV4 - SN:7541

July 22, 2018

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:7541****Basic Calibration Parameters**

|                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2)    |
|-------------------------------------------|----------|----------|----------|--------------|
| Norm ( $\mu V/(V/m)^{1/N}$ ) <sup>a</sup> | 0.64     | 0.65     | 0.63     | $\pm 10.1\%$ |
| DCP (mV) <sup>b</sup>                     | 98.0     | 100.2    | 98.5     |              |

**Calibration Results for Modulation Response**

| UID           | Communication System Name   |   | A<br>dB | B<br>dB/ $\mu V$ | C     | D<br>dB | VR<br>mV | Max<br>dev. | Max<br>Unc <sup>c</sup><br>(k=2) |
|---------------|-----------------------------|---|---------|------------------|-------|---------|----------|-------------|----------------------------------|
| 0             | CW                          | X | 0.00    | 0.00             | 1.00  | 0.00    | 163.9    | $\pm 3.3\%$ | $\pm 4.7\%$                      |
|               |                             | Y | 0.00    | 0.00             | 1.00  |         | 171.0    |             |                                  |
|               |                             | Z | 0.00    | 0.00             | 1.00  |         | 177.4    |             |                                  |
| 10352-<br>AAA | Pulse Waveform (200Hz, 10%) | X | 15.00   | 89.24            | 20.97 | 10.00   | 60.0     | $\pm 3.8\%$ | $\pm 9.6\%$                      |
|               |                             | Y | 15.00   | 89.00            | 20.61 |         | 60.0     |             |                                  |
|               |                             | Z | 15.00   | 87.08            | 19.12 |         | 60.0     |             |                                  |
| 10353-<br>AAA | Pulse Waveform (200Hz, 20%) | X | 15.00   | 90.10            | 20.20 | 6.99    | 80.0     | $\pm 1.8\%$ | $\pm 8.6\%$                      |
|               |                             | Y | 15.00   | 89.92            | 20.13 |         | 80.0     |             |                                  |
|               |                             | Z | 15.00   | 88.77            | 18.64 |         | 80.0     |             |                                  |
| 10354-<br>AAA | Pulse Waveform (200Hz, 40%) | X | 15.00   | 93.48            | 20.36 | 3.98    | 95.0     | $\pm 1.1\%$ | $\pm 9.8\%$                      |
|               |                             | Y | 15.00   | 93.01            | 20.37 |         | 95.0     |             |                                  |
|               |                             | Z | 15.00   | 89.51            | 17.36 |         | 95.0     |             |                                  |
| 10355-<br>AAA | Pulse Waveform (200Hz, 60%) | X | 15.00   | 94.75            | 19.43 | 2.22    | 120.0    | $\pm 1.2\%$ | $\pm 9.6\%$                      |
|               |                             | Y | 15.00   | 97.64            | 21.26 |         | 120.0    |             |                                  |
|               |                             | Z | 15.00   | 85.01            | 13.77 |         | 120.0    |             |                                  |
| 10387-<br>AAA | QPSK Waveform, 1 MHz        | X | 0.68    | 60.98            | 8.91  | 0.00    | 150.0    | $\pm 2.8\%$ | $\pm 9.8\%$                      |
|               |                             | Y | 0.90    | 64.10            | 11.17 |         | 150.0    |             |                                  |
|               |                             | Z | 0.59    | 60.31            | 7.62  |         | 150.0    |             |                                  |
| 10388-<br>AAA | QPSK Waveform, 10 MHz       | X | 2.13    | 67.08            | 15.12 | 0.00    | 150.0    | $\pm 1.1\%$ | $\pm 9.8\%$                      |
|               |                             | Y | 2.46    | 69.59            | 16.56 |         | 150.0    |             |                                  |
|               |                             | Z | 2.12    | 67.38            | 15.19 |         | 150.0    |             |                                  |
| 10390-<br>AAA | 64-QAM Waveform, 100 kHz    | X | 3.04    | 69.43            | 18.15 | 3.01    | 150.0    | $\pm 0.7\%$ | $\pm 9.8\%$                      |
|               |                             | Y | 3.44    | 72.37            | 19.64 |         | 150.0    |             |                                  |
|               |                             | Z | 2.67    | 66.49            | 17.81 |         | 150.0    |             |                                  |
| 10390-<br>AAA | 64-QAM Waveform, 40 MHz     | X | 3.46    | 66.60            | 15.51 | 0.00    | 150.0    | $\pm 2.0\%$ | $\pm 9.8\%$                      |
|               |                             | Y | 3.65    | 67.77            | 16.19 |         | 150.0    |             |                                  |
|               |                             | Z | 3.47    | 66.92            | 15.82 |         | 150.0    |             |                                  |
| 10414-<br>AAA | WLAN CCDF, 64-QAM, 40MHz    | X | 4.87    | 65.42            | 15.44 | 0.00    | 150.0    | $\pm 4.0\%$ | $\pm 9.8\%$                      |
|               |                             | Y | 5.02    | 68.01            | 15.82 |         | 150.0    |             |                                  |
|               |                             | Z | 4.69    | 65.71            | 15.80 |         | 150.0    |             |                                  |

Note: For details on UID parameters see Appendix.

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

<sup>a</sup> The uncertainties of Norm X,Y,Z do not affect the E-field uncertainty inside TSL (see Page 5).<sup>b</sup> Numerical linearization parameter; uncertainty not required.<sup>c</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Report No.:  
KR19-SPF0032-A  
Page (178) of (308)



EX3DV4- SN:7541

July 22, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:7541****Sensor Model Parameters**

|   | C1<br>fF | C2<br>fF | $\alpha$<br>V <sup>-1</sup> | T1<br>ms.V <sup>-2</sup> | T2<br>ms.V <sup>-1</sup> | T3<br>ms | T4<br>V <sup>-2</sup> | T5<br>V <sup>-1</sup> | T6   |
|---|----------|----------|-----------------------------|--------------------------|--------------------------|----------|-----------------------|-----------------------|------|
| X | 50.2     | 384.41   | 37.02                       | 16.28                    | 0.46                     | 5.10     | 0.25                  | 0.61                  | 1.01 |
| Y | 52.2     | 393.23   | 36.19                       | 20.99                    | 0.25                     | 5.10     | 0.92                  | 0.45                  | 1.01 |
| Z | 45.4     | 351.05   | 37.69                       | 10.04                    | 0.23                     | 5.10     | 0.00                  | 0.49                  | 1.01 |

**Other Probe Parameters**

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 89.7       |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 9 mm       |
| Tip Diameter                                  | 2.5 mm     |
| Probe Tip to Sensor X Calibration Point       | 1 mm       |
| Probe Tip to Sensor Y Calibration Point       | 1 mm       |
| Probe Tip to Sensor Z Calibration Point       | 1 mm       |
| Recommended Measurement Distance from Surface | 1.4 mm     |

EX3DV4- SN:7541

July 22, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:7541****Calibration Parameter Determined in Head Tissue Simulating Media**

| F (MHz) <sup>a</sup> | Relative Permittivity <sup>b</sup> | Conductivity (S/m) <sup>c</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>d</sup> | Depth (mm) <sup>e</sup> | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-----------|
| 750                  | 41.9                               | 0.89                            | 10.41   | 10.41   | 10.41   | 0.48               | 0.80                    | ± 12.0 %  |
| 900                  | 41.5                               | 0.97                            | 9.87    | 9.87    | 9.87    | 0.49               | 0.80                    | ± 12.0 %  |
| 1750                 | 40.1                               | 1.37                            | 8.61    | 8.61    | 8.61    | 0.22               | 0.86                    | ± 12.0 %  |
| 1900                 | 40.0                               | 1.40                            | 8.30    | 8.30    | 8.30    | 0.29               | 0.86                    | ± 12.0 %  |
| 2300                 | 39.5                               | 1.67                            | 7.85    | 7.85    | 7.85    | 0.22               | 0.90                    | ± 12.0 %  |
| 2450                 | 39.2                               | 1.80                            | 7.58    | 7.58    | 7.58    | 0.22               | 0.90                    | ± 12.0 %  |
| 2600                 | 39.0                               | 1.96                            | 7.51    | 7.51    | 7.51    | 0.16               | 0.90                    | ± 12.0 %  |
| 3500                 | 37.9                               | 2.91                            | 6.69    | 6.69    | 6.69    | 0.32               | 1.30                    | ± 13.1 %  |
| 3700                 | 37.7                               | 3.12                            | 6.67    | 6.57    | 6.57    | 0.35               | 1.35                    | ± 13.1 %  |
| 5200                 | 36.0                               | 4.66                            | 5.46    | 5.46    | 5.46    | 0.40               | 1.80                    | ± 13.1 %  |
| 5300                 | 35.9                               | 4.76                            | 5.20    | 5.20    | 5.20    | 0.40               | 1.80                    | ± 13.1 %  |
| 5500                 | 35.6                               | 4.96                            | 4.79    | 4.79    | 4.79    | 0.40               | 1.80                    | ± 13.1 %  |
| 5600                 | 35.5                               | 5.07                            | 4.70    | 4.70    | 4.70    | 0.40               | 1.80                    | ± 13.1 %  |
| 5800                 | 35.3                               | 5.27                            | 4.75    | 4.75    | 4.75    | 0.40               | 1.80                    | ± 13.1 %  |

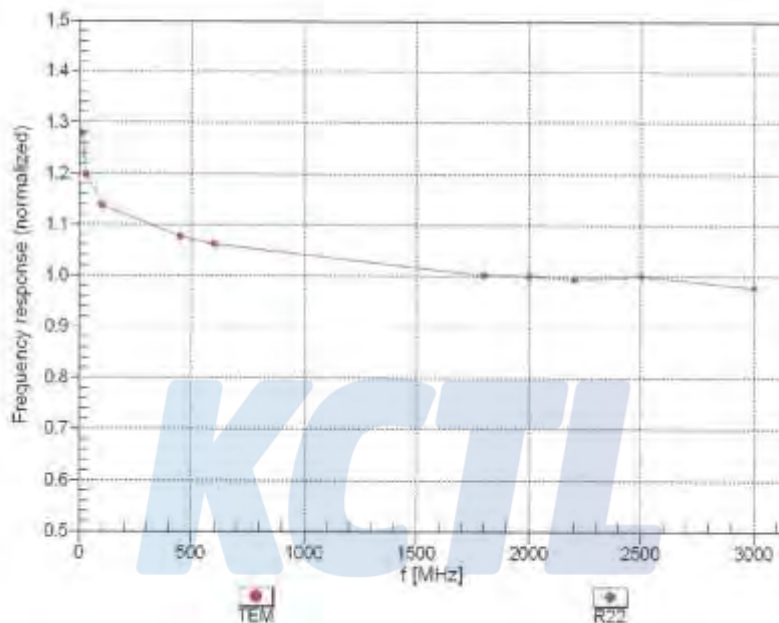
<sup>a</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 0 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>b</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>c</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe (or diameter from the boundary).

EX3DV4- SN:7541

July 22, 2019

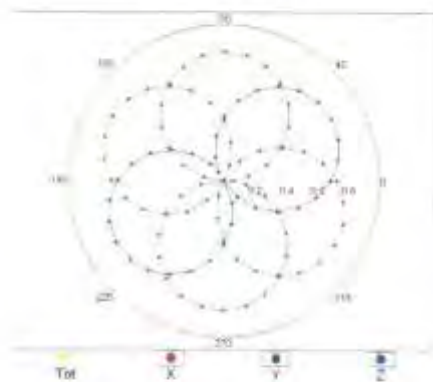
**Frequency Response of E-Field**  
(TEM-Cell: ifi110 EXX, Waveguide: R22)Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

EX3DV4- SN:7541

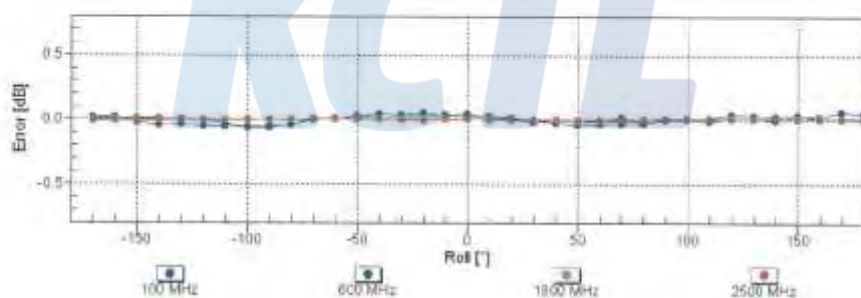
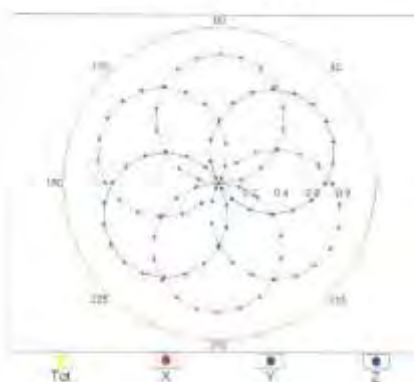
July 22, 2019

**Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$** 

f=600 MHz,TEM

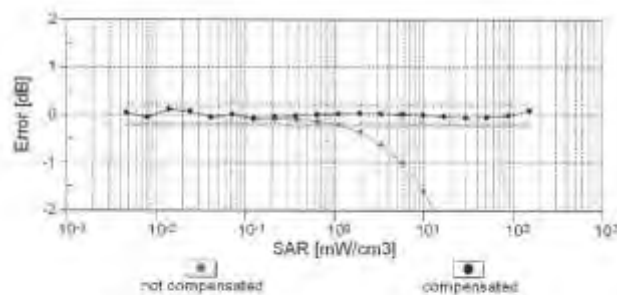
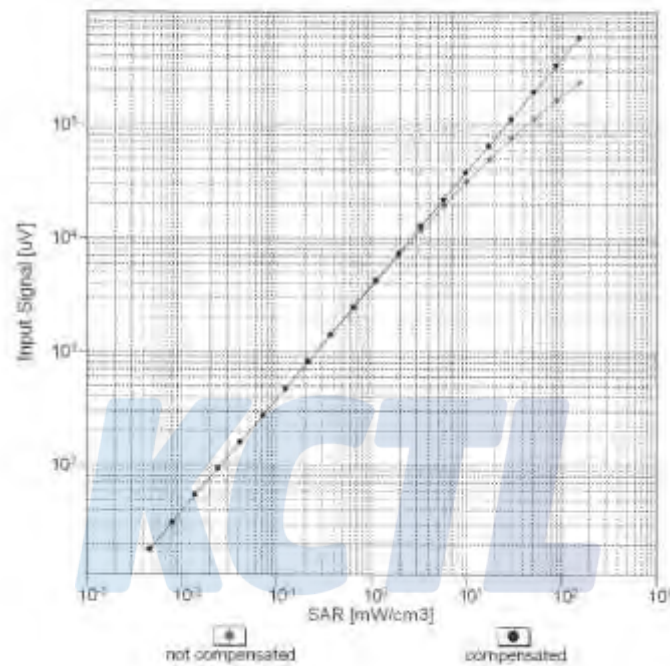


f=1800 MHz,R22

Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

EX3DV4-SN.7541

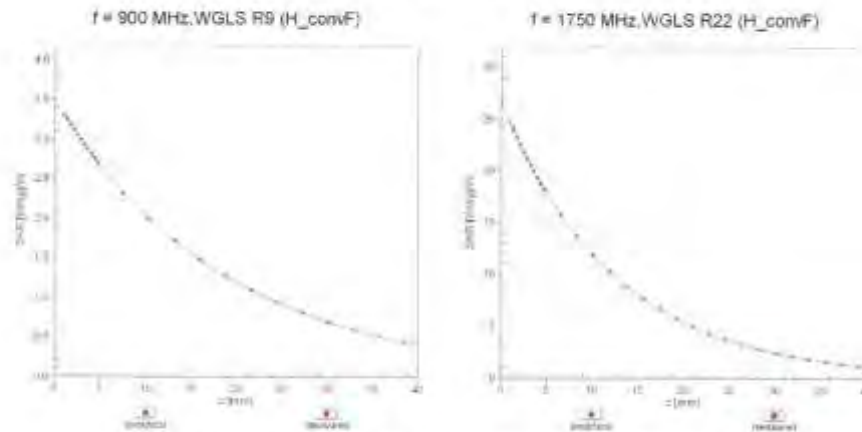
July 22, 2019

**Dynamic Range  $f(\text{SAR}_{\text{head}})$**   
(TEM cell,  $f_{\text{eval}} = 1900 \text{ MHz}$ )Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

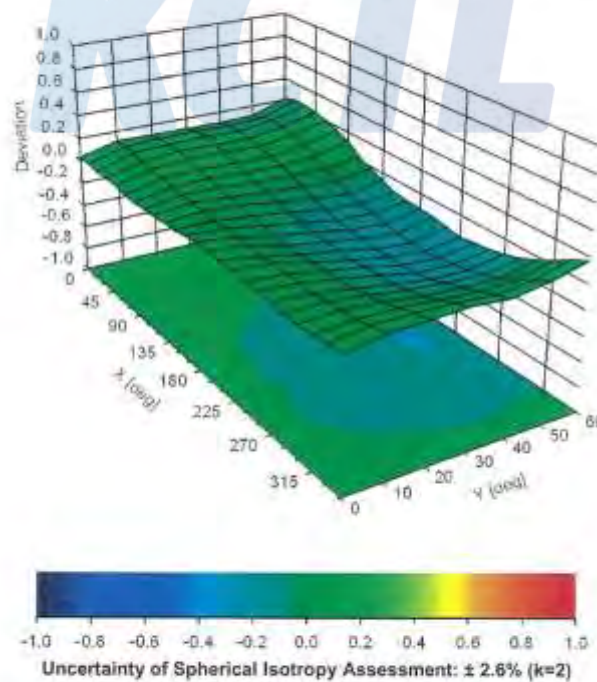
EX3DV4-SN:7541

July 22, 2019

### Conversion Factor Assessment



### Deviation from Isotropy in Liquid

Error ( $\phi, \theta$ ),  $f = 900 \text{ MHz}$ 

EX3DV4-SN:7541

July 22, 2019

**Appendix: Modulation Calibration Parameters**

| UID   | Rev | Communication System Name                          | Group     | PAR (dB) | Unc <sup>2</sup> (k=2) |
|-------|-----|----------------------------------------------------|-----------|----------|------------------------|
| 0     |     | CW                                                 | CW        | 0.00     | ±4.7 %                 |
| 10010 | CAA | SAR Validation (Square, 100ms, 10ms)               | Test      | 10.00    | ±9.6 %                 |
| 10011 | CAB | UMTS-FDD (WCDMA)                                   | WCDMA     | 2.91     | ±9.6 %                 |
| 10012 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)           | WLAN      | 1.67     | ±9.6 %                 |
| 10013 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)      | WLAN      | 9.46     | ±9.6 %                 |
| 10021 | DAC | GSM-FDD (TDMA, GMSK)                               | GSM       | 9.39     | ±9.6 %                 |
| 10023 | DAC | GPRS-FDD (TDMA, GMSK, TN 0)                        | GSM       | 9.57     | ±9.6 %                 |
| 10024 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1)                      | GSM       | 6.56     | ±9.6 %                 |
| 10025 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0)                        | GSM       | 12.02    | ±9.6 %                 |
| 10026 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1)                      | GSM       | 9.50     | ±9.6 %                 |
| 10027 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2)                    | GSM       | 4.80     | ±9.6 %                 |
| 10028 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)                  | GSM       | 3.55     | ±9.6 %                 |
| 10029 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2)                    | GSM       | 7.78     | ±9.6 %                 |
| 10030 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH1)                | Bluetooth | 5.30     | ±9.6 %                 |
| 10031 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH3)                | Bluetooth | 1.87     | ±9.6 %                 |
| 10032 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH5)                | Bluetooth | 1.16     | ±9.6 %                 |
| 10033 | CAA | IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH1)           | Bluetooth | 7.74     | ±9.6 %                 |
| 10034 | CAA | IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH3)           | Bluetooth | 4.53     | ±9.6 %                 |
| 10035 | CAA | IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH5)           | Bluetooth | 3.83     | ±9.6 %                 |
| 10036 | CAA | IEEE 802.15.1 Bluetooth (8-QPSK, DH1)              | Bluetooth | 8.61     | ±9.6 %                 |
| 10037 | CAA | IEEE 802.15.1 Bluetooth (8-QPSK, DH3)              | Bluetooth | 4.77     | ±9.6 %                 |
| 10039 | CAA | IEEE 802.15.1 Bluetooth (8-QPSK, DH5)              | Bluetooth | 4.10     | ±9.6 %                 |
| 10039 | CAB | CDMA2000 (1xRTT, RC1)                              | CDMA2000  | 4.57     | ±9.6 %                 |
| 10042 | CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI4-DQPSK, Halfrate) | AMPS      | 7.78     | ±9.6 %                 |
| 10044 | CAA | IS-91/IS-136 FDD (TDMA/FDM, FMI)                   | AMPS      | 0.00     | ±9.6 %                 |
| 10048 | CAA | DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)          | DECT      | 13.80    | ±9.6 %                 |
| 10048 | CAA | DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)        | DECT      | 10.79    | ±9.6 %                 |
| 10056 | CAA | UMTS-TDD (TD-SCDMA, 1.28 Mcps)                     | TD-SCDMA  | 11.01    | ±9.6 %                 |
| 10058 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)                  | GSM       | 6.52     | ±9.6 %                 |
| 10059 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)           | WLAN      | 2.12     | ±9.6 %                 |
| 10060 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)         | WLAN      | 2.63     | ±9.6 %                 |
| 10061 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)          | WLAN      | 3.60     | ±9.6 %                 |
| 10062 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)           | WLAN      | 8.68     | ±9.6 %                 |
| 10063 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 8 Mbps)           | WLAN      | 8.63     | ±9.6 %                 |
| 10064 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)          | WLAN      | 9.09     | ±9.6 %                 |
| 10065 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)          | WLAN      | 9.00     | ±9.6 %                 |
| 10066 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)          | WLAN      | 9.38     | ±9.6 %                 |
| 10067 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)          | WLAN      | 10.12    | ±9.6 %                 |
| 10068 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)          | WLAN      | 10.24    | ±9.6 %                 |
| 10069 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)          | WLAN      | 10.56    | ±9.6 %                 |
| 10071 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 6 Mbps)      | WLAN      | 9.63     | ±9.6 %                 |
| 10072 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)     | WLAN      | 9.62     | ±9.6 %                 |
| 10073 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)     | WLAN      | 9.94     | ±9.6 %                 |
| 10074 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)     | WLAN      | 10.30    | ±9.6 %                 |
| 10075 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)     | WLAN      | 10.77    | ±9.6 %                 |
| 10076 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)     | WLAN      | 10.94    | ±9.6 %                 |
| 10077 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)     | WLAN      | 11.00    | ±9.6 %                 |
| 10081 | CAB | CDMA2000 (1xRTT, RC3)                              | CDMA2000  | 3.97     | ±9.6 %                 |
| 10082 | CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI4-DQPSK, Fullrate) | AMPS      | 4.77     | ±9.6 %                 |
| 10090 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-4)                      | GSM       | 6.56     | ±9.6 %                 |
| 10097 | CAB | UMTS-FDD (HSDPA)                                   | WCDMA     | 3.98     | ±9.6 %                 |
| 10098 | CAB | UMTS-FDD (HSUPA, Subrate 2)                        | WCDMA     | 3.88     | ±9.6 %                 |
| 10099 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-4)                      | GSM       | 3.55     | ±9.6 %                 |
| 10100 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)           | LTE-FDD   | 3.67     | ±9.6 %                 |
| 10101 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)         | LTE-FDD   | 6.42     | ±9.6 %                 |
| 10102 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)         | LTE-FDD   | 6.80     | ±9.6 %                 |
| 10103 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)           | LTE-TDD   | 3.29     | ±9.6 %                 |
| 10104 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)         | LTE-TDD   | 9.97     | ±9.6 %                 |
| 10105 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)         | LTE-TDD   | 10.01    | ±9.6 %                 |
| 10108 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)           | LTE-FDD   | 5.80     | ±9.6 %                 |

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Report No.:  
KR19-SPF0032-A  
Page (185) of (308)



ENV04- 3N704

July 22, 2019

|       |     |                                                |         |       |         |
|-------|-----|------------------------------------------------|---------|-------|---------|
| 10109 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)     | LTE-FDD | 6.43  | ± 9.6 % |
| 10110 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)        | LTE-FDD | 6.75  | ± 9.6 % |
| 10111 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)      | LTE-FDD | 6.44  | ± 9.6 % |
| 10112 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)     | LTE-FDD | 6.59  | ± 9.6 % |
| 10113 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)      | LTE-FDD | 6.62  | ± 9.6 % |
| 10114 | CAC | IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)  | WLAN    | 8.10  | ± 9.6 % |
| 10115 | CAC | IEEE 802.11n (HT Greenfield, 61 Mbps, 16-QAM)  | WLAN    | 8.46  | ± 9.6 % |
| 10116 | CAC | IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM) | WLAN    | 8.15  | ± 9.6 % |
| 10117 | CAC | IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)       | WLAN    | 8.07  | ± 9.6 % |
| 10118 | CAC | IEEE 802.11n (HT Mixed, 61 Mbps, 16-QAM)       | WLAN    | 8.59  | ± 9.6 % |
| 10119 | CAC | IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)      | WLAN    | 8.13  | ± 9.6 % |
| 10140 | CAE | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)     | LTE-FDD | 6.49  | ± 9.6 % |
| 10141 | CAE | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)     | LTE-FDD | 6.53  | ± 9.6 % |
| 10142 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)        | LTE-FDD | 5.73  | ± 9.6 % |
| 10143 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)      | LTE-FDD | 6.35  | ± 9.6 % |
| 10144 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)      | LTE-FDD | 6.65  | ± 9.6 % |
| 10145 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)      | LTE-FDD | 5.76  | ± 9.6 % |
| 10146 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)    | LTE-FDD | 6.41  | ± 9.6 % |
| 10147 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)    | LTE-FDD | 6.72  | ± 9.6 % |
| 10148 | CAE | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)      | LTE-FDD | 6.42  | ± 9.6 % |
| 10150 | CAE | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)      | LTE-FDD | 6.60  | ± 9.6 % |
| 10151 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)        | LTE-TDD | 9.28  | ± 9.6 % |
| 10152 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)      | LTE-TDD | 9.92  | ± 9.6 % |
| 10153 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)      | LTE-TDD | 10.05 | ± 9.6 % |
| 10154 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)        | LTE-FDD | 5.75  | ± 9.6 % |
| 10155 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)      | LTE-FDD | 6.43  | ± 9.6 % |
| 10156 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)         | LTE-FDD | 5.79  | ± 9.6 % |
| 10157 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)       | LTE-FDD | 6.49  | ± 9.6 % |
| 10158 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)      | LTE-FDD | 6.62  | ± 9.6 % |
| 10159 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)       | LTE-FDD | 6.56  | ± 9.6 % |
| 10160 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)        | LTE-FDD | 5.82  | ± 9.6 % |
| 10161 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)      | LTE-FDD | 6.43  | ± 9.6 % |
| 10162 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)      | LTE-FDD | 6.58  | ± 9.6 % |
| 10166 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)       | LTE-FDD | 5.46  | ± 9.6 % |
| 10167 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)     | LTE-FDD | 6.21  | ± 9.6 % |
| 10168 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)     | LTE-FDD | 6.79  | ± 9.6 % |
| 10169 | CAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)          | LTE-FDD | 5.73  | ± 9.6 % |
| 10170 | CAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)        | LTE-FDD | 6.82  | ± 9.6 % |
| 10171 | AAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)        | LTE-FDD | 6.49  | ± 9.6 % |
| 10172 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)          | LTE-TDD | 9.21  | ± 9.6 % |
| 10173 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)        | LTE-TDD | 9.48  | ± 9.6 % |
| 10174 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)        | LTE-TDD | 10.25 | ± 9.6 % |
| 10175 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)          | LTE-FDD | 5.72  | ± 9.6 % |
| 10176 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)        | LTE-FDD | 6.52  | ± 9.6 % |
| 10177 | CAI | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)           | LTE-FDD | 5.75  | ± 9.6 % |
| 10178 | CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)         | LTE-FDD | 6.52  | ± 9.6 % |
| 10179 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)        | LTE-FDD | 6.50  | ± 9.6 % |
| 10180 | CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)         | LTE-FDD | 6.50  | ± 9.6 % |
| 10181 | CAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)          | LTE-FDD | 5.72  | ± 9.6 % |
| 10182 | CAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)        | LTE-FDD | 6.52  | ± 9.6 % |
| 10183 | AAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)        | LTE-FDD | 6.50  | ± 9.6 % |
| 10184 | CAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)           | LTE-FDD | 5.73  | ± 9.6 % |
| 10185 | CAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)         | LTE-FDD | 6.51  | ± 9.6 % |
| 10186 | AAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)         | LTE-FDD | 6.50  | ± 9.6 % |
| 10187 | CAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)         | LTE-FDD | 5.73  | ± 9.6 % |
| 10189 | CAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)       | LTE-FDD | 6.52  | ± 9.6 % |
| 10189 | AAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)       | LTE-FDD | 6.50  | ± 9.6 % |
| 10193 | CAC | IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)   | WLAN    | 8.09  | ± 9.6 % |
| 10194 | CAC | IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)  | WLAN    | 8.12  | ± 9.6 % |
| 10195 | CAC | IEEE 802.11n (HT Greenfield, 85 Mbps, 64-QAM)  | WLAN    | 8.21  | ± 9.6 % |
| 10196 | CAC | IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)        | WLAN    | 8.10  | ± 9.6 % |
| 10197 | CAC | IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)       | WLAN    | 8.13  | ± 9.6 % |
| 10198 | CAC | IEEE 802.11n (HT Mixed, 85 Mbps, 64-QAM)       | WLAN    | 8.27  | ± 9.6 % |
| 10219 | CAC | IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)        | WLAN    | 8.03  | ± 9.6 % |

Certificate No: EX3-7541\_Jul19

Page 11 of 79

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Report No.:  
KR19-SPF0032-A  
Page (186) of (308)



EX30V4-SN:7541

July 22, 2019

|       |     |                                             |          |       |         |
|-------|-----|---------------------------------------------|----------|-------|---------|
| 10220 | CAC | IEEE 802.11a (HT Mixed, 49.2 Mbps, 16-QAM)  | WLAN     | 8.13  | ± 9.6 % |
| 10221 | CAC | IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)  | WLAN     | 8.27  | ± 9.6 % |
| 10222 | CAC | IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)      | WLAN     | 8.06  | ± 9.6 % |
| 10223 | CAC | IEEE 802.11n (HT Mixed, 60 Mbps, 16-QAM)    | WLAN     | 8.48  | ± 9.6 % |
| 10224 | CAC | IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)   | WLAN     | 8.08  | ± 9.6 % |
| 10225 | CAB | UMTS-FDD (HSPA+)                            | WCDMA    | 5.97  | ± 9.6 % |
| 10226 | CAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)    | LTE-TDD  | 9.49  | ± 9.6 % |
| 10227 | CAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)    | LTE-TDD  | 10.26 | ± 9.6 % |
| 10228 | CAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)      | LTE-TDD  | 9.22  | ± 9.6 % |
| 10229 | CAC | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)      | LTE-TDD  | 9.48  | ± 9.6 % |
| 10230 | CAC | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)      | LTE-TDD  | 10.25 | ± 9.6 % |
| 10231 | CAC | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)        | LTE-TDD  | 8.19  | ± 9.6 % |
| 10232 | CAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)      | LTE-TDD  | 9.48  | ± 9.6 % |
| 10233 | CAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)      | LTE-TDD  | 10.25 | ± 9.6 % |
| 10234 | CAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)        | LTE-TDD  | 9.21  | ± 9.6 % |
| 10235 | CAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)     | LTE-TDD  | 9.48  | ± 9.6 % |
| 10236 | CAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)     | LTE-TDD  | 10.25 | ± 9.6 % |
| 10237 | CAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)       | LTE-TDD  | 9.21  | ± 9.6 % |
| 10238 | CAF | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)     | LTE-TDD  | 9.48  | ± 9.6 % |
| 10239 | CAF | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)     | LTE-TDD  | 10.25 | ± 9.6 % |
| 10240 | CAF | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)       | LTE-TDD  | 9.21  | ± 9.6 % |
| 10241 | CAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)  | LTE-TDD  | 9.92  | ± 9.6 % |
| 10242 | CAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)  | LTE-TDD  | 9.86  | ± 9.6 % |
| 10243 | CAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)    | LTE-TDD  | 9.46  | ± 9.6 % |
| 10244 | CAC | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)    | LTE-TDD  | 10.06 | ± 9.6 % |
| 10245 | CAC | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)    | LTE-TDD  | 10.06 | ± 9.6 % |
| 10246 | CAC | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK)      | LTE-TDD  | 9.30  | ± 9.6 % |
| 10247 | CAF | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)    | LTE-TDD  | 9.91  | ± 9.6 % |
| 10248 | CAF | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)    | LTE-TDD  | 10.09 | ± 9.6 % |
| 10249 | CAF | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)      | LTE-TDD  | 9.29  | ± 9.6 % |
| 10250 | CAF | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)   | LTE-TDD  | 9.81  | ± 9.6 % |
| 10251 | CAF | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)   | LTE-TDD  | 10.17 | ± 9.6 % |
| 10252 | CAF | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)     | LTE-TDD  | 9.24  | ± 9.6 % |
| 10253 | CAF | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)   | LTE-TDD  | 9.90  | ± 9.6 % |
| 10254 | CAF | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)   | LTE-TDD  | 10.14 | ± 9.6 % |
| 10255 | CAF | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)     | LTE-TDD  | 9.20  | ± 9.6 % |
| 10256 | CAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM) | LTE-TDD  | 9.96  | ± 9.6 % |
| 10257 | CAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM) | LTE-TDD  | 10.08 | ± 9.6 % |
| 10258 | CAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)   | LTE-TDD  | 9.34  | ± 9.6 % |
| 10259 | CAC | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)   | LTE-TDD  | 9.98  | ± 9.6 % |
| 10260 | CAC | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)   | LTE-TDD  | 9.97  | ± 9.6 % |
| 10261 | CAC | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK)     | LTE-TDD  | 9.24  | ± 9.6 % |
| 10262 | CAF | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)   | LTE-TDD  | 9.83  | ± 9.6 % |
| 10263 | CAF | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)   | LTE-TDD  | 10.16 | ± 9.6 % |
| 10264 | CAF | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)     | LTE-TDD  | 9.23  | ± 9.6 % |
| 10265 | CAF | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)  | LTE-TDD  | 9.92  | ± 9.6 % |
| 10266 | CAF | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)  | LTE-TDD  | 10.07 | ± 9.6 % |
| 10267 | CAF | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)    | LTE-TDD  | 9.30  | ± 9.6 % |
| 10268 | CAF | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)  | LTE-TDD  | 10.06 | ± 9.6 % |
| 10269 | CAF | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)  | LTE-TDD  | 10.11 | ± 9.6 % |
| 10270 | CAF | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)    | LTE-TDD  | 9.58  | ± 9.6 % |
| 10274 | CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)   | WCDMA    | 4.87  | ± 9.6 % |
| 10275 | CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)    | WCDMA    | 3.96  | ± 9.6 % |
| 10277 | CAA | PHS (QPSK)                                  | PHS      | 11.81 | ± 9.6 % |
| 10278 | CAA | PHS (QPSK, BW 884MHz, Roll-off 0.5)         | PHS      | 11.81 | ± 9.6 % |
| 10279 | CAA | PHS (QPSK, BW 884MHz, Roll-off 0.38)        | PHS      | 12.19 | ± 9.6 % |
| 10280 | AAB | CDMA2000, RC1, SO55, Full Rate              | CDMA2000 | 3.91  | ± 9.6 % |
| 10281 | AAB | CDMA2000, RC3, SO55, Full Rate              | CDMA2000 | 3.46  | ± 9.6 % |
| 10282 | AAB | CDMA2000, RC3, SO32, Full Rate              | CDMA2000 | 3.39  | ± 9.6 % |
| 10283 | AAB | CDMA2000, RC3, SO3, Full Rate               | CDMA2000 | 3.50  | ± 9.6 % |
| 10285 | AAB | CDMA2000, RC1, SO3, 1/8th Rate 25 n         | CDMA2000 | 12.49 | ± 9.6 % |
| 10297 | AAD | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)     | LTE-FDD  | 5.81  | ± 9.6 % |
| 10298 | AAD | LTE-FDD (SC-FDMA, 50% RB, 2 MHz, QPSK)      | LTE-FDD  | 5.72  | ± 9.6 % |
| 10299 | AAD | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)    | LTE-FDD  | 6.39  | ± 9.6 % |

Certificate No: EX3-7541, Jul19

Page 12 of 18

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Report No.:  
KR19-SPF0032-A  
Page (187) of (308)



2019V4-SN.7541

July 22, 2019

|       |     |                                                                                 |          |       |         |
|-------|-----|---------------------------------------------------------------------------------|----------|-------|---------|
| 10300 | AAD | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)                                        | LTE-FDD  | 6.80  | ± 9.6 % |
| 10301 | AAA | IEEE 802.16e WiMAX (29-18, 5ms, 10MHz, QPSK, PUSC)                              | WiMAX    | 12.03 | ± 9.6 % |
| 10302 | AAA | IEEE 802.16e WiMAX (29-18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL symbols)              | WiMAX    | 12.57 | ± 9.6 % |
| 10303 | AAA | IEEE 802.16e WiMAX (31-15, 5ms, 10MHz, 64QAM, PUSC)                             | WiMAX    | 12.52 | ± 9.6 % |
| 10304 | AAA | IEEE 802.16e WiMAX (29-18, 5ms, 10MHz, 64QAM, PUSC)                             | WiMAX    | 11.86 | ± 9.6 % |
| 10306 | AAA | IEEE 802.16e WiMAX (31-15, 10ms, 10MHz, 64QAM, PUSC, 15 symbols)                | WiMAX    | 15.24 | ± 9.6 % |
| 10308 | AAA | IEEE 802.16e WiMAX (29-18, 10ms, 10MHz, 64QAM, PUSC, 15 symbols)                | WiMAX    | 14.67 | ± 9.6 % |
| 10307 | AAA | IEEE 802.16e WiMAX (29-18, 10ms, 10MHz, QPSK, PUSC, 15 symbols)                 | WiMAX    | 14.49 | ± 9.6 % |
| 10308 | AAA | IEEE 802.16e WiMAX (29-18, 10ms, 10MHz, 16QAM, PUSC)                            | WiMAX    | 14.46 | ± 9.6 % |
| 10309 | AAA | IEEE 802.16e WiMAX (29-18, 10ms, 10MHz, 16QAM, AMC 2x3, 15 symbols)             | WiMAX    | 14.58 | ± 9.6 % |
| 10310 | AAA | IEEE 802.16e WiMAX (29-18, 10ms, 10MHz, QPSK, AMC 2x3, 15 symbols)              | WiMAX    | 14.57 | ± 9.6 % |
| 10311 | AAD | LTE-FDD (SC-FDMA, 100% RB, 16 MHz, QPSK)                                        | LTE-FDD  | -6.06 | ± 9.6 % |
| 10313 | AAA | IDEN 1:3                                                                        | IDEN     | 10.51 | ± 9.6 % |
| 10314 | AAA | IDEN 1:6                                                                        | IDEN     | 13.48 | ± 9.6 % |
| 10315 | AAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)                       | WLAN     | 1.71  | ± 9.6 % |
| 10316 | AAB | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)                   | WLAN     | 8.36  | ± 9.6 % |
| 10317 | AAC | IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)                         | WLAN     | 8.36  | ± 9.6 % |
| 10352 | AAA | Pulse Waveform (200Hz, 10%)                                                     | Generic  | 10.00 | ± 9.6 % |
| 10353 | AAA | Pulse Waveform (200Hz, 20%)                                                     | Generic  | 6.99  | ± 9.6 % |
| 10354 | AAA | Pulse Waveform (200Hz, 40%)                                                     | Generic  | 3.98  | ± 9.6 % |
| 10355 | AAA | Pulse Waveform (200Hz, 60%)                                                     | Generic  | 2.22  | ± 9.6 % |
| 10356 | AAA | Pulse Waveform (200Hz, 80%)                                                     | Generic  | 0.97  | ± 9.6 % |
| 10387 | AAA | QPSK Waveform, 1 MHz                                                            | Generic  | 5.10  | ± 9.6 % |
| 10388 | AAA | QPSK Waveform, 10 MHz                                                           | Generic  | 5.22  | ± 9.6 % |
| 10389 | AAA | 64-QAM Waveform, 100 kHz                                                        | Generic  | 8.27  | ± 9.6 % |
| 10390 | AAA | 64-QAM Waveform, 40 MHz                                                         | Generic  | 6.27  | ± 9.6 % |
| 10400 | AAD | IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)                             | WLAN     | 8.37  | ± 9.6 % |
| 10401 | AAD | IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)                             | WLAN     | 8.80  | ± 9.6 % |
| 10402 | AAD | IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)                             | WLAN     | 9.53  | ± 9.6 % |
| 10403 | AAB | CDMA2000 (1xEV-DO, Rev. 0)                                                      | CDMA2000 | 3.76  | ± 9.6 % |
| 10404 | AAB | CDMA2000 (1xEV-DO, Rev. A)                                                      | CDMA2000 | 3.77  | ± 9.6 % |
| 10406 | AAB | CDMA2000, RC3, SC32, SCH0, Full Rate                                            | CDMA2000 | 5.22  | ± 9.6 % |
| 10410 | AAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9, Subframe Cont=4) | LTE-TDD  | 7.82  | ± 9.6 % |
| 10414 | AAA | WLAN CCDF, 64-QAM, 40MHz                                                        | Generic  | 8.54  | ± 9.6 % |
| 10415 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)                       | WLAN     | 1.54  | ± 9.6 % |
| 10416 | AAA | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)                   | WLAN     | 8.23  | ± 9.6 % |
| 10417 | AAB | IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)                         | WLAN     | 8.23  | ± 9.6 % |
| 10418 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preamble)   | WLAN     | 8.14  | ± 9.6 % |
| 10419 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preamble)  | WLAN     | 8.19  | ± 9.6 % |
| 10422 | AAB | IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)                                    | WLAN     | 8.32  | ± 9.6 % |
| 10423 | AAB | IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM)                                 | WLAN     | 8.47  | ± 9.6 % |
| 10424 | AAB | IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM)                                 | WLAN     | 8.40  | ± 9.6 % |
| 10425 | AAB | IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)                                     | WLAN     | 8.41  | ± 9.6 % |
| 10426 | AAB | IEEE 802.11n (HT Greenfield, 30 Mbps, 16-QAM)                                   | WLAN     | 8.45  | ± 9.6 % |
| 10427 | AAB | IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)                                  | WLAN     | 8.41  | ± 9.6 % |
| 10430 | AAD | LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)                                                | LTE-FDD  | 8.28  | ± 9.6 % |
| 10431 | AAD | LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)                                               | LTE-FDD  | 8.38  | ± 9.6 % |
| 10432 | AAC | LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)                                               | LTE-FDD  | 8.34  | ± 9.6 % |
| 10433 | AAC | LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)                                               | LTE-FDD  | 8.34  | ± 9.6 % |
| 10434 | AAA | W-CDMA (BS Test Model 1, 64 QPCH)                                               | WCDMA    | 8.80  | ± 9.6 % |
| 10435 | AAF | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)                  | LTE-TDD  | 7.62  | ± 9.6 % |
| 10447 | AAD | LTE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)                                  | LTE-FDD  | 7.56  | ± 9.6 % |
| 10448 | AAD | LTE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)                                 | LTE-FDD  | 7.53  | ± 9.6 % |
| 10449 | AAC | LTE-FDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)                                 | LTE-FDD  | 7.51  | ± 9.6 % |
| 10450 | AAC | LTE-FDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)                                 | LTE-FDD  | 7.48  | ± 9.6 % |

Certificate No: EX3-7541\_Jul19

Page 13 of 19

EX3DV4- SN:7541

July 22, 2019

|       |     |                                                                        |          |      |       |
|-------|-----|------------------------------------------------------------------------|----------|------|-------|
| 10451 | AAA | W-CDMA (BS Test Model T, 64 DPCH, Clipping 44%)                        | WCDMA    | 7.59 | ±9.6% |
| 10456 | AAB | IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle)                   | WLAN     | 8.63 | ±9.6% |
| 10457 | AAA | UMTS-FDD (DC-HSDPA)                                                    | WCDMA    | 8.62 | ±9.6% |
| 10458 | AAA | CDMA2000 (1xEV-DO, Rev. B, 2 carriers)                                 | CDMA2000 | 6.55 | ±9.6% |
| 10459 | AAA | CDMA2000 (1xEV-DO, Rev. B, 3 carriers)                                 | CDMA2000 | 8.25 | ±9.6% |
| 10460 | AAA | UMTS-FDD (WCDMA, AMR)                                                  | WCDMA    | 2.39 | ±9.6% |
| 10461 | AAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 7.82 | ±9.6% |
| 10462 | AAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 8.30 | ±9.6% |
| 10463 | AAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 8.56 | ±9.6% |
| 10464 | AAB | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)       | LTE-TDD  | 7.82 | ±9.6% |
| 10465 | AAB | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 8.32 | ±9.6% |
| 10466 | AAB | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 8.57 | ±9.6% |
| 10467 | AAE | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)       | LTE-TDD  | 7.82 | ±9.6% |
| 10468 | AAE | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 8.32 | ±9.6% |
| 10469 | AAE | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 8.56 | ±9.6% |
| 10470 | AAE | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)      | LTE-TDD  | 7.82 | ±9.6% |
| 10471 | AAE | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 8.32 | ±9.6% |
| 10472 | AAE | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 8.57 | ±9.6% |
| 10473 | AAE | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)      | LTE-TDD  | 7.82 | ±9.6% |
| 10474 | AAE | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 8.32 | ±9.6% |
| 10475 | AAE | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 8.57 | ±9.6% |
| 10477 | AAF | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 8.32 | ±9.6% |
| 10478 | AAF | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 8.57 | ±9.6% |
| 10479 | AAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 7.74 | ±9.6% |
| 10480 | AAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9) | LTE-TDD  | 8.18 | ±9.6% |
| 10481 | AAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9) | LTE-TDD  | 8.45 | ±9.6% |
| 10482 | AAB | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 7.71 | ±9.6% |
| 10483 | AAB | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 8.39 | ±9.6% |
| 10484 | AAB | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 8.47 | ±9.6% |
| 10485 | AAE | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)     | LTE-TDD  | 7.59 | ±9.6% |
| 10486 | AAE | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 8.38 | ±9.6% |
| 10487 | AAE | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)   | LTE-TDD  | 8.60 | ±9.6% |
| 10488 | AAE | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 7.70 | ±9.6% |
| 10489 | AAE | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL<br>Subframe=2,3,4,7,8,9)  | LTE-TDD  | 8.31 | ±9.6% |
| 10490 | AAE | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL<br>Subframe=2,3,4,7,8,9)  | LTE-TDD  | 8.54 | ±9.6% |
| 10491 | AAE | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL<br>Subframe=2,3,4,7,8,9)    | LTE-TDD  | 7.74 | ±9.6% |

Certificate No: EX3-7541\_Jul19

Page 14 of 19

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Report No.:  
KR19-SPF0032-A  
Page (189) of (308)



EX3DV4- SN:7541

July 23, 2019

|       |     |                                                                      |         |      |         |
|-------|-----|----------------------------------------------------------------------|---------|------|---------|
| 10492 | AAE | LTE-TDD (SC-FDMA, 50% RB, 18 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.41 | ± 9.6 % |
| 10493 | AAE | LTE-TDD (SC-FDMA, 50% RB, 18 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.55 | ± 9.6 % |
| 10494 | AAF | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | LTE-TDD | 7.74 | ± 9.6 % |
| 10495 | AAF | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.37 | ± 9.6 % |
| 10496 | AAF | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.54 | ± 9.6 % |
| 10497 | AAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 7.67 | ± 9.6 % |
| 10498 | AAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.40 | ± 9.6 % |
| 10499 | AAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.69 | ± 9.6 % |
| 10500 | AAB | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | LTE-TDD | 7.67 | ± 9.6 % |
| 10501 | AAB | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.44 | ± 9.6 % |
| 10502 | AAB | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.52 | ± 9.6 % |
| 10503 | AAE | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | LTE-TDD | 7.72 | ± 9.6 % |
| 10504 | AAE | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.31 | ± 9.6 % |
| 10505 | AAE | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | LTE-TDD | 8.84 | ± 9.6 % |
| 10506 | AAE | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | LTE-TDD | 7.74 | ± 9.6 % |
| 10507 | AAE | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | LTE-TDD | 8.36 | ± 9.6 % |
| 10508 | AAE | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)  | LTE-TDD | 8.50 | ± 9.6 % |
| 10509 | AAE | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | LTE-TDD | 7.98 | ± 9.6 % |
| 10510 | AAE | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | LTE-TDD | 8.88 | ± 9.6 % |
| 10511 | AAE | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)  | LTE-TDD | 8.51 | ± 9.6 % |
| 10512 | AAF | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | LTE-TDD | 7.74 | ± 9.6 % |
| 10513 | AAF | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | LTE-TDD | 8.42 | ± 9.6 % |
| 10514 | AAF | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)  | LTE-TDD | 8.45 | ± 9.6 % |
| 10515 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)            | WLAN    | 1.58 | ± 9.6 % |
| 10516 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 99pc duty cycle)          | WLAN    | 1.57 | ± 9.6 % |
| 10517 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 99pc duty cycle)           | WLAN    | 1.58 | ± 9.6 % |
| 10518 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)            | WLAN    | 6.23 | ± 9.6 % |
| 10519 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 12 Mbps, 99pc duty cycle)           | WLAN    | 6.39 | ± 9.6 % |
| 10520 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 18 Mbps, 99pc duty cycle)           | WLAN    | 6.12 | ± 9.6 % |
| 10521 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 24 Mbps, 99pc duty cycle)           | WLAN    | 7.97 | ± 9.6 % |
| 10522 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 36 Mbps, 99pc duty cycle)           | WLAN    | 8.45 | ± 9.6 % |
| 10523 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 48 Mbps, 99pc duty cycle)           | WLAN    | 8.08 | ± 9.6 % |
| 10524 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps, 99pc duty cycle)           | WLAN    | 8.27 | ± 9.6 % |
| 10525 | AAB | IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)                    | WLAN    | 8.36 | ± 9.6 % |
| 10526 | AAB | IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)                    | WLAN    | 8.42 | ± 9.6 % |
| 10527 | AAB | IEEE 802.11ac WiFi (20MHz, MCS2, 99pc duty cycle)                    | WLAN    | 8.21 | ± 9.6 % |
| 10528 | AAB | IEEE 802.11ac WiFi (20MHz, MCS3, 99pc duty cycle)                    | WLAN    | 8.36 | ± 9.6 % |
| 10529 | AAB | IEEE 802.11ac WiFi (20MHz, MCS4, 99pc duty cycle)                    | WLAN    | 8.36 | ± 9.6 % |
| 10531 | AAB | IEEE 802.11ac WiFi (20MHz, MCS6, 99pc duty cycle)                    | WLAN    | 8.43 | ± 9.6 % |
| 10532 | AAB | IEEE 802.11ac WiFi (20MHz, MCS7, 99pc duty cycle)                    | WLAN    | 8.29 | ± 9.6 % |
| 10533 | AAB | IEEE 802.11ac WiFi (20MHz, MCS8, 99pc duty cycle)                    | WLAN    | 8.38 | ± 9.6 % |
| 10534 | AAB | IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)                    | WLAN    | 8.45 | ± 9.6 % |

Certificate No: EX3-7541\_Jul19

Page 15 of 19

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Report No.:  
KR19-SPF0032-A  
Page (190) of (308)



EX30V4-SN:7541

July 22, 2019

|       |     |                                                                 |      |      |         |
|-------|-----|-----------------------------------------------------------------|------|------|---------|
| 10535 | AAB | IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)               | WLAN | 8.45 | ± 9.6 % |
| 10536 | AAB | IEEE 802.11ac WiFi (40MHz, MCS2, 99pc duty cycle)               | WLAN | 8.32 | ± 9.6 % |
| 10537 | AAB | IEEE 802.11ac WiFi (40MHz, MCS3, 99pc duty cycle)               | WLAN | 8.44 | ± 9.6 % |
| 10538 | AAB | IEEE 802.11ac WiFi (40MHz, MCS4, 99pc duty cycle)               | WLAN | 8.54 | ± 9.6 % |
| 10540 | AAB | IEEE 802.11ac WiFi (40MHz, MCS6, 99pc duty cycle)               | WLAN | 8.39 | ± 9.6 % |
| 10541 | AAB | IEEE 802.11ac WiFi (40MHz, MCS7, 99pc duty cycle)               | WLAN | 8.46 | ± 9.6 % |
| 10542 | AAB | IEEE 802.11ac WiFi (40MHz, MCS8, 99pc duty cycle)               | WLAN | 8.65 | ± 9.6 % |
| 10543 | AAB | IEEE 802.11ac WiFi (40MHz, MCS9, 99pc duty cycle)               | WLAN | 8.65 | ± 9.6 % |
| 10544 | AAB | IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)               | WLAN | 8.47 | ± 9.6 % |
| 10545 | AAB | IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)               | WLAN | 8.55 | ± 9.6 % |
| 10546 | AAB | IEEE 802.11ac WiFi (80MHz, MCS2, 99pc duty cycle)               | WLAN | 8.35 | ± 9.6 % |
| 10547 | AAB | IEEE 802.11ac WiFi (80MHz, MCS3, 99pc duty cycle)               | WLAN | 8.49 | ± 9.6 % |
| 10548 | AAB | IEEE 802.11ac WiFi (80MHz, MCS4, 99pc duty cycle)               | WLAN | 8.37 | ± 9.6 % |
| 10550 | AAB | IEEE 802.11ac WiFi (80MHz, MCS5, 99pc duty cycle)               | WLAN | 8.38 | ± 9.6 % |
| 10551 | AAB | IEEE 802.11ac WiFi (80MHz, MCS7, 99pc duty cycle)               | WLAN | 8.50 | ± 9.6 % |
| 10552 | AAB | IEEE 802.11ac WiFi (80MHz, MCS8, 99pc duty cycle)               | WLAN | 8.42 | ± 9.6 % |
| 10553 | AAB | IEEE 802.11ac WiFi (80MHz, MCS9, 99pc duty cycle)               | WLAN | 8.45 | ± 9.6 % |
| 10554 | AAC | IEEE 802.11ac WiFi (160MHz, MCS0, 99pc duty cycle)              | WLAN | 8.48 | ± 9.6 % |
| 10555 | AAC | IEEE 802.11ac WiFi (160MHz, MCS1, 99pc duty cycle)              | WLAN | 8.47 | ± 9.6 % |
| 10556 | AAC | IEEE 802.11ac WiFi (160MHz, MCS2, 99pc duty cycle)              | WLAN | 8.50 | ± 9.6 % |
| 10557 | AAC | IEEE 802.11ac WiFi (160MHz, MCS3, 99pc duty cycle)              | WLAN | 8.52 | ± 9.6 % |
| 10558 | AAC | IEEE 802.11ac WiFi (160MHz, MCS4, 99pc duty cycle)              | WLAN | 8.61 | ± 9.6 % |
| 10560 | AAC | IEEE 802.11ac WiFi (160MHz, MCS6, 99pc duty cycle)              | WLAN | 8.73 | ± 9.6 % |
| 10561 | AAC | IEEE 802.11ac WiFi (160MHz, MCS7, 99pc duty cycle)              | WLAN | 8.56 | ± 9.6 % |
| 10562 | AAC | IEEE 802.11ac WiFi (160MHz, MCS8, 99pc duty cycle)              | WLAN | 8.69 | ± 9.6 % |
| 10563 | AAC | IEEE 802.11ac WiFi (160MHz, MCS9, 99pc duty cycle)              | WLAN | 8.77 | ± 9.6 % |
| 10564 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)  | WLAN | 8.25 | ± 9.6 % |
| 10565 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 99pc duty cycle) | WLAN | 8.45 | ± 9.6 % |
| 10566 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 99pc duty cycle) | WLAN | 8.13 | ± 9.6 % |
| 10567 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 99pc duty cycle) | WLAN | 8.00 | ± 9.6 % |
| 10568 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 99pc duty cycle) | WLAN | 8.37 | ± 9.6 % |
| 10569 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 99pc duty cycle) | WLAN | 8.10 | ± 9.6 % |
| 10570 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 99pc duty cycle) | WLAN | 8.30 | ± 9.6 % |
| 10571 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)       | WLAN | 1.99 | ± 9.6 % |
| 10572 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)       | WLAN | 1.99 | ± 9.6 % |
| 10573 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 90pc duty cycle)     | WLAN | 1.98 | ± 9.6 % |
| 10574 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc duty cycle)      | WLAN | 1.98 | ± 9.6 % |
| 10575 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)  | WLAN | 8.59 | ± 9.6 % |
| 10576 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)  | WLAN | 8.60 | ± 9.6 % |
| 10577 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc duty cycle) | WLAN | 8.70 | ± 9.6 % |
| 10578 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc duty cycle) | WLAN | 8.49 | ± 9.6 % |
| 10579 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle) | WLAN | 8.36 | ± 9.6 % |
| 10580 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle) | WLAN | 8.76 | ± 9.6 % |
| 10581 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle) | WLAN | 8.35 | ± 9.6 % |
| 10582 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle) | WLAN | 8.67 | ± 9.6 % |
| 10583 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)       | WLAN | 8.59 | ± 9.6 % |
| 10584 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)       | WLAN | 8.60 | ± 9.6 % |
| 10585 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 12 Mbps, 90pc duty cycle)      | WLAN | 8.70 | ± 9.6 % |
| 10586 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 18 Mbps, 90pc duty cycle)      | WLAN | 8.49 | ± 9.6 % |
| 10587 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 24 Mbps, 90pc duty cycle)      | WLAN | 8.36 | ± 9.6 % |

Certificate No: EXJ-7541\_Jul19

Page 16 of 19

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Report No.:  
KR19-SPF0032-A  
Page (191) of (308)



EX3DV4-3N7541

July 22, 2019

|       |     |                                                            |          |       |         |
|-------|-----|------------------------------------------------------------|----------|-------|---------|
| 10588 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 36 Mbps, 30pc duty cycle) | WLAN     | 8.76  | ± 9.6 % |
| 10589 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 48 Mbps, 90pc duty cycle) | WLAN     | 8.35  | ± 9.6 % |
| 10590 | AAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps, 30pc duty cycle) | WLAN     | 8.67  | ± 9.6 % |
| 10591 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)      | WLAN     | 8.63  | ± 9.6 % |
| 10592 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)      | WLAN     | 8.79  | ± 9.6 % |
| 10593 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS2, 90pc duty cycle)      | WLAN     | 8.64  | ± 9.6 % |
| 10594 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS3, 90pc duty cycle)      | WLAN     | 8.74  | ± 9.6 % |
| 10595 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS4, 90pc duty cycle)      | WLAN     | 8.74  | ± 9.6 % |
| 10596 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS5, 90pc duty cycle)      | WLAN     | 8.71  | ± 9.6 % |
| 10597 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS6, 90pc duty cycle)      | WLAN     | 8.72  | ± 9.6 % |
| 10598 | AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS7, 90pc duty cycle)      | WLAN     | 8.50  | ± 9.6 % |
| 10599 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)      | WLAN     | 8.79  | ± 9.6 % |
| 10600 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)      | WLAN     | 8.68  | ± 9.6 % |
| 10601 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS2, 90pc duty cycle)      | WLAN     | 8.82  | ± 9.6 % |
| 10602 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS3, 90pc duty cycle)      | WLAN     | 9.54  | ± 9.6 % |
| 10603 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS4, 90pc duty cycle)      | WLAN     | 8.05  | ± 9.6 % |
| 10604 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS5, 90pc duty cycle)      | WLAN     | 8.78  | ± 9.6 % |
| 10605 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS6, 90pc duty cycle)      | WLAN     | 8.97  | ± 9.6 % |
| 10606 | AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS7, 90pc duty cycle)      | WLAN     | 8.62  | ± 9.6 % |
| 10607 | AAB | IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)          | WLAN     | 8.64  | ± 9.6 % |
| 10608 | AAB | IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)          | WLAN     | 8.77  | ± 9.6 % |
| 10609 | AAB | IEEE 802.11ac WiFi (20MHz, MCS2, 90pc duty cycle)          | WLAN     | 8.57  | ± 9.6 % |
| 10610 | AAB | IEEE 802.11ac WiFi (20MHz, MCS3, 90pc duty cycle)          | WLAN     | 8.76  | ± 9.6 % |
| 10611 | AAB | IEEE 802.11ac WiFi (20MHz, MCS4, 90pc duty cycle)          | WLAN     | 8.70  | ± 9.6 % |
| 10612 | AAB | IEEE 802.11ac WiFi (20MHz, MCS5, 90pc duty cycle)          | WLAN     | 8.77  | ± 9.6 % |
| 10613 | AAB | IEEE 802.11ac WiFi (20MHz, MCS6, 90pc duty cycle)          | WLAN     | 8.94  | ± 9.6 % |
| 10614 | AAB | IEEE 802.11ac WiFi (20MHz, MCS7, 90pc duty cycle)          | WLAN     | 8.59  | ± 9.6 % |
| 10615 | AAB | IEEE 802.11ac WiFi (20MHz, MCS8, 90pc duty cycle)          | WLAN     | 8.82  | ± 9.6 % |
| 10616 | AAB | IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)          | WLAN     | 8.82  | ± 9.6 % |
| 10617 | AAB | IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)          | WLAN     | 8.61  | ± 9.6 % |
| 10618 | AAB | IEEE 802.11ac WiFi (40MHz, MCS2, 90pc duty cycle)          | WLAN     | 8.59  | ± 9.6 % |
| 10619 | AAB | IEEE 802.11ac WiFi (40MHz, MCS3, 90pc duty cycle)          | WLAN     | 8.66  | ± 9.6 % |
| 10620 | AAB | IEEE 802.11ac WiFi (40MHz, MCS4, 90pc duty cycle)          | WLAN     | 8.87  | ± 9.6 % |
| 10621 | AAB | IEEE 802.11ac WiFi (40MHz, MCS5, 90pc duty cycle)          | WLAN     | 8.77  | ± 9.6 % |
| 10622 | AAB | IEEE 802.11ac WiFi (40MHz, MCS6, 90pc duty cycle)          | WLAN     | 8.88  | ± 9.6 % |
| 10623 | AAB | IEEE 802.11ac WiFi (40MHz, MCS7, 90pc duty cycle)          | WLAN     | 8.82  | ± 9.6 % |
| 10624 | AAB | IEEE 802.11ac WiFi (40MHz, MCS8, 90pc duty cycle)          | WLAN     | 8.86  | ± 9.6 % |
| 10625 | AAB | IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)          | WLAN     | 8.96  | ± 9.6 % |
| 10626 | AAB | IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)          | WLAN     | 8.83  | ± 9.6 % |
| 10627 | AAB | IEEE 802.11ac WiFi (80MHz, MCS2, 90pc duty cycle)          | WLAN     | 8.88  | ± 9.6 % |
| 10628 | AAB | IEEE 802.11ac WiFi (80MHz, MCS3, 90pc duty cycle)          | WLAN     | 8.71  | ± 9.6 % |
| 10629 | AAB | IEEE 802.11ac WiFi (80MHz, MCS4, 90pc duty cycle)          | WLAN     | 8.85  | ± 9.6 % |
| 10630 | AAB | IEEE 802.11ac WiFi (80MHz, MCS5, 90pc duty cycle)          | WLAN     | 8.72  | ± 9.6 % |
| 10631 | AAB | IEEE 802.11ac WiFi (80MHz, MCS6, 90pc duty cycle)          | WLAN     | 8.81  | ± 9.6 % |
| 10632 | AAB | IEEE 802.11ac WiFi (80MHz, MCS7, 90pc duty cycle)          | WLAN     | 8.74  | ± 9.6 % |
| 10633 | AAB | IEEE 802.11ac WiFi (80MHz, MCS8, 90pc duty cycle)          | WLAN     | 8.83  | ± 9.6 % |
| 10634 | AAB | IEEE 802.11ac WiFi (160MHz, MCS0, 90pc duty cycle)         | WLAN     | 8.80  | ± 9.6 % |
| 10635 | AAB | IEEE 802.11ac WiFi (160MHz, MCS1, 90pc duty cycle)         | WLAN     | 8.81  | ± 9.6 % |
| 10636 | AAC | IEEE 802.11ac WiFi (160MHz, MCS2, 90pc duty cycle)         | WLAN     | 8.83  | ± 9.6 % |
| 10637 | AAC | IEEE 802.11ac WiFi (160MHz, MCS3, 90pc duty cycle)         | WLAN     | 8.79  | ± 9.6 % |
| 10638 | AAC | IEEE 802.11ac WiFi (160MHz, MCS4, 90pc duty cycle)         | WLAN     | 8.86  | ± 9.6 % |
| 10639 | AAC | IEEE 802.11ac WiFi (160MHz, MCS5, 90pc duty cycle)         | WLAN     | 8.85  | ± 9.6 % |
| 10640 | AAC | IEEE 802.11ac WiFi (160MHz, MCS6, 90pc duty cycle)         | WLAN     | 8.98  | ± 9.6 % |
| 10641 | AAC | IEEE 802.11ac WiFi (160MHz, MCS7, 90pc duty cycle)         | WLAN     | 8.96  | ± 9.6 % |
| 10642 | AAC | IEEE 802.11ac WiFi (160MHz, MCS8, 90pc duty cycle)         | WLAN     | 9.06  | ± 9.6 % |
| 10643 | AAC | IEEE 802.11ac WiFi (160MHz, MCS9, 90pc duty cycle)         | WLAN     | 8.99  | ± 9.6 % |
| 10644 | AAC | IEEE 802.11ac WiFi (160MHz, MCS10, 90pc duty cycle)        | WLAN     | 9.05  | ± 9.6 % |
| 10645 | AAC | IEEE 802.11ac WiFi (160MHz, MCS11, 90pc duty cycle)        | WLAN     | 9.11  | ± 9.6 % |
| 10646 | AAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe<2,7)      | LTE-TDD  | 11.96 | ± 9.6 % |
| 10647 | AAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe<2,7)      | LTE-TDD  | 11.96 | ± 9.6 % |
| 10648 | AAA | CDMA2000 (1x Advanced)                                     | CDMA2000 | 3.45  | ± 9.6 % |
| 10652 | AAD | LTE-TDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)             | LTE-TDD  | 6.91  | ± 9.6 % |
| 10653 | AAD | LTE-TDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)            | LTE-TDD  | 7.42  | ± 9.6 % |
| 10654 | AAD | LTE-TDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)            | LTE-TDD  | 6.98  | ± 9.6 % |

Certificate No: EX3-7541\_Ju19

Page 17 of 19

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Report No.:  
KR19-SPF0032-A  
Page (192) of (308)



EX3DV4-SN.7541

July 22, 2019

|       |     |                                                 |           |       |        |
|-------|-----|-------------------------------------------------|-----------|-------|--------|
| 10655 | AAE | LTE-TDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%) | LTE-TDD   | 7.21  | ±9.6 % |
| 10656 | AAA | Pulse Waveform (200Hz, 10%)                     | Test      | 10.00 | ±9.6 % |
| 10658 | AAA | Pulse Waveform (200Hz, 20%)                     | Test      | 6.99  | ±9.6 % |
| 10660 | AAA | Pulse Waveform (200Hz, 40%)                     | Test      | 3.98  | ±9.6 % |
| 10661 | AAA | Pulse Waveform (200Hz, 60%)                     | Test      | 2.22  | ±9.6 % |
| 10662 | AAA | Pulse Waveform (200Hz, 80%)                     | Test      | 0.97  | ±9.6 % |
| 10670 | AAA | Bluetooth Low Energy                            | Bluetooth | 2.19  | ±9.6 % |
| 10671 | AAA | IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)    | WLAN      | 9.09  | ±9.6 % |
| 10672 | AAA | IEEE 802.11ax (20MHz, MCS1, 90pc duty cycle)    | WLAN      | 8.57  | ±9.6 % |
| 10673 | AAA | IEEE 802.11ax (20MHz, MCS2, 90pc duty cycle)    | WLAN      | 8.78  | ±9.6 % |
| 10674 | AAA | IEEE 802.11ax (20MHz, MCS3, 90pc duty cycle)    | WLAN      | 8.74  | ±9.6 % |
| 10675 | AAA | IEEE 802.11ax (20MHz, MCS4, 90pc duty cycle)    | WLAN      | 8.90  | ±9.6 % |
| 10676 | AAA | IEEE 802.11ax (20MHz, MCS5, 90pc duty cycle)    | WLAN      | 8.77  | ±9.6 % |
| 10677 | AAA | IEEE 802.11ax (20MHz, MCS6, 90pc duty cycle)    | WLAN      | 8.73  | ±9.6 % |
| 10678 | AAA | IEEE 802.11ax (20MHz, MCS7, 90pc duty cycle)    | WLAN      | 8.78  | ±9.6 % |
| 10679 | AAA | IEEE 802.11ax (20MHz, MCS8, 90pc duty cycle)    | WLAN      | 8.89  | ±9.6 % |
| 10680 | AAA | IEEE 802.11ax (20MHz, MCS9, 90pc duty cycle)    | WLAN      | 8.60  | ±9.6 % |
| 10681 | AAA | IEEE 802.11ax (20MHz, MCS10, 90pc duty cycle)   | WLAN      | 8.62  | ±9.6 % |
| 10682 | AAA | IEEE 802.11ax (20MHz, MCS11, 90pc duty cycle)   | WLAN      | 8.63  | ±9.6 % |
| 10683 | AAA | IEEE 802.11ax (20MHz, MCS0, 99pc duty cycle)    | WLAN      | 8.42  | ±9.6 % |
| 10684 | AAA | IEEE 802.11ax (20MHz, MCS1, 99pc duty cycle)    | WLAN      | 8.26  | ±9.6 % |
| 10685 | AAA | IEEE 802.11ax (20MHz, MCS2, 99pc duty cycle)    | WLAN      | 8.33  | ±9.6 % |
| 10686 | AAA | IEEE 802.11ax (20MHz, MCS3, 99pc duty cycle)    | WLAN      | 8.28  | ±9.6 % |
| 10687 | AAA | IEEE 802.11ax (20MHz, MCS4, 99pc duty cycle)    | WLAN      | 8.45  | ±9.6 % |
| 10688 | AAA | IEEE 802.11ax (20MHz, MCS5, 99pc duty cycle)    | WLAN      | 8.29  | ±9.6 % |
| 10689 | AAA | IEEE 802.11ax (20MHz, MCS6, 99pc duty cycle)    | WLAN      | 8.55  | ±9.6 % |
| 10690 | AAA | IEEE 802.11ax (20MHz, MCS7, 99pc duty cycle)    | WLAN      | 8.29  | ±9.6 % |
| 10691 | AAA | IEEE 802.11ax (20MHz, MCS8, 99pc duty cycle)    | WLAN      | 8.25  | ±9.6 % |
| 10692 | AAA | IEEE 802.11ax (20MHz, MCS9, 99pc duty cycle)    | WLAN      | 8.29  | ±9.6 % |
| 10693 | AAA | IEEE 802.11ax (20MHz, MCS10, 99pc duty cycle)   | WLAN      | 8.25  | ±9.6 % |
| 10694 | AAA | IEEE 802.11ax (20MHz, MCS11, 99pc duty cycle)   | WLAN      | 8.57  | ±9.6 % |
| 10695 | AAA | IEEE 802.11ax (40MHz, MCS0, 90pc duty cycle)    | WLAN      | 8.78  | ±9.6 % |
| 10696 | AAA | IEEE 802.11ax (40MHz, MCS1, 90pc duty cycle)    | WLAN      | 8.91  | ±9.6 % |
| 10697 | AAA | IEEE 802.11ax (40MHz, MCS2, 90pc duty cycle)    | WLAN      | 8.61  | ±9.6 % |
| 10698 | AAA | IEEE 802.11ax (40MHz, MCS3, 90pc duty cycle)    | WLAN      | 8.89  | ±9.6 % |
| 10699 | AAA | IEEE 802.11ax (40MHz, MCS4, 90pc duty cycle)    | WLAN      | 8.82  | ±9.6 % |
| 10700 | AAA | IEEE 802.11ax (40MHz, MCS5, 90pc duty cycle)    | WLAN      | 8.73  | ±9.6 % |
| 10701 | AAA | IEEE 802.11ax (40MHz, MCS6, 90pc duty cycle)    | WLAN      | 8.56  | ±9.6 % |
| 10702 | AAA | IEEE 802.11ax (40MHz, MCS7, 90pc duty cycle)    | WLAN      | 8.70  | ±9.6 % |
| 10703 | AAA | IEEE 802.11ax (40MHz, MCS8, 90pc duty cycle)    | WLAN      | 8.82  | ±9.6 % |
| 10704 | AAA | IEEE 802.11ax (40MHz, MCS9, 90pc duty cycle)    | WLAN      | 8.58  | ±9.6 % |
| 10705 | AAA | IEEE 802.11ax (40MHz, MCS10, 90pc duty cycle)   | WLAN      | 8.69  | ±9.6 % |
| 10706 | AAA | IEEE 802.11ax (40MHz, MCS11, 90pc duty cycle)   | WLAN      | 8.65  | ±9.6 % |
| 10707 | AAA | IEEE 802.11ax (40MHz, MCS0, 99pc duty cycle)    | WLAN      | 8.32  | ±9.6 % |
| 10708 | AAA | IEEE 802.11ax (40MHz, MCS1, 99pc duty cycle)    | WLAN      | 8.55  | ±9.6 % |
| 10709 | AAA | IEEE 802.11ax (40MHz, MCS2, 99pc duty cycle)    | WLAN      | 8.33  | ±9.6 % |
| 10710 | AAA | IEEE 802.11ax (40MHz, MCS3, 99pc duty cycle)    | WLAN      | 8.29  | ±9.6 % |
| 10711 | AAA | IEEE 802.11ax (40MHz, MCS4, 99pc duty cycle)    | WLAN      | 8.36  | ±9.6 % |
| 10712 | AAA | IEEE 802.11ax (40MHz, MCS5, 99pc duty cycle)    | WLAN      | 8.67  | ±9.6 % |
| 10713 | AAA | IEEE 802.11ax (40MHz, MCS6, 99pc duty cycle)    | WLAN      | 8.33  | ±9.6 % |
| 10714 | AAA | IEEE 802.11ax (40MHz, MCS7, 99pc duty cycle)    | WLAN      | 8.26  | ±9.6 % |
| 10715 | AAA | IEEE 802.11ax (40MHz, MCS8, 99pc duty cycle)    | WLAN      | 8.45  | ±9.6 % |
| 10716 | AAA | IEEE 802.11ax (40MHz, MCS9, 99pc duty cycle)    | WLAN      | 8.60  | ±9.6 % |
| 10717 | AAA | IEEE 802.11ax (40MHz, MCS10, 99pc duty cycle)   | WLAN      | 8.48  | ±9.6 % |
| 10718 | AAA | IEEE 802.11ax (40MHz, MCS11, 99pc duty cycle)   | WLAN      | 8.24  | ±9.6 % |
| 10719 | AAA | IEEE 802.11ax (80MHz, MCS0, 90pc duty cycle)    | WLAN      | 8.61  | ±9.6 % |
| 10720 | AAA | IEEE 802.11ax (80MHz, MCS1, 90pc duty cycle)    | WLAN      | 8.67  | ±9.6 % |
| 10721 | AAA | IEEE 802.11ax (80MHz, MCS2, 90pc duty cycle)    | WLAN      | 8.76  | ±9.6 % |
| 10722 | AAA | IEEE 802.11ax (80MHz, MCS3, 90pc duty cycle)    | WLAN      | 8.55  | ±9.6 % |
| 10723 | AAA | IEEE 802.11ax (80MHz, MCS4, 90pc duty cycle)    | WLAN      | 8.70  | ±9.6 % |
| 10724 | AAA | IEEE 802.11ax (80MHz, MCS5, 90pc duty cycle)    | WLAN      | 8.90  | ±9.6 % |
| 10725 | AAA | IEEE 802.11ax (80MHz, MCS6, 90pc duty cycle)    | WLAN      | 8.74  | ±9.6 % |
| 10726 | AAA | IEEE 802.11ax (80MHz, MCS7, 90pc duty cycle)    | WLAN      | 8.72  | ±9.6 % |
| 10727 | AAA | IEEE 802.11ax (80MHz, MCS8, 90pc duty cycle)    | WLAN      | 8.66  | ±9.6 % |

Certificate No: EX3-7541\_Jul19

Page 18 of 18

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Report No.:  
KR19-SPF0032-A  
Page (193) of (308)



EX30V4-5N7541

JULY 23, 2019

|       |     |                                                |      |      |         |
|-------|-----|------------------------------------------------|------|------|---------|
| 10728 | AAA | IEEE 802.11ax (80MHz, MCS9, 99pc duty cycle)   | WLAN | 8.65 | ± 9.6 % |
| 10728 | AAA | IEEE 802.11ax (80MHz, MCS10, 99pc duty cycle)  | WLAN | 8.64 | ± 9.6 % |
| 10730 | AAA | IEEE 802.11ax (80MHz, MCS11, 99pc duty cycle)  | WLAN | 8.67 | ± 9.6 % |
| 10731 | AAA | IEEE 802.11ax (80MHz, MCS0, 99pc duty cycle)   | WLAN | 8.42 | ± 9.6 % |
| 10732 | AAA | IEEE 802.11ax (80MHz, MCS1, 99pc duty cycle)   | WLAN | 8.46 | ± 9.6 % |
| 10733 | AAA | IEEE 802.11ax (80MHz, MCS2, 99pc duty cycle)   | WLAN | 8.40 | ± 9.6 % |
| 10734 | AAA | IEEE 802.11ax (80MHz, MCS3, 99pc duty cycle)   | WLAN | 8.25 | ± 9.6 % |
| 10735 | AAA | IEEE 802.11ax (80MHz, MCS4, 99pc duty cycle)   | WLAN | 8.33 | ± 9.6 % |
| 10736 | AAA | IEEE 802.11ax (80MHz, MCS5, 99pc duty cycle)   | WLAN | 8.27 | ± 9.6 % |
| 10737 | AAA | IEEE 802.11ax (80MHz, MCS6, 99pc duty cycle)   | WLAN | 8.36 | ± 9.6 % |
| 10738 | AAA | IEEE 802.11ax (80MHz, MCS7, 99pc duty cycle)   | WLAN | 8.42 | ± 9.6 % |
| 10739 | AAA | IEEE 802.11ax (80MHz, MCS8, 99pc duty cycle)   | WLAN | 8.29 | ± 9.6 % |
| 10740 | AAA | IEEE 802.11ax (80MHz, MCS9, 99pc duty cycle)   | WLAN | 8.48 | ± 9.6 % |
| 10741 | AAA | IEEE 802.11ax (80MHz, MCS10, 99pc duty cycle)  | WLAN | 8.40 | ± 9.6 % |
| 10742 | AAA | IEEE 802.11ax (80MHz, MCS11, 99pc duty cycle)  | WLAN | 8.43 | ± 9.6 % |
| 10743 | AAA | IEEE 802.11ax (160MHz, MCS0, 99pc duty cycle)  | WLAN | 8.94 | ± 9.6 % |
| 10744 | AAA | IEEE 802.11ax (160MHz, MCS1, 99pc duty cycle)  | WLAN | 9.16 | ± 9.6 % |
| 10745 | AAA | IEEE 802.11ax (160MHz, MCS2, 99pc duty cycle)  | WLAN | 8.35 | ± 9.6 % |
| 10746 | AAA | IEEE 802.11ax (160MHz, MCS3, 99pc duty cycle)  | WLAN | 9.11 | ± 9.6 % |
| 10747 | AAA | IEEE 802.11ax (160MHz, MCS4, 99pc duty cycle)  | WLAN | 9.04 | ± 9.6 % |
| 10748 | AAA | IEEE 802.11ax (160MHz, MCS5, 99pc duty cycle)  | WLAN | 8.93 | ± 9.6 % |
| 10749 | AAA | IEEE 802.11ax (160MHz, MCS6, 99pc duty cycle)  | WLAN | 8.90 | ± 9.6 % |
| 10750 | AAA | IEEE 802.11ax (160MHz, MCS7, 99pc duty cycle)  | WLAN | 8.79 | ± 9.6 % |
| 10751 | AAA | IEEE 802.11ax (160MHz, MCS8, 99pc duty cycle)  | WLAN | 8.82 | ± 9.6 % |
| 10752 | AAA | IEEE 802.11ax (160MHz, MCS9, 99pc duty cycle)  | WLAN | 8.81 | ± 9.6 % |
| 10753 | AAA | IEEE 802.11ax (160MHz, MCS10, 99pc duty cycle) | WLAN | 9.00 | ± 9.6 % |
| 10754 | AAA | IEEE 802.11ax (160MHz, MCS11, 99pc duty cycle) | WLAN | 8.94 | ± 9.6 % |
| 10755 | AAA | IEEE 802.11ax (160MHz, MCS0, 99pc duty cycle)  | WLAN | 8.64 | ± 9.6 % |
| 10756 | AAA | IEEE 802.11ax (160MHz, MCS1, 99pc duty cycle)  | WLAN | 8.77 | ± 9.6 % |
| 10757 | AAA | IEEE 802.11ax (160MHz, MCS2, 99pc duty cycle)  | WLAN | 8.77 | ± 9.6 % |
| 10758 | AAA | IEEE 802.11ax (160MHz, MCS3, 99pc duty cycle)  | WLAN | 8.69 | ± 9.6 % |
| 10759 | AAA | IEEE 802.11ax (160MHz, MCS4, 99pc duty cycle)  | WLAN | 8.56 | ± 9.6 % |
| 10760 | AAA | IEEE 802.11ax (160MHz, MCS5, 99pc duty cycle)  | WLAN | 8.49 | ± 9.6 % |
| 10761 | AAA | IEEE 802.11ax (160MHz, MCS6, 99pc duty cycle)  | WLAN | 8.58 | ± 9.6 % |
| 10762 | AAA | IEEE 802.11ax (160MHz, MCS7, 99pc duty cycle)  | WLAN | 8.49 | ± 9.6 % |
| 10763 | AAA | IEEE 802.11ax (160MHz, MCS8, 99pc duty cycle)  | WLAN | 8.53 | ± 9.6 % |
| 10764 | AAA | IEEE 802.11ax (160MHz, MCS9, 99pc duty cycle)  | WLAN | 8.54 | ± 9.6 % |
| 10765 | AAA | IEEE 802.11ax (160MHz, MCS10, 99pc duty cycle) | WLAN | 8.54 | ± 9.6 % |
| 10766 | AAA | IEEE 802.11ax (160MHz, MCS11, 99pc duty cycle) | WLAN | 8.51 | ± 9.6 % |

\* Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the test value

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Report No.:  
KR19-SPF0032-A  
Page (194) of (308)

# KCTL

## Appendix A.2 Probe Calibration certificate (EX3DV4 3928)

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



S Schweizerischer Kalibrierdienst  
S Service suisse d'étalonnage  
S Servizio svizzero di taratura  
S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client KCTL (Dymstec)

Certificate No: EX3-3928 Jan19

### CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3928

Calibration procedure(s): QA CAL-01 v9, QA CAL-14 v5, QA CAL-23 v5, QA CAL-25 v7  
Calibration procedure for dosimetric E-field probes

Calibration date: January 31, 2019

This calibration certificate documents the traceability to national standards, which realizes 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-18 (No. 217-02672/02673)   | Apr-18                 |
| Power sensor NRP-Z91       | SN: 103244       | 04-Apr-18 (No. 217-02672)         | Apr-18                 |
| Power sensor NRP-Z91       | SN: 103245       | 04-Apr-18 (No. 217-02673)         | Apr-18                 |
| Reference 20 dB Attenuator | SN: 85277 (20x)  | 04-Apr-18 (No. 217-02682)         | Apr-18                 |
| DAE4                       | SN: 660          | 19-Dec-18 (No. DAE4-660_Dec18)    | Dec-18                 |
| Reference Probe ES3DV2     | SN: 3013         | 31-Dec-18 (No. ES3-3013_Dec18)    | Dec-18                 |
| Secondary Standards        | ID               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B         | SN: GB41293874   | 06-Apr-18 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: MY41498087   | 06-Apr-18 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: 000110210    | 06-Apr-18 (in house check Jun-18) | In house check: Jun-20 |
| RF generator HP 8648C      | SN: US3642U01700 | 04-Aug-09 (in house check Jun-15) | In house check: Jun-20 |
| Network Analyzer E8368A    | SN: US41080477   | 31-Mar-14 (in house check Oct-18) | In house check: Oct-18 |

|                                                                                                                 | Name           | Function              | Signature |
|-----------------------------------------------------------------------------------------------------------------|----------------|-----------------------|-----------|
| Calibrated by:                                                                                                  | Jeton Kasprali | Laboratory Technician |           |
| Approved by:                                                                                                    | Kajsa Polovic  | Technical Manager     |           |
| Issued: February 3, 2019                                                                                        |                |                       |           |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. |                |                       |           |

Certificate No: EX3-3928\_Jan19

Page 1 of 10

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



S  
C  
S  
Schweizerischer Kalibrierdienst  
Service suisse d'étalonnage  
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

#### Glossary:

|                        |                                                                                                                                                   |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                    | tissue simulating liquid                                                                                                                          |
| $NORM_{x,y,z}$         | sensitivity in free space                                                                                                                         |
| $ConvF$                | sensitivity in TSL / $NORM_{x,y,z}$                                                                                                               |
| DCP                    | diode compression point                                                                                                                           |
| CF                     | crest factor (1/duty_cycle) of the RF signal                                                                                                      |
| A, B, C, D             | modulation dependent linearization parameters                                                                                                     |
| Polarization $\varphi$ | $\varphi$ rotation around probe axis                                                                                                              |
| Polarization $\theta$  | $\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\theta = 0$ is normal to probe axis |
| Connector Angle        | information used in DASY system to align probe sensor X to the robot coordinate system                                                            |

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$ : Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide).  $NORM_{x,y,z}$  are only intermediate values, i.e., the uncertainties of  $NORM_{x,y,z}$  does not affect the  $E^2$ -field uncertainty inside TSL (see below  $ConvF$ ).
- $NORM(\tilde{r})_{x,y,z} = NORM_{x,y,z} \cdot \text{frequency\_response}$  (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of  $ConvF$ .
- $DCP_{x,y,z}$ : DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- $A_{x,y,z}$ ,  $B_{x,y,z}$ ,  $C_{x,y,z}$ ,  $D_{x,y,z}$ ,  $VR_{x,y,z}$ : A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- $ConvF$  and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to  $NORM_{x,y,z} \cdot ConvF$  whereby the uncertainty corresponds to that given for  $ConvF$ . A frequency dependent  $ConvF$  is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical Isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the  $NORM$  (no uncertainty required).

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Report No.:  
KR19-SPF0032-A  
Page (196) of (308)



EX3DV4 - SN:3928

January 31, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928****Basic Calibration Parameters**

|                          | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|--------------------------|----------|----------|----------|---------------|
| Norm $(\mu V/(V/m)^2)^A$ | 0.48     | 0.22     | 0.55     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>    | 94.9     | 94.8     | 96.3     |               |

**Calibration Results for Modulation Response**

| UID | Communication System Name |   | A<br>dB | B<br>dB $\sqrt{\mu V}$ | C   | D<br>dB | VR<br>mV | Max<br>dev.  | Unc<br>(k=2) |
|-----|---------------------------|---|---------|------------------------|-----|---------|----------|--------------|--------------|
| 0   | CW                        | X | 0.0     | 0.0                    | 0.0 | 0.00    | 135.8    | $\pm 3.0 \%$ | $\pm 4.7 \%$ |
|     |                           | Y | 0.0     | 0.0                    | 0.0 |         | 135.4    |              |              |
|     |                           | Z | 0.0     | 0.0                    | 1.0 |         | 143.6    |              |              |

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

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

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

<sup>C</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Report No.:  
KR19-SPF0032-A  
Page (197) of (308)



EX3DV4 - SN:3928

January 31, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928****Other Probe Parameters**

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 70.7       |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 9 mm       |
| Tip Diameter                                  | 2.5 mm     |
| Probe Tip to Sensor X Calibration Point       | 1 mm       |
| Probe Tip to Sensor Y Calibration Point       | 1 mm       |
| Probe Tip to Sensor Z Calibration Point       | 1 mm       |
| Recommended Measurement Distance from Surface | 1.4 mm     |

EX3DV4 - SN:3928

January 31, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928****Calibration Parameter Determined in Head Tissue Simulating Media**

| f (MHz) <sup>c</sup> | Relative Permittivity <sup>e</sup> | Conductivity (Sim) <sup>e</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>d</sup> | Depth <sup>a</sup> (mm) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-----------|
| 750                  | 41.9                               | 0.59                            | 9.34    | 9.34    | 9.34    | 0.55               | 0.90                    | ± 12.0 %  |
| 850                  | 41.5                               | 0.92                            | 9.27    | 9.27    | 9.27    | 0.60               | 0.85                    | ± 12.0 %  |
| 900                  | 41.5                               | 0.97                            | 9.02    | 9.02    | 9.02    | 0.47               | 0.89                    | ± 12.0 %  |
| 1750                 | 40.1                               | 1.37                            | 7.97    | 7.97    | 7.97    | 0.38               | 0.84                    | ± 12.0 %  |
| 1900                 | 40.0                               | 1.40                            | 7.79    | 7.79    | 7.79    | 0.25               | 0.85                    | ± 12.0 %  |
| 2300                 | 39.5                               | 1.67                            | 7.51    | 7.51    | 7.51    | 0.28               | 0.84                    | ± 12.0 %  |
| 2450                 | 39.2                               | 1.80                            | 7.21    | 7.21    | 7.21    | 0.31               | 0.85                    | ± 12.0 %  |
| 2600                 | 39.0                               | 1.96                            | 6.92    | 6.92    | 6.92    | 0.35               | 0.89                    | ± 12.0 %  |
| 3500                 | 37.9                               | 2.91                            | 6.86    | 6.86    | 6.86    | 0.25               | 1.20                    | ± 13.1 %  |
| 3700                 | 37.7                               | 3.12                            | 6.70    | 6.70    | 6.70    | 0.25               | 1.20                    | ± 13.1 %  |
| 5200                 | 36.0                               | 4.66                            | 5.16    | 5.16    | 5.16    | 0.40               | 1.80                    | ± 13.1 %  |
| 5300                 | 35.9                               | 4.76                            | 4.95    | 4.95    | 4.95    | 0.40               | 1.80                    | ± 13.1 %  |
| 5500                 | 35.6                               | 4.96                            | 4.86    | 4.86    | 4.86    | 0.40               | 1.80                    | ± 13.1 %  |
| 5600                 | 35.5                               | 5.07                            | 4.78    | 4.78    | 4.78    | 0.40               | 1.80                    | ± 13.1 %  |
| 5800                 | 35.3                               | 5.27                            | 4.70    | 4.70    | 4.70    | 0.40               | 1.80                    | ± 13.1 %  |

<sup>c</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>d</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>e</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4 - SN:3928

January 31, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928****Calibration Parameter Determined in Body Tissue Simulating Media**

| f (MHz) <sup>1)</sup> | Relative Permittivity <sup>2)</sup> | Conductivity (S/m) <sup>3)</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>4)</sup> | Depth (mm) <sup>5)</sup> | Unc (k=2) |
|-----------------------|-------------------------------------|----------------------------------|---------|---------|---------|---------------------|--------------------------|-----------|
| 750                   | 55.5                                | 0.96                             | 9.55    | 9.55    | 9.55    | 0.51                | 0.80                     | ± 12.0 %  |
| 850                   | 55.2                                | 0.99                             | 9.32    | 9.32    | 9.32    | 0.39                | 0.84                     | ± 12.0 %  |
| 900                   | 55.0                                | 1.05                             | 9.28    | 9.28    | 9.28    | 0.46                | 0.86                     | ± 12.0 %  |
| 1750                  | 53.4                                | 1.49                             | 7.70    | 7.70    | 7.70    | 0.37                | 0.84                     | ± 12.0 %  |
| 1900                  | 53.3                                | 1.52                             | 7.46    | 7.46    | 7.46    | 0.37                | 0.84                     | ± 12.0 %  |
| 2300                  | 52.9                                | 1.81                             | 7.25    | 7.25    | 7.25    | 0.38                | 0.86                     | ± 12.0 %  |
| 2450                  | 52.7                                | 1.95                             | 7.22    | 7.22    | 7.22    | 0.24                | 0.93                     | ± 12.0 %  |
| 2600                  | 52.5                                | 2.16                             | 6.95    | 6.95    | 6.95    | 0.25                | 0.94                     | ± 12.0 %  |
| 3500                  | 51.3                                | 3.31                             | 6.66    | 6.66    | 6.66    | 0.25                | 1.20                     | ± 13.1 %  |
| 3700                  | 51.0                                | 3.55                             | 6.84    | 6.84    | 6.84    | 0.25                | 1.25                     | ± 13.1 %  |
| 5200                  | 49.0                                | 5.30                             | 4.43    | 4.43    | 4.43    | 0.50                | 1.90                     | ± 13.1 %  |
| 5300                  | 48.9                                | 5.42                             | 4.30    | 4.30    | 4.30    | 0.50                | 1.90                     | ± 13.1 %  |
| 5500                  | 48.6                                | 5.65                             | 4.03    | 4.03    | 4.03    | 0.50                | 1.90                     | ± 13.1 %  |
| 5600                  | 48.5                                | 5.77                             | 3.91    | 3.91    | 3.91    | 0.50                | 1.90                     | ± 13.1 %  |
| 5800                  | 48.2                                | 6.00                             | 4.00    | 4.00    | 4.00    | 0.50                | 1.90                     | ± 13.1 %  |

<sup>1)</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>2)</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10%, if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>3)</sup> Alpha/Depth are determined during calibration. SPEAG warns that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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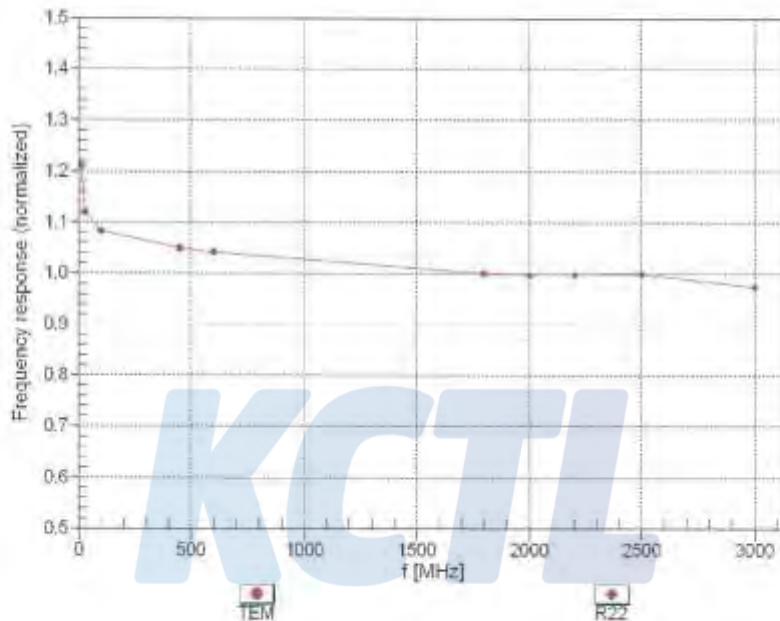
Report No.:  
KR19-SPF0032-A  
Page (200) of (308)



EX3DV4-SN:3928

January 31, 2019

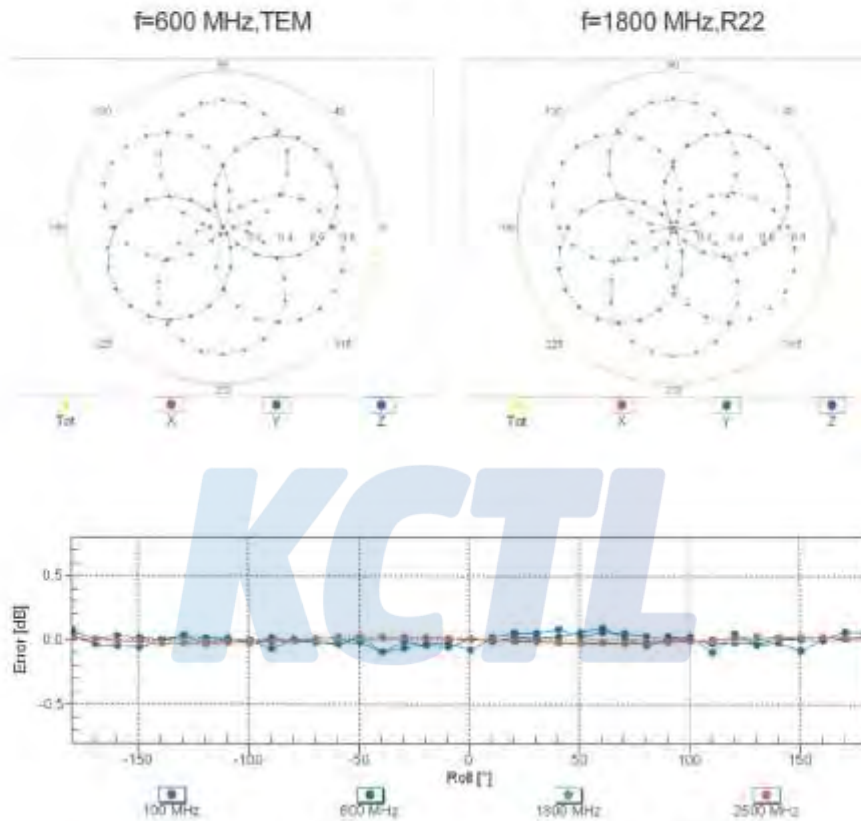
## Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

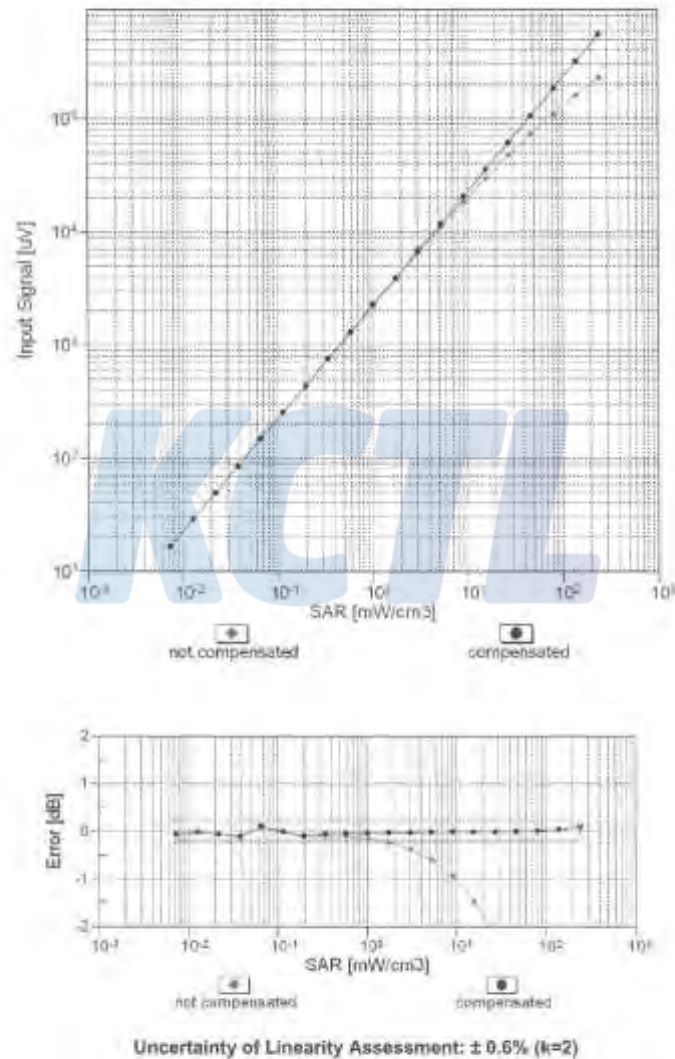
EX3DV4- SN:3928

January 31, 2019

**Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$** Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

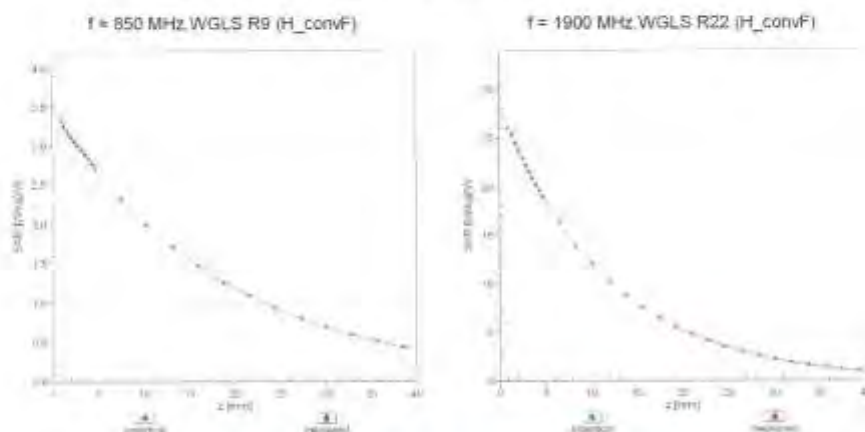
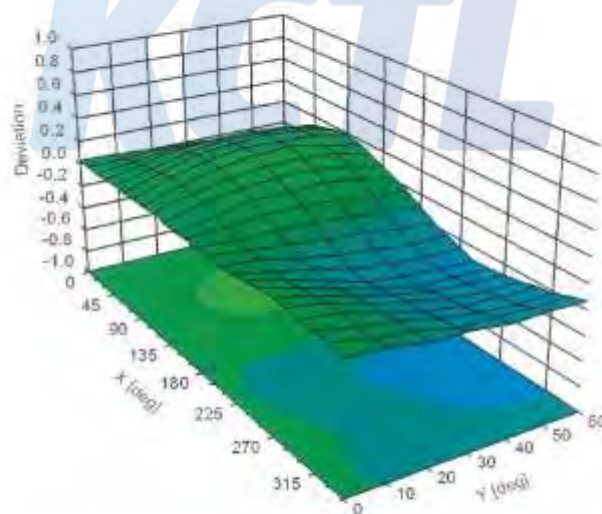
EX3DV4-SN:3928

January 31, 2019

**Dynamic Range  $f(\text{SAR}_{\text{head}})$**   
(TEM cell,  $f_{\text{eval}} = 1900 \text{ MHz}$ )

EX3DV4-SN:3928

January 31, 2019

**Conversion Factor Assessment****Deviation from Isotropy in Liquid**Error ( $\phi, \theta$ ),  $f = 900 \text{ MHz}$ Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )

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Report No.:  
KR19-SPF0032-A  
Page (204) of (308)

# KCTL

## Appendix A.3 Probe Calibration certificate (EX3DV4\_3697)

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Client: **KCTL (Dymstec)**

Certificate No: **EX3-3697\_Mar19**

### CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3697**

Calibration procedure(s): **QA CAL-01.V9, QA CAL-14.V5, QA CAL-23.V5, QA CAL-25.V7**  
Calibration procedure for dosimetric E-field probes

Calibration date: **March 28, 2019**

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-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91       | SN: 103244       | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91       | SN: 103245       | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator | SN: 55277 (20x)  | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| DAE4                       | SN: 660          | 18-Dec-18 (No. DAE4-660_Dec18)    | Dec-19                 |
| Reference Probe ES3DV2     | SN: 3013         | 31-Dec-18 (No. ES3-3013_Dec18)    | Dec-19                 |
| Secondary Standards        | ID               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B         | SN: QB41293874   | 06-Apr-18 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: MY41488067   | 06-Apr-18 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: 000110210    | 06-Apr-18 (in house check Jun-18) | In house check: Jun-20 |
| RF generator HP 8648C      | SN: US3642U01700 | 04-Aug-99 (in house check Jun-18) | In house check: Jun-20 |
| Network Analyzer E8358A    | SN: US41060477   | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Claudio Loubler** Function: **Laboratory Technician** Signature:

Approved by: **Rajja Pokorny** Technical Manager Signature:

Issue: **March 28, 2019**

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

Certificate No: **EX3-3697\_Mar19**

Page 1 of 10

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



S Schweizerischer Kalibrierdienst  
S Service suisse d'étalonnage  
S Servizio svizzero di taratura  
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: SCS 0108

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

#### Glossary:

|                       |                                                                                                                                                   |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                   | issue simulating liquid                                                                                                                           |
| $NORM_{x,y,z}$        | sensitivity in free space                                                                                                                         |
| ConvF                 | sensitivity in TSL / $NORM_{x,y,z}$                                                                                                               |
| DCP                   | diode compression point                                                                                                                           |
| CF                    | crest factor (1/duty_cycle) of the RF signal                                                                                                      |
| A, B, C, D            | modulation dependent linearization parameters                                                                                                     |
| Polarization $\phi$   | $\phi$ rotation around probe axis                                                                                                                 |
| Polarization $\theta$ | $\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\theta = 0$ is normal to probe axis |
| Connector Angle       | information used in DASY system to align probe sensor X to the robot coordinate system                                                            |

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013.
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2018
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$ : Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide).  $NORM_{x,y,z}$  are only intermediate values, i.e., the uncertainties of  $NORM_{x,y,z}$  does not affect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- $NORM(f)_{x,y,z} = NORM_{x,y,z} \cdot \text{frequency\_response}$  (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to  $NORM_{x,y,z} \cdot \text{ConvF}$  whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy) in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the  $NORM_x$  (no uncertainty required).

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Report No.:  
KR19-SPF0032-A  
Page (206) of (308)



EX3DV4 - SN:3697

March 28, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3697****Basic Calibration Parameters**

|                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|-------------------------------------------|----------|----------|----------|---------------|
| Norm ( $\mu V/(V/m)^{1/2}$ ) <sup>A</sup> | 0.35     | 0.38     | 0.34     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                     | 102.3    | 105.3    | 104.3    |               |

**Calibration Results for Modulation Response**

| UID | Communication System Name |   | A<br>dB | B<br>dB $\sqrt{\mu V}$ | C   | D<br>dB | VR<br>mV | Max<br>dev.  | Unc <sup>C</sup><br>(k=2) |
|-----|---------------------------|---|---------|------------------------|-----|---------|----------|--------------|---------------------------|
| 0   | CW                        | X | 0.0     | 0.0                    | 1.0 | 0.00    | 149.5    | $\pm 3.3 \%$ | $\pm 4.7 \%$              |
|     |                           | Y | 0.0     | 0.0                    | 1.0 |         | 157.6    |              |                           |
|     |                           | Z | 0.0     | 0.0                    | 1.0 |         | 143.0    |              |                           |

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

<sup>A</sup> The uncertainties of Norm A, Y, Z do not effect the E<sup>3</sup> lead uncertainty inside (5). (see Pages 5 and 6).

<sup>B</sup> Numerical frequency parameter: uncertainty not required.

<sup>C</sup> Uncertainty is determined using the max. deviation from three response applying rectangular distribution and is expressed for the square of the lead value.

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Report No.:  
KR19-SPF0032-A  
Page (207) of (308)



EX3DV4 - SN:3697

March 28, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3697****Other Probe Parameters**

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | -25.1      |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 9 mm       |
| Tip Diameter                                  | 2.5 mm     |
| Probe Tip to Sensor X Calibration Point       | 1 mm       |
| Probe Tip to Sensor Y Calibration Point       | 1 mm       |
| Probe Tip to Sensor Z Calibration Point       | 1 mm       |
| Recommended Measurement Distance from Surface | 1.4 mm     |

EX3DV4--SN:3697

March 28, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3697****Calibration Parameter Determined in Head Tissue Simulating Media**

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>G</sup> | Depth (mm) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|------------|-----------|
| 750                  | 41.9                               | 0.89                            | 9.00    | 9.00    | 9.00    | 0.50               | 0.80       | ± 12.0 %  |
| 850                  | 41.5                               | 0.92                            | 8.73    | 8.73    | 8.73    | 0.40               | 0.95       | ± 12.0 %  |
| 900                  | 41.5                               | 0.97                            | 8.59    | 8.59    | 8.59    | 0.49               | 0.80       | ± 12.0 %  |
| 1640                 | 40.2                               | 1.31                            | 7.78    | 7.78    | 7.78    | 0.30               | 0.80       | ± 12.0 %  |
| 1750                 | 40.1                               | 1.37                            | 7.62    | 7.62    | 7.62    | 0.39               | 0.80       | ± 12.0 %  |
| 1900                 | 40.0                               | 1.40                            | 7.47    | 7.47    | 7.47    | 0.25               | 0.80       | ± 12.0 %  |
| 2300                 | 39.5                               | 1.87                            | 7.11    | 7.11    | 7.11    | 0.36               | 0.86       | ± 12.0 %  |
| 2450                 | 39.2                               | 1.80                            | 6.86    | 6.86    | 6.86    | 0.36               | 0.86       | ± 12.0 %  |
| 2600                 | 39.0                               | 1.96                            | 6.71    | 6.71    | 6.71    | 0.40               | 0.87       | ± 12.0 %  |
| 3500                 | 37.9                               | 2.91                            | 6.61    | 6.61    | 6.61    | 0.25               | 1.20       | ± 13.1 %  |
| 3700                 | 37.7                               | 3.12                            | 6.32    | 6.32    | 6.32    | 0.25               | 1.20       | ± 13.1 %  |
| 5200                 | 36.0                               | 4.66                            | 4.83    | 4.83    | 4.83    | 0.40               | 1.80       | ± 13.1 %  |
| 5300                 | 35.9                               | 4.76                            | 4.70    | 4.70    | 4.70    | 0.40               | 1.80       | ± 13.1 %  |
| 5500                 | 35.6                               | 4.96                            | 4.46    | 4.46    | 4.46    | 0.40               | 1.80       | ± 13.1 %  |
| 5600                 | 35.5                               | 5.07                            | 4.32    | 4.32    | 4.32    | 0.40               | 1.80       | ± 13.1 %  |
| 5800                 | 35.3                               | 5.27                            | 4.39    | 4.39    | 4.39    | 0.40               | 1.80       | ± 13.1 %  |

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:3697

March 28, 2019

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3697****Calibration Parameter Determined in Body Tissue Simulating Media**

| f (MHz) <sup>c</sup> | Relative Permittivity <sup>f</sup> | Conductivity (S/m) <sup>f</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>d</sup> | Depth (mm) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|------------|-----------|
| 750                  | 55.5                               | 0.96                            | 8.90    | 8.90    | 8.90    | 0.44               | 0.81       | ± 12.0 %  |
| 850                  | 55.2                               | 0.99                            | 8.81    | 8.81    | 8.81    | 0.47               | 0.82       | ± 12.0 %  |
| 900                  | 55.0                               | 1.05                            | 8.79    | 8.79    | 8.79    | 0.52               | 0.82       | ± 12.0 %  |
| 1640                 | 53.7                               | 1.42                            | 7.69    | 7.69    | 7.69    | 0.44               | 0.80       | ± 12.0 %  |
| 1750                 | 53.4                               | 1.49                            | 7.44    | 7.44    | 7.44    | 0.43               | 0.82       | ± 12.0 %  |
| 1900                 | 53.3                               | 1.52                            | 7.21    | 7.21    | 7.21    | 0.40               | 0.80       | ± 12.0 %  |
| 2300                 | 52.9                               | 1.81                            | 7.05    | 7.05    | 7.05    | 0.35               | 0.94       | ± 12.0 %  |
| 2450                 | 52.7                               | 1.95                            | 6.96    | 6.96    | 6.96    | 0.32               | 0.90       | ± 12.0 %  |
| 2600                 | 52.5                               | 2.16                            | 6.78    | 6.78    | 6.78    | 0.33               | 0.95       | ± 12.0 %  |
| 3500                 | 51.3                               | 3.31                            | 6.28    | 6.28    | 6.28    | 0.23               | 1.25       | ± 13.1 %  |
| 3700                 | 51.0                               | 3.55                            | 6.10    | 6.10    | 6.10    | 0.27               | 1.25       | ± 13.1 %  |
| 5200                 | 49.0                               | 5.30                            | 4.16    | 4.16    | 4.16    | 0.50               | 1.90       | ± 13.1 %  |
| 5300                 | 48.9                               | 5.42                            | 4.00    | 4.00    | 4.00    | 0.50               | 1.90       | ± 13.1 %  |
| 5500                 | 48.6                               | 5.65                            | 3.78    | 3.78    | 3.78    | 0.50               | 1.90       | ± 13.1 %  |
| 5600                 | 48.5                               | 5.77                            | 3.73    | 3.73    | 3.73    | 0.50               | 1.90       | ± 13.1 %  |
| 5800                 | 48.2                               | 6.00                            | 3.85    | 3.85    | 3.85    | 0.50               | 1.90       | ± 13.1 %  |

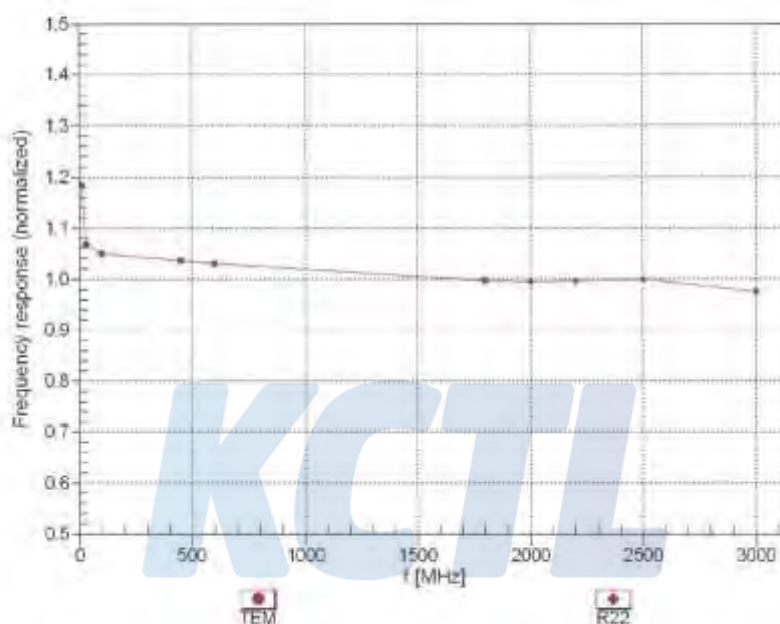
<sup>c</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 126, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>d</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4--SN:3697

March 28, 2019

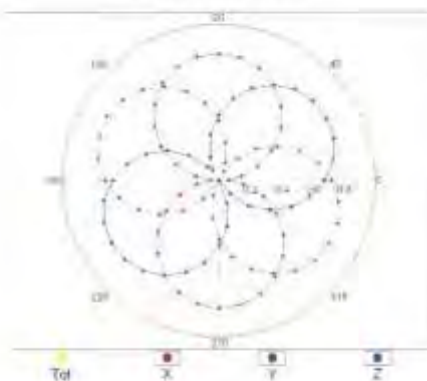
**Frequency Response of E-Field**  
(TEM-Cell:ifi110 EXX, Waveguide: R22)Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

EX3DV4- SN:3697

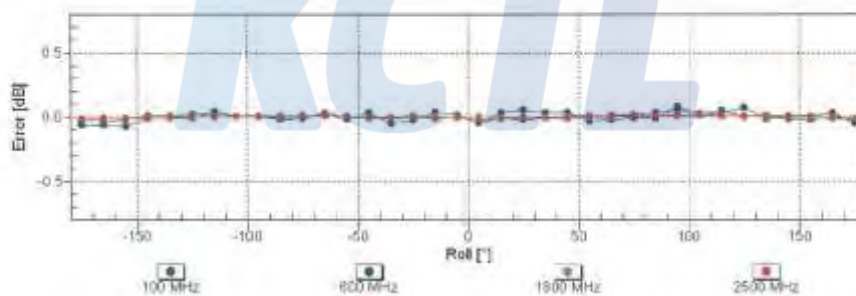
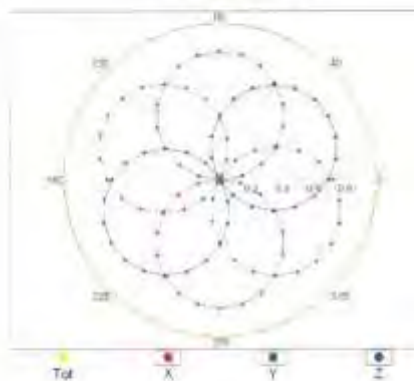
March 28, 2019

**Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$** 

f=600 MHz,TEM

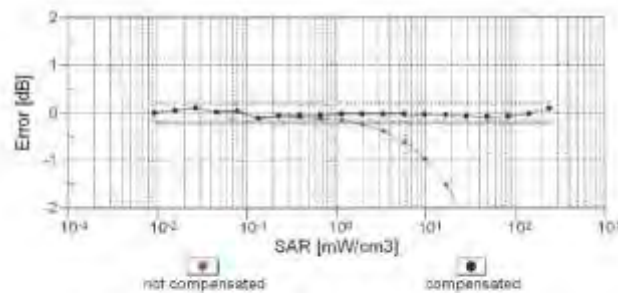
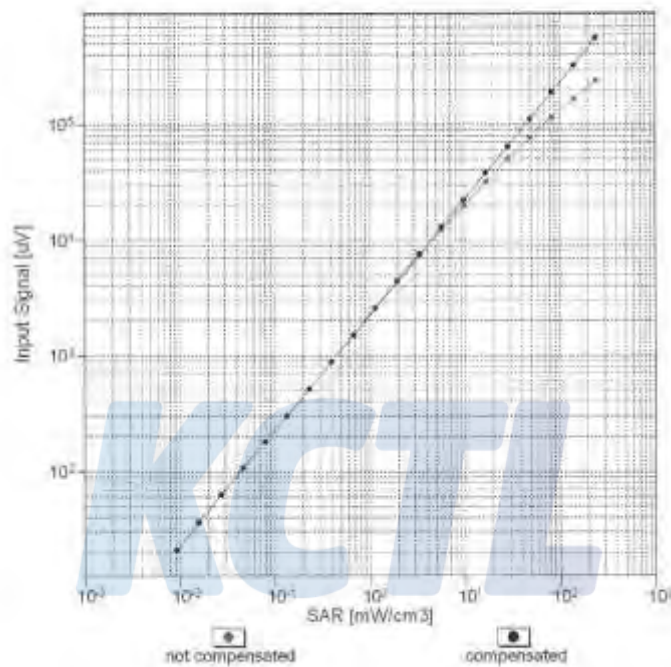


f=1800 MHz,R22

Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

EX3DV4--SN:3697

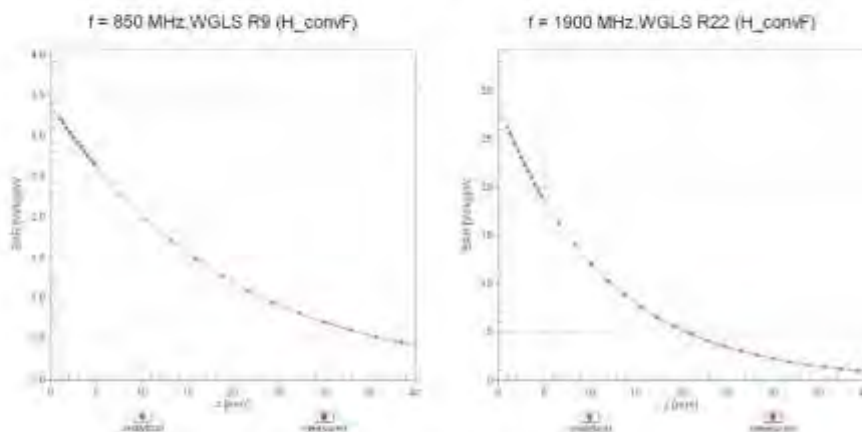
March 26, 2019

**Dynamic Range f(SAR<sub>head</sub>)**  
(TEM cell, f<sub>eval</sub> = 1900 MHz)Uncertainty of Linearity Assessment:  $\pm 0.6\%$  (k=2)

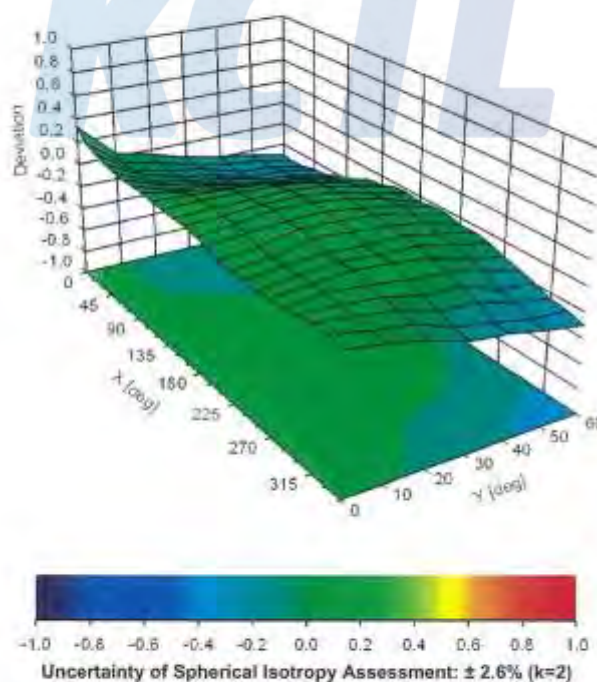
EX3DV4- SN:3697

March 28, 2019

### Conversion Factor Assessment



### Deviation from Isotropy in Liquid

Error ( $\phi, \theta$ ),  $f = 900 \text{ MHz}$ 

Certificate No: EX3-3697\_Mar19

Page 10 of 10

# KCTL Inc.

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Report No.:  
KR19-SPF0032-A  
Page (214) of (308)



## Appendix A.4 Dipole Calibration certificate (D750V3\_1183)

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



S Schweizerischer Kalibrierdienst  
C Service suisse d'étalonnage  
S Servizio svizzero di taratura  
S Swiss Calibration Service

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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

Client KCTL (Dymstec)

Certificate No: D750V3-1183\_Sep18

### CALIBRATION CERTIFICATE

Object D750V3 - SN:1183

Calibration procedure(s) QA CAL-05.v10  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: September 03, 2018

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  $\leq 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 04-Apr-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5056 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                            | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| RF generator R&S SMT-08         | SN: 100872         | 15-Jun-15 (in house check Oct-16) | in house check: Oct-18 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | in house check: Oct-18 |

Calibrated by: Name Michael Weber Function Laboratory Technician

Signature

Approved by: Name Katja Pokovic Technical Manager

Issued: September 4, 2018

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

Certificate No: D750V3-1183\_Sep18

Page 1 of 8

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Page (215) of (308)



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



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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   | Issue 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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| 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             | 41.8           | 0.89 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.9 $\pm$ 6 % | 0.89 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ---            | ---                  |

**SAR result with Head TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 2.06 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 6.19 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.34 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.34 W/kg $\pm$ 16.5 % (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.5           | 0.96 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 55.0 $\pm$ 6 % | 0.96 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ---            | ---                  |

**SAR result with Body TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 2.13 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 8.50 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.40 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 5.59 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 | 54.2 $\Omega$ - 2.1 j $\Omega$ |
| Return Loss                          | -26.9 dB                       |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.5 $\Omega$ - 5.3 j $\Omega$ |
| Return Loss                          | -25.4 dB                       |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.030 ns |
|----------------------------------|----------|

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

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

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

**Additional EUT Data**

|                 |                    |
|-----------------|--------------------|
| Manufactured by | SPEAG              |
| Manufactured on | September 07, 2017 |

**DASY5 Validation Report for Head TSL**

Date: 03.09.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.89$  S/m;  $\epsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

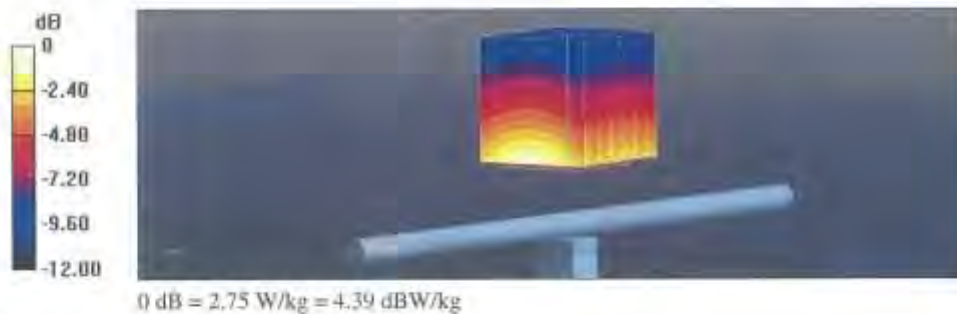
**Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 59.07 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.08 W/kg

**SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.34 W/kg**

Maximum value of SAR (measured) = 2.75 W/kg



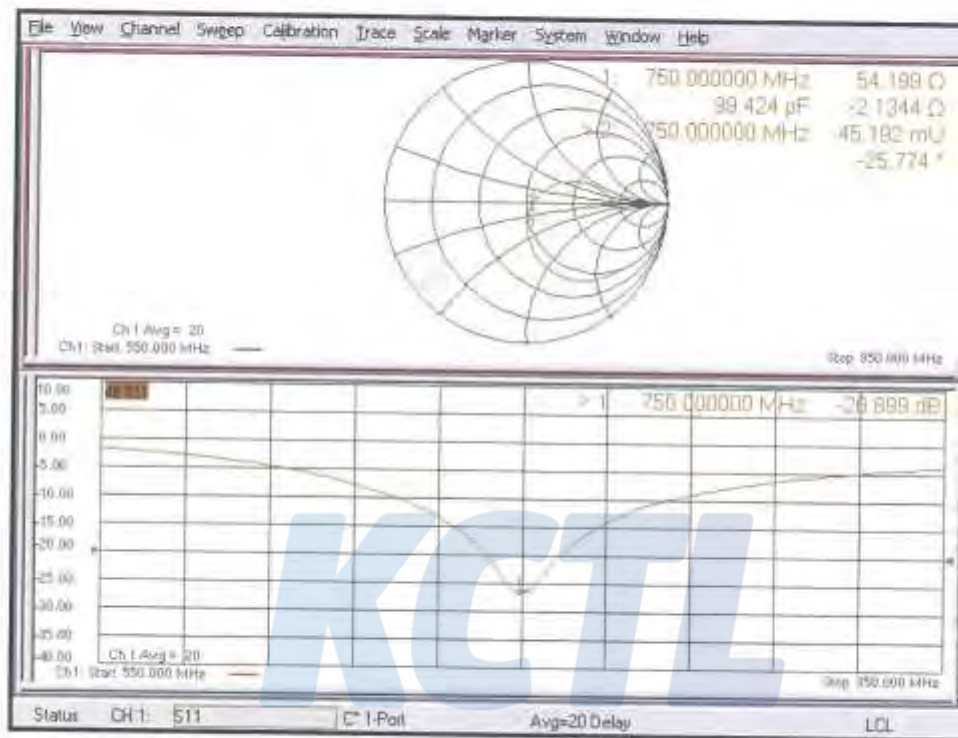
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Page (219) of (308)



## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 03.09.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.96$  S/m;  $\epsilon_r = 55$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

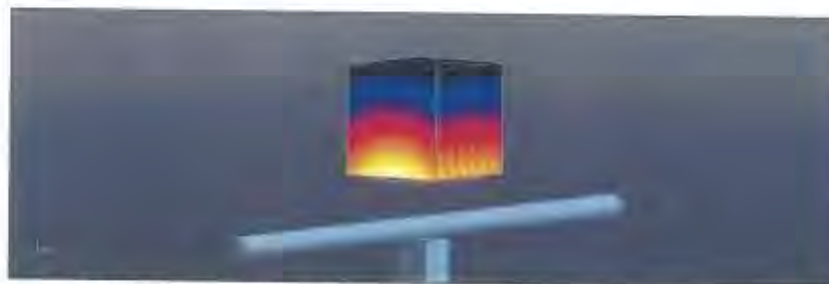
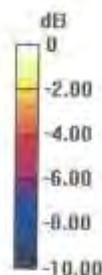
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.83 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.15 W/kg

SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.82 W/kg



() dB = 2.82 W/kg = 4.50 dBW/kg

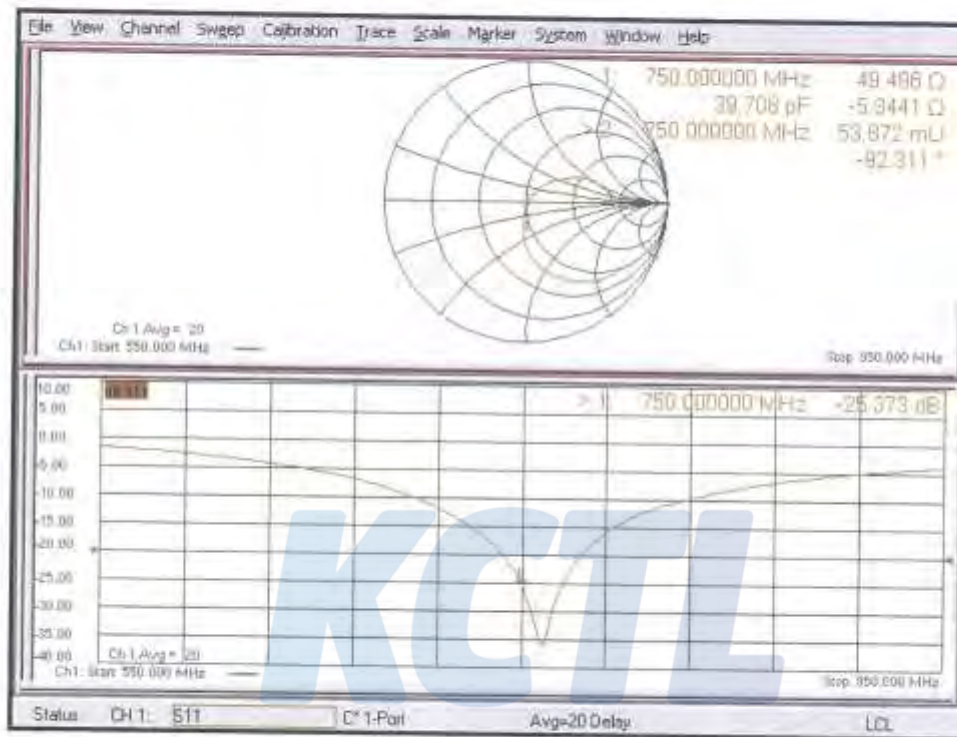
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## Impedance Measurement Plot for Body TSL



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KR19-SPF0032-A  
Page (222) of (308)



## Appendix A.5 Dipole Calibration certificate (D850V2\_1006)

Calibration Laboratory of  
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Engineering AG  
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 0108

Client KCTL (Dymstec)

Certificate No: D850V2-1006\_Apr18

### CALIBRATION CERTIFICATE

Object D850V2 - SN:1006

Calibration procedure(s) QA CAL-05.v10  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: April 20, 2018

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  $\leq 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP             | SN: 104778         | 04-Apr-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator  | SN: 5056 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DVA      | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                        | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A        | SN: GB37480704     | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| Power sensor HP 8481A       | SN: US37292783     | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| Power sensor HP 8481A       | SN: MY41082317     | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| RF generator R&S SMT-06     | SN: 100872         | 15-Jun-15 (in house check Oct-16) | in house check: Oct-18 |
| Network Analyzer HP 8753E   | SN: US37390585     | 18-Oct-01 (in house check Oct-17) | in house check: Oct-18 |

Calibrated by: Name: Michael Weber Function: Laboratory Technician Signature:

Approved by: Name: Kalja Pokovic Function: Technical Manager Signature:

Issued: April 23, 2018

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

Certificate No: D850V2-1006\_Apr18

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

- DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                                     |             |
|------------------------------|-------------------------------------|-------------|
| DASY Version                 | DASY5                               | V62.10.0    |
| Extrapolation                | Advanced Extrapolation              |             |
| Phantom                      | Modular Flat Phantom                |             |
| Distance Dipole Center - TSL | 15 mm                               | with Spacer |
| Zoom Scan Resolution         | $dx, dy, dz = 5 \text{ mm}$         |             |
| Frequency                    | $850 \text{ MHz} \pm 1 \text{ MHz}$ |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|                                         | Temperature                               | Permittivity    | Conductivity                  |
|-----------------------------------------|-------------------------------------------|-----------------|-------------------------------|
| Nominal Head TSL parameters             | $22.0 \text{ }^{\circ}\text{C}$           | 41.5            | 0.92 mho/m                    |
| Measured Head TSL parameters            | $(22.0 \pm 0.2) \text{ }^{\circ}\text{C}$ | $40.9 \pm 6 \%$ | $0.93 \text{ mho/m} \pm 6 \%$ |
| Head TSL temperature change during test | $< 0.5 \text{ }^{\circ}\text{C}$          | —               | —                             |

**SAR result with Head TSL**

|                                                        |                    |                                       |
|--------------------------------------------------------|--------------------|---------------------------------------|
| SAR averaged over $1 \text{ cm}^3$ (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   | $10.0 \text{ W/kg} \pm 17.0 \%$ (k=2) |
| SAR averaged over $10 \text{ cm}^3$ (10 g) of Head TSL | condition          |                                       |
| SAR measured                                           | 250 mW input power | 1.63 W/kg                             |
| SAR for nominal Head TSL parameters                    | normalized to 1W   | $6.46 \text{ W/kg} \pm 16.5 \%$ (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied.

|                                         | Temperature                               | Permittivity    | Conductivity                  |
|-----------------------------------------|-------------------------------------------|-----------------|-------------------------------|
| Nominal Body TSL parameters             | $22.0 \text{ }^{\circ}\text{C}$           | 55.2            | 0.99 mho/m                    |
| Measured Body TSL parameters            | $(22.0 \pm 0.2) \text{ }^{\circ}\text{C}$ | $53.8 \pm 6 \%$ | $1.00 \text{ mho/m} \pm 6 \%$ |
| Body TSL temperature change during test | $< 0.5 \text{ }^{\circ}\text{C}$          | —               | —                             |

**SAR result with Body TSL**

|                                                        |                    |                                       |
|--------------------------------------------------------|--------------------|---------------------------------------|
| SAR averaged over $1 \text{ cm}^3$ (1 g) of Body TSL   | Condition          |                                       |
| SAR measured                                           | 250 mW input power | 2.54 W/kg                             |
| SAR for nominal Body TSL parameters                    | normalized to 1W   | $10.0 \text{ W/kg} \pm 17.0 \%$ (k=2) |
| SAR averaged over $10 \text{ cm}^3$ (10 g) of Body TSL | condition          |                                       |
| SAR measured                                           | 250 mW input power | 1.65 W/kg                             |
| SAR for nominal Body TSL parameters                    | normalized to 1W   | $6.54 \text{ W/kg} \pm 16.5 \%$ (k=2) |

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Page (225) of (308)

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

|                                      |                                 |
|--------------------------------------|---------------------------------|
| Impedance, transformed to feed point | 52.5 $\Omega$ - 2.8 $\mu\Omega$ |
| Return Loss                          | - 26.7 dB                       |

**Antenna Parameters with Body TSL**

|                                      |                                 |
|--------------------------------------|---------------------------------|
| Impedance, transformed to feed point | 48.7 $\Omega$ - 3.4 $\mu\Omega$ |
| Return Loss                          | - 28.8 dB                       |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.434 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 and caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

**Additional EUT Data**

|                 |                  |
|-----------------|------------------|
| Manufactured by | SPEAG            |
| Manufactured on | January 30, 2009 |

**DASY5 Validation Report for Head TSL**

Date: 20.04.2018

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;  $\sigma = 0.93$  S/m;  $\epsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.78, 9.78, 9.78); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**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 = 64.04 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.84 W/kg

**SAR(1 g) = 2.53 W/kg; SAR(10 g) = 1.63 W/kg**

Maximum value of SAR (measured) = 3.38 W/kg



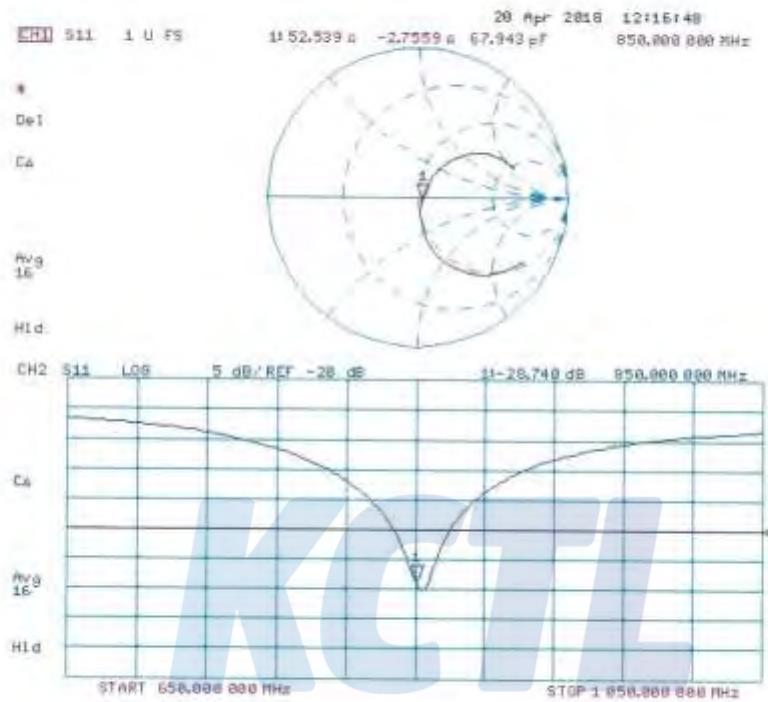
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Report No.:  
KR19-SPF0032-A  
Page (227) of (308)



## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 20.04.2018

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;  $\sigma = 1$  S/m;  $\epsilon_r = 53.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.95, 9.95, 9.95); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

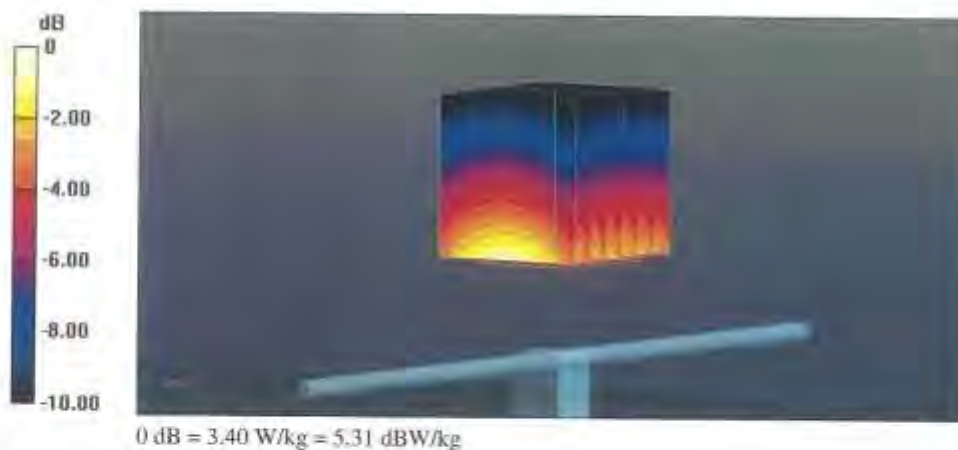
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 61.80 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.84 W/kg

**SAR(1 g) = 2.54 W/kg; SAR(10 g) = 1.65 W/kg**

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



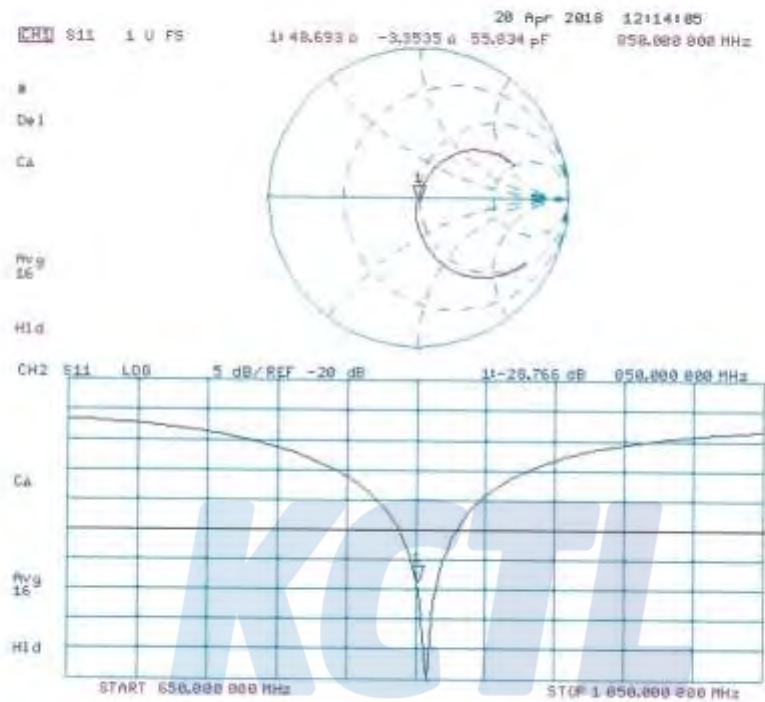
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## Impedance Measurement Plot for Body TSL



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## Appendix A.6 Dipole Calibration certificate (D1750V2\_072)

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



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Accreditation No.: SCS 0108

Client **KCTL (Dymstec)**

Certificate No: **D1750V2-1072\_Apr18**

| CALIBRATION CERTIFICATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                 |                                   |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------|------------------------|
| Object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | D1750V2 - SN:1072                                                               |                                   |                        |
| Calibration procedure(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | QA CAL-05.v10<br>Calibration procedure for dipole validation kits above 700 MHz |                                   |                        |
| Calibration date:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | April 19, 2018                                                                  |                                   |                        |
| <p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).<br/>The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature <math>(22 \pm 3)^\circ\text{C}</math> and humidity <math>&lt; 70\%</math>.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> |                                                                                 |                                   |                        |
| Primary Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ID #                                                                            | Cal Date (Certificate No.)        | Scheduled Calibration  |
| Power meter NRP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | SN: 104778                                                                      | 04-Apr-18 (No. 217-02572/02573)   | Apr-19                 |
| Power sensor NRP-Z91                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SN: 103244                                                                      | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SN: 103245                                                                      | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | SN: 5058 (20K)                                                                  | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | SN: 5047.2 / 06327                                                              | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SN: 7349                                                                        | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SN: 601                                                                         | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| Secondary Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ID #                                                                            | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SN: GB37480704                                                                  | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| Power sensor HP 8481A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | SN: US37292783                                                                  | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| Power sensor HP 8481A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | SN: MY41092317                                                                  | 07-Oct-15 (in house check Oct-16) | in house check: Oct-18 |
| RF generator R&S SMT-06                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SN: 100072                                                                      | 15-Jun-15 (in house check Oct-16) | in house check: Oct-18 |
| Network Analyzer HP 8753E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SN: US37390585                                                                  | 18-Oct-01 (in house check Oct-17) | in house check: Oct-18 |
| Calibrated by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Name<br>Michael Weber                                                           | Function<br>Laboratory Technician | Signature<br>          |
| Approved by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Name<br>Katja Pokovic                                                           | Technical Manager                 | Signature<br>          |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory.                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 |                                   |                        |

Issued: April 23, 2018

Certificate No: D1750V2-1072\_Apr18

Page 1 of 8

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

- DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.0    |
| 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 | 39.2 $\pm$ 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 <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 9.15 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 36.8 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 4.84 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 19.4 W/kg $\pm$ 16.5 % (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.4 $\pm$ 6 % | 1.46 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | —              | —                    |

**SAR result with Body TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 9.18 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 37.0 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 4.93 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 19.8 W/kg $\pm$ 16.5 % (k=2) |

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Page (233) of (308)

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

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $50.5 \Omega + 0.3 j\Omega$ |
| Return Loss                          | $> 44.8 \text{ dB}$         |

**Antenna Parameters with Body TSL**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $46.3 \Omega - 1.4 j\Omega$ |
| Return Loss                          | $> 27.8 \text{ dB}$         |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.215 ns |
|----------------------------------|----------|

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

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

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

**Additional EUT Data**

|                 |                  |
|-----------------|------------------|
| Manufactured by | SPEAG            |
| Manufactured on | January 10, 2011 |

**DASY5 Validation Report for Head TSL**

Date: 19.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.35$  S/m;  $\epsilon_r = 39.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

**DASY52 Configuration:**

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

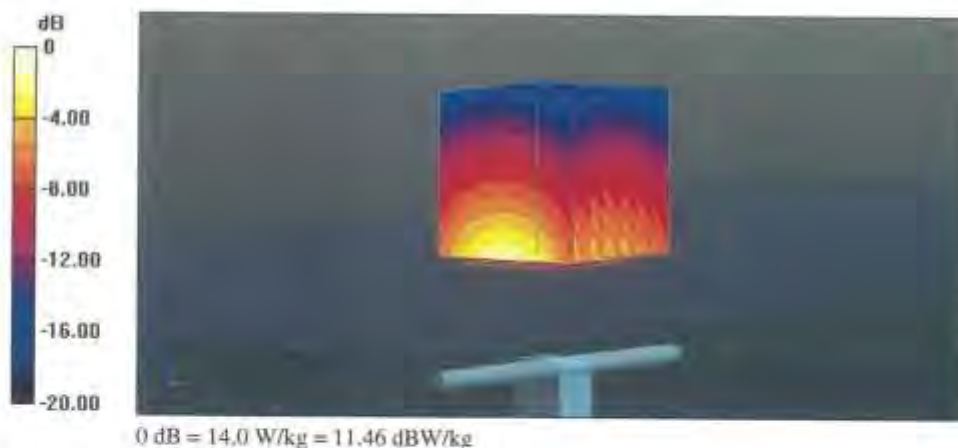
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.3 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 16.8 W/kg

**SAR(1 g) = 9.15 W/kg; SAR(10 g) = 4.84 W/kg**

Maximum value of SAR (measured) = 14.0 W/kg



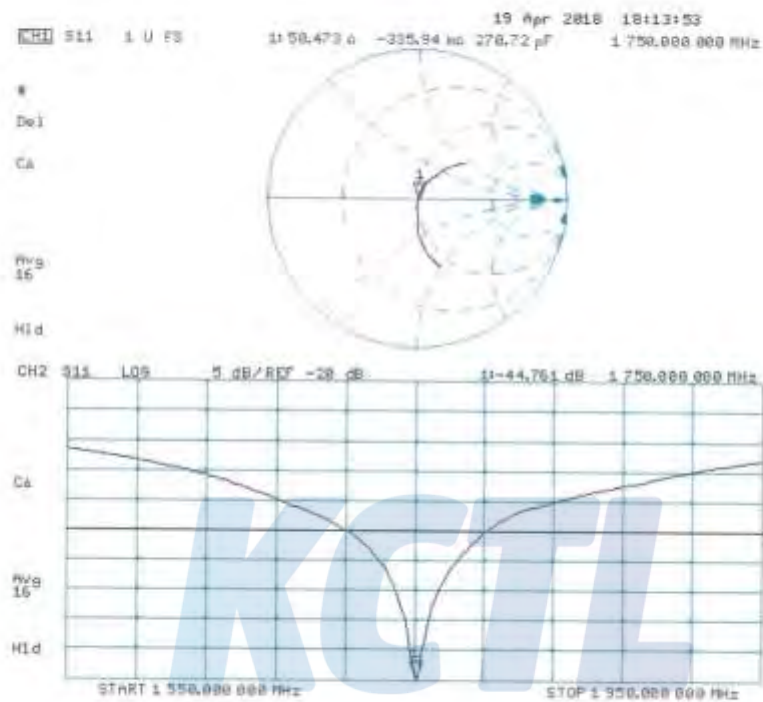
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Page (235) of (308)

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## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 19.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 52.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

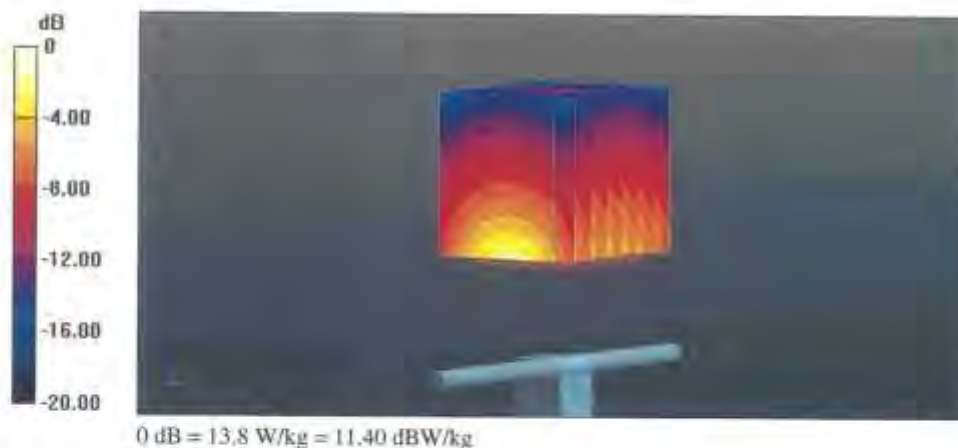
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.8 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 16.0 W/kg

**SAR(1 g) = 9.18 W/kg; SAR(10 g) = 4.93 W/kg**

Maximum value of SAR (measured) = 13.8 W/kg



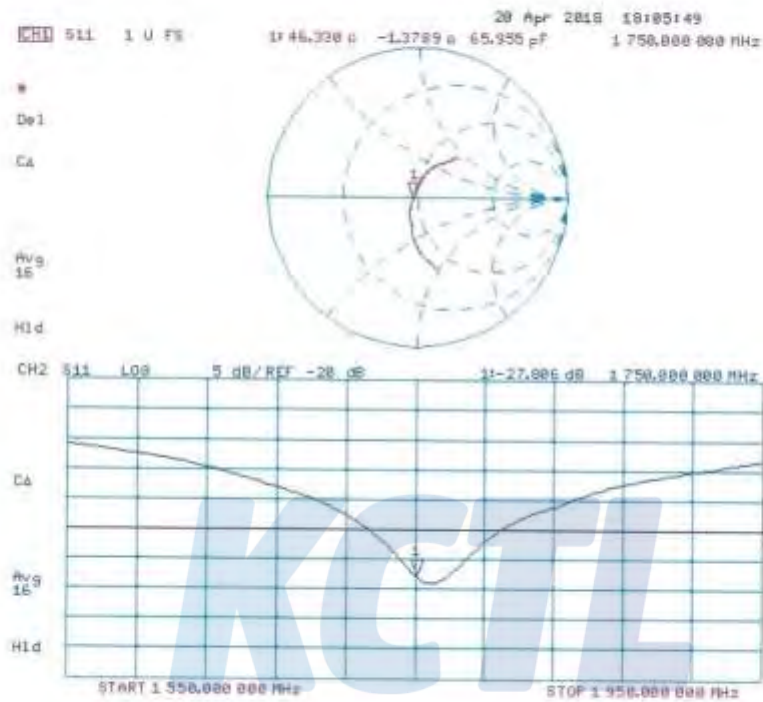
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## Impedance Measurement Plot for Body TSL



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Page (238) of (308)

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## Appendix A.7 Dipole Calibration certificate (D1900V2\_5d160)

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 **KCTL (Dymstec)**

Certificate No: **D1900V2-5d160\_Apr18**

### CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d160**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **April 25, 2018**

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-18 (No. 217-02672/02673)   | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-18                 |
| Reference 20 dB Attenuator  | SN: 5054 (20K)     | 04-Apr-18 (No. 217-02682)         | Apr-18                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-18                 |
| Reference Probe EX3DV4      | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                        | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter FPM-442A        | SN: GB37480708     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A       | SN: US37292783     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A       | SN: MY41062317     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-06     | SN: 100972         | 15-Jun-15 (in house check Oct-16) | In house check: Oct-18 |
| Network Analyzer HP 8753E   | SN: US37590585     | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |

Calibrated by: Name **Claudio Leubler** Function **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Issued: April 25, 2018

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Certificate No: D1900V2-5d160\_Apr18

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Report No.:  
KR19-SPF0032-A  
Page (239) of (308)



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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

- DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52 10.0    |
| 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 | 41.1 $\pm$ 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 <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 9.88 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 39.8 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 5.10 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 20.8 W/kg $\pm$ 16.5 % (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied:

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 55.3 $\pm$ 6 % | 1.47 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | —              | —                    |

**SAR result with Body TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 9.82 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 40.4 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 5.24 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.3 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 | $51.1 \Omega + 5.6 j\Omega$ |
| Return Loss                          | -25.0 dB                    |

**Antenna Parameters with Body TSL**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $47.7 \Omega + 5.6 j\Omega$ |
| Return Loss                          | -22.9 dB                    |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.198 ns |
|----------------------------------|----------|

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

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

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

**Additional EUT Data**

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | December 20, 2011 |

**DASY5 Validation Report for Head TSL**

Date: 25.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.35$  S/m;  $\epsilon_0 = 41.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvP(8.18, 8.18, 8.18); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

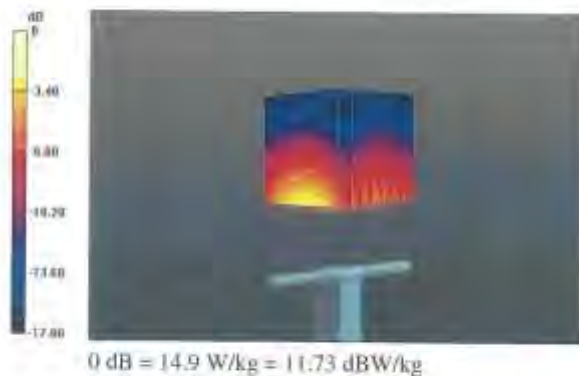
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.1 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.0 W/kg

**SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.1 W/kg**

Maximum value of SAR (measured) = 14.9 W/kg



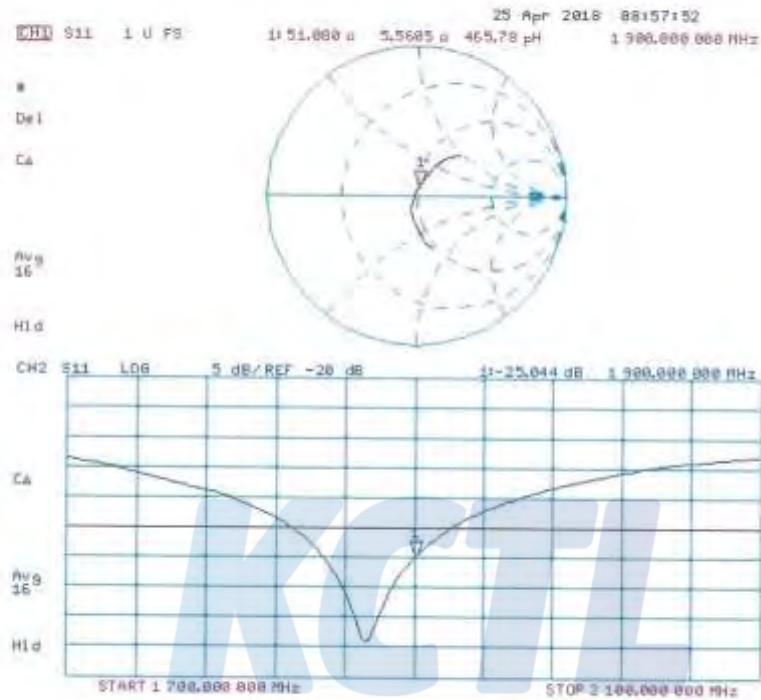
# KCTL Inc.

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TEL: 82-31-285-0894 FAX: 82-505-299-8311  
[www.kctl.co.kr](http://www.kctl.co.kr)

Report No.:  
KR19-SPF0032-A  
Page (243) of (308)



## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 25.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 55.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.15, 8.15, 8.15); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

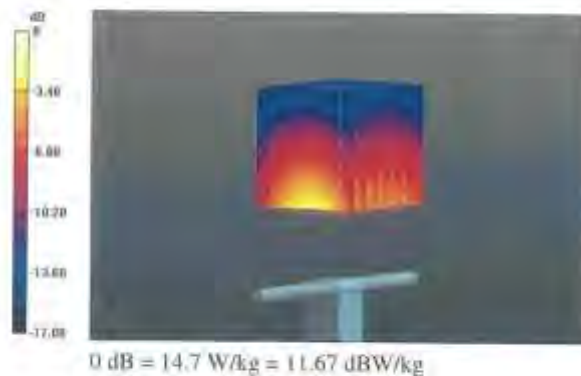
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.0 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 17.4 W/kg

**SAR(1 g) = 9.82 W/kg; SAR(10 g) = 5.24 W/kg**

Maximum value of SAR (measured) = 14.7 W/kg



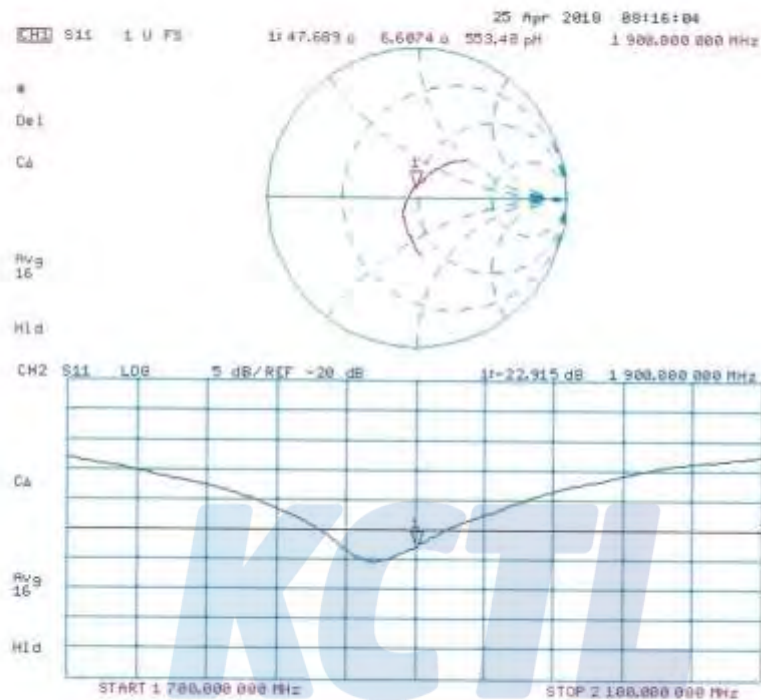
# KCTL Inc.

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Report No.:  
KR19-SPF0032-A  
Page (245) of (308)

# KCTL

## Impedance Measurement Plot for Body TSL



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KR19-SPF0032-A  
Page (246) of (308)

# KCTL

## Appendix A.8 Dipole Calibration certificate (D2450V2\_895)

Calibration Laboratory of  
Schmid & Partner  
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst  
C Service suisse d'étalonnage  
S Servizio svizzero di taratura  
S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client: KCTL (Dymstec)

Certificate No: D2450V2-895\_Jul18

### CALIBRATION CERTIFICATE

Object: D2450V2 - SN:895

Calibration procedure(s): QA CAL-05.v10  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 24, 2018

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-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                            | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A           | SN: U537292783     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-16) | In house check: Oct-18 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

Calibrated by: Name: Gluklin Leutler Function: Laboratory Technician

Approved by: Name: Kalje Polovic Function: Technical Manager

Issued: July 24, 2018

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

Certificate No: D2450V2-895\_Jul18

Page 1 of 8

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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

Accreditation No.: **SCS 0100**

**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:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| 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             | 89.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.8 $\pm$ 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 <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 13.1 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 51.3 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.10 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.1 W/kg $\pm$ 16.5 % (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.9 $\pm$ 6 % | 2.02 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | —              | —                    |

**SAR result with Body TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 12.9 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 50.6 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.03 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 23.8 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 | $53.8 \Omega + 1.8 j\Omega$ |
| Return Loss                          | -27.9 dB                    |

**Antenna Parameters with Body TSL**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $49.2 \Omega + 5.0 j\Omega$ |
| Return Loss                          | -25.8 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 and caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

**Additional EUT Data**

|                 |               |
|-----------------|---------------|
| Manufactured by | SPEAG         |
| Manufactured on | June 19, 2012 |

**DASY5 Validation Report for Head TSL**

Date: 24.07.2018

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;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

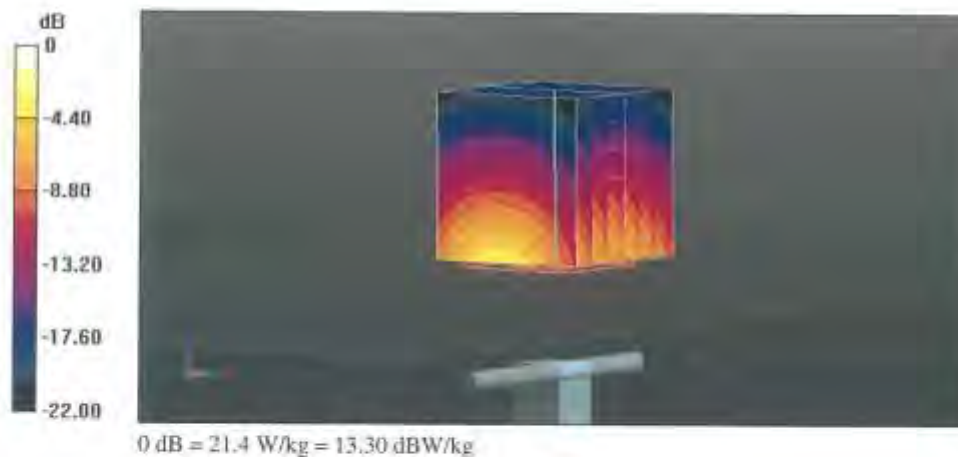
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.0 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 26.1 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 21.4 W/kg



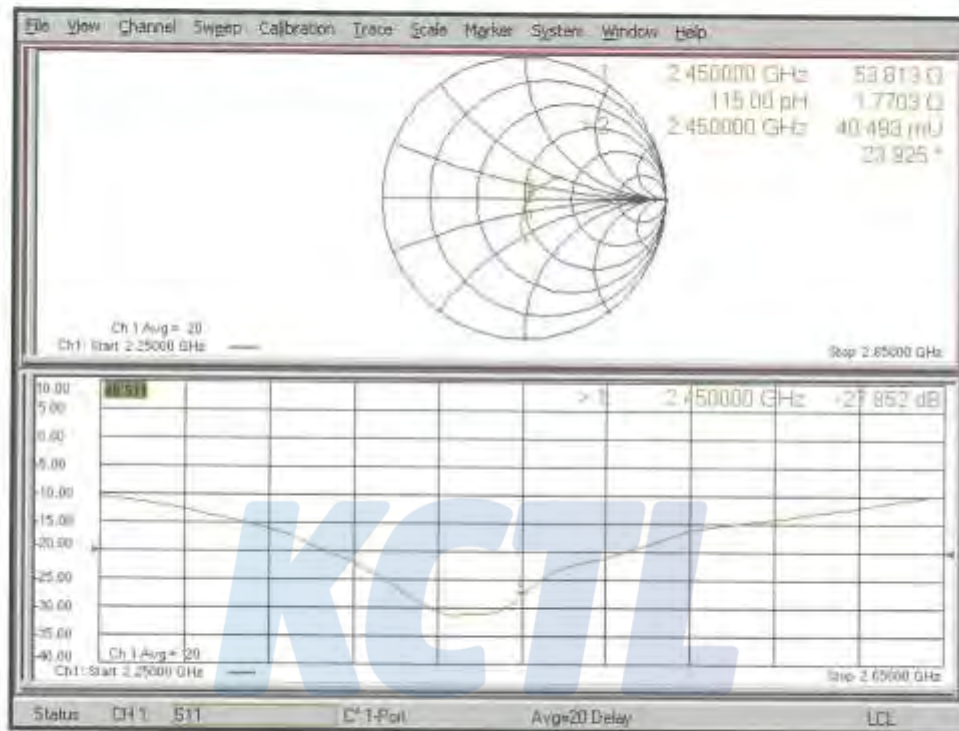
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Suwon-si, Gyeonggi-do, 16677, Korea  
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Report No.:  
KR19-SPF0032-A  
Page (251) of (308)

# KCTL

### Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 24.07.2018

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;  $\sigma = 2.02$  S/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

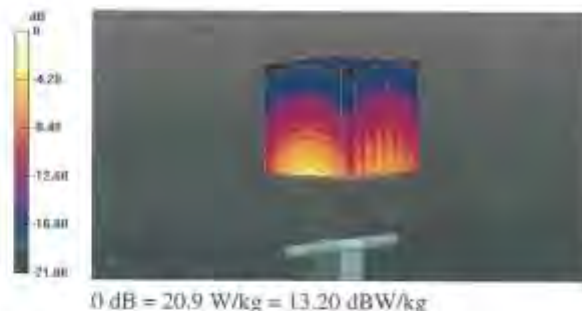
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.0 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 25.1 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.03 W/kg

Maximum value of SAR (measured) = 20.9 W/kg



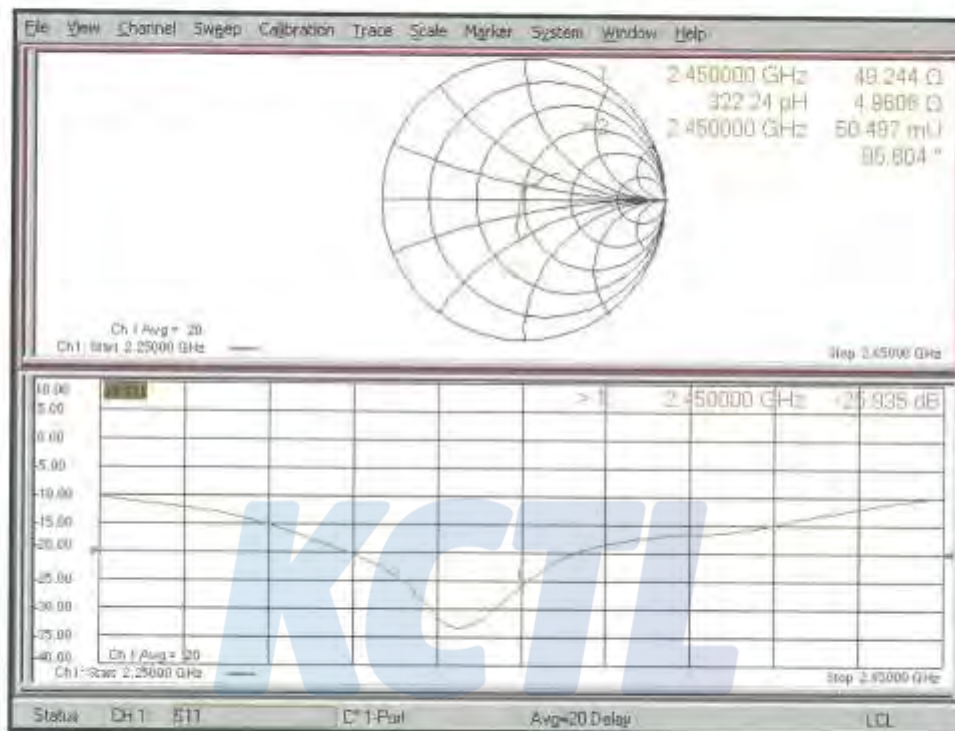
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Suwon-si, Gyeonggi-do, 16677, Korea  
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Report No.:  
KR19-SPF0032-A  
Page (253) of (308)

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## Impedance Measurement Plot for Body TSL



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Page (254) of (308)



## Appendix A.9 Dipole Calibration certificate (D2600V2\_1050)

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



S Schweizerischer Kalibrierdienst  
C Service suisse d'étalonnage  
S Servizio svizzero di taratura  
S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client KCTL (Dymstec)

Certificate No: D2600V2-1050\_Jul18

### CALIBRATION CERTIFICATE

Object D2600V2 - SN:1050

Calibration procedure(s) QA CAL-05.v10  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 26, 2018

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-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3D V4         | SN: 7546           | 30-Dec-17 (No. EX3-7349, Dec17)   | Dec-18                 |
| DAE4                            | SN: 601            | 26-Oct-17 (No. DAE4-601, Oct17)   | Oct-18                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-36         | SN: 100972         | 15-Jun-15 (in house check Oct-16) | In house check: Oct-18 |
| Network Analyzer Agilent E6358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

Calibrated by: Name Michael Weber Function Laboratory Technician

Signature

Approved by: Katja Pokovic Technical Manager

issued: July 26, 2018

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

Certificate No: D2600V2-1050\_Jul18

Page 1 of 8

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



S Schweizerischer Kallibriationsdienst  
C Service suisse d'étalonnage  
S Servizio svizzero di taratura  
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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| 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 | 57.2 $\pm$ 8 % | 2.02 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | —              | —                    |

**SAR result with Head TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 14.4 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 56.2 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.42 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 25.3 W/kg $\pm$ 16.5 % (k=2) |

**Body TSL parameters**

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.5           | 2.16 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.5 $\pm$ 8 % | 2.20 mho/m $\pm$ 8 % |
| Body TSL temperature change during test | < 0.5 °C            | —              | —                    |

**SAR result with Body TSL**

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 13.9 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 54.9 W/kg $\pm$ 17.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.21 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.7 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 | $48.7 \Omega - 7.5 j\Omega$ |
| Return Loss                          | $\sim 22.3 \text{ dB}$      |

**Antenna Parameters with Body TSL**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $45.6 \Omega - 5.0 j\Omega$ |
| Return Loss                          | $\sim 23.1 \text{ dB}$      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.150 ns |
|----------------------------------|----------|

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

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

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

**Additional EUT Data**

|                 |              |
|-----------------|--------------|
| Manufactured by | SPEAG        |
| Manufactured on | May 24, 2011 |

**DASY5 Validation Report for Head TSL**

Date: 26.07.2018

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;  $\sigma = 2.02$  S/m;  $\epsilon_r = 37.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

**DASY52 Configuration:**

- Probe: EX3DV4 - SN7349; ConvF(7.7, 7.7, 7.7) @ 2600 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

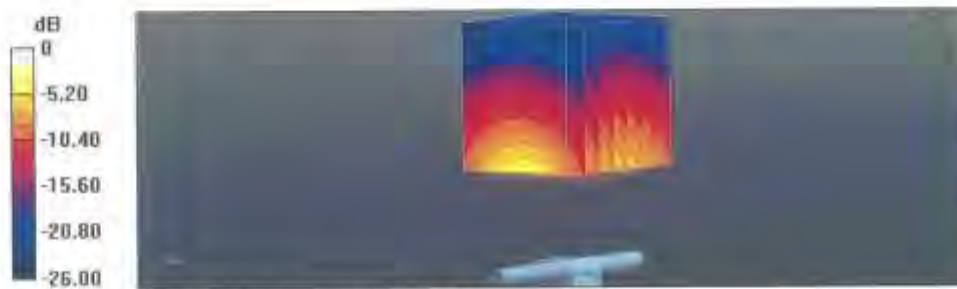
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 119.1 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 28.9 W/kg

**SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.42 W/kg**

Maximum value of SAR (measured) = 24.0 W/kg



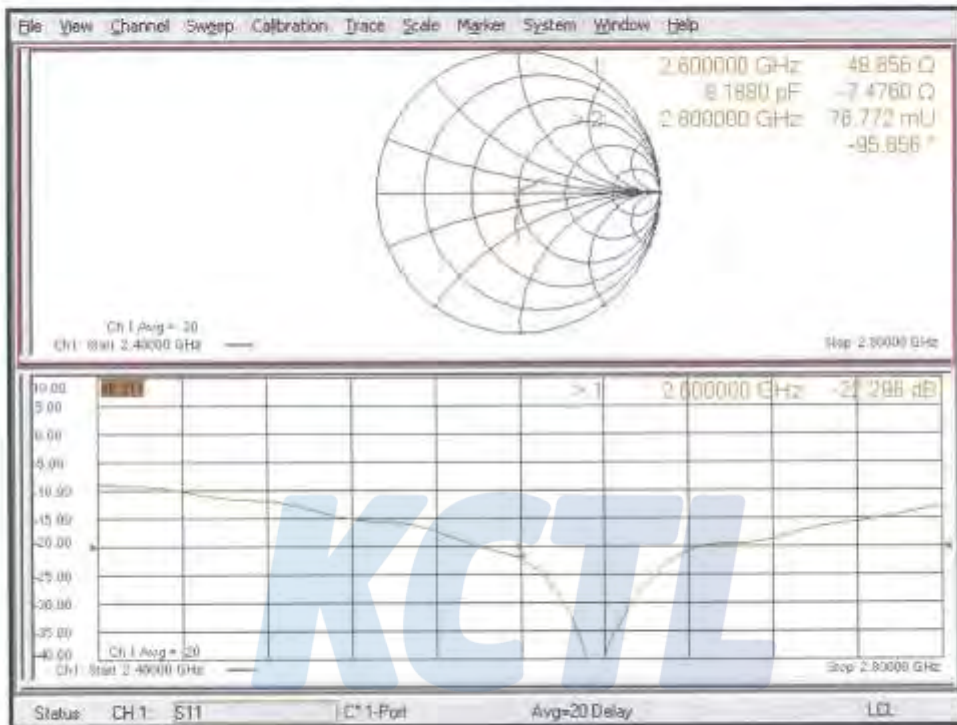
# KCTL Inc.

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](http://www.kctl.co.kr)

Report No.:  
KR19-SPF0032-A  
Page (259) of (308)



## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 26.07.2018

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;  $\sigma = 2.2$  S/m;  $\epsilon_r = 51.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

**DASY52 Configuration:**

- Probe: EX3DV4 - SN7349; ConvF(7.81, 7.81, 7.81) @ 2600 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

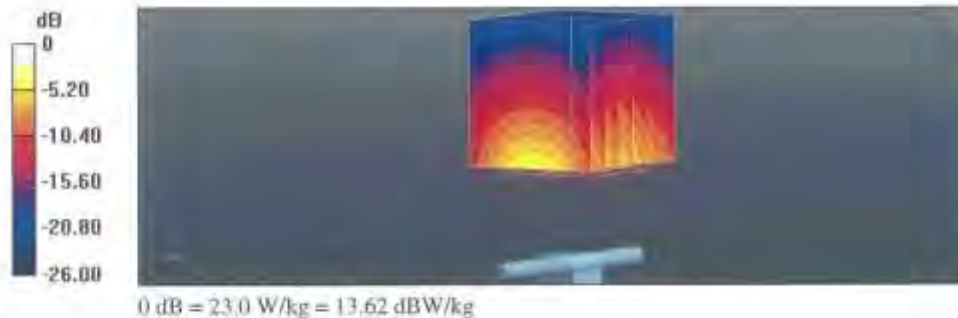
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.6 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.21 W/kg

Maximum value of SAR (measured) = 23.0 W/kg



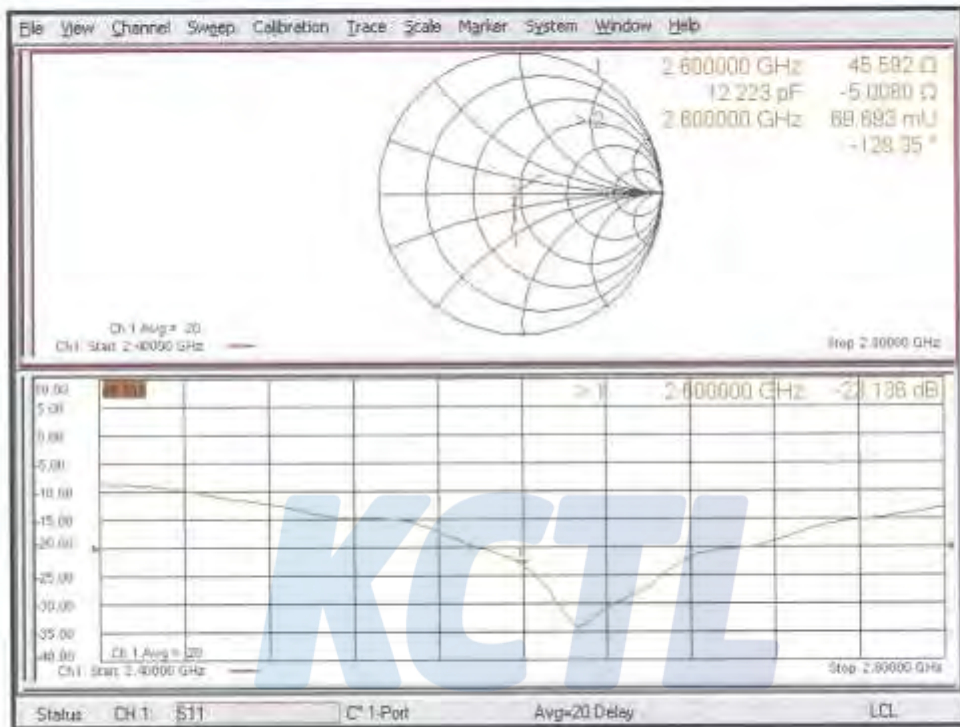
# KCTL Inc.

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Suwon-si, Gyeonggi-do, 16677, Korea  
TEL: 82-31-285-0894 FAX: 82-505-299-8311  
[www.kctl.co.kr](http://www.kctl.co.kr)

Report No.:  
KR19-SPF0032-A  
Page (261) of (308)



## Impedance Measurement Plot for Body TSL



# KCTL Inc.

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Report No.:  
KR19-SPF0032-A  
Page (262) of (308)



## Appendix A.10 Dipole Calibration certificate (D5GHzV2\_1134)

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



S Schweizerischer Kalibrierdienst  
C Service suisse d'étalonnage  
S Servizio svizzero di taratura  
S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client KCTL (Dymstec)

Certificate No: D5GHzV2-1134\_May19

### CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1134

Calibration procedure(s): QA CAL-22.v4  
Calibration Procedure for SAR Validation Sources between 3-6 GHz

Calibration date: May 23, 2019

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         | 03-Apr-19 (No: 217-02892/02893)   | Apr-20                 |
| Power sensor NRP-Z91            | SN: 103244         | 03-Apr-19 (No: 217-02892)         | Apr-20                 |
| Power sensor NRP-Z91            | SN: 103245         | 03-Apr-19 (No: 217-02893)         | Apr-20                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-19 (No: 217-02894)         | Apr-20                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-19 (No: 217-02895)         | Apr-20                 |
| Reference Probe EX3DV4          | SN: 3503           | 25-Mar-19 (No: EX3-3503_Mar19)    | Mar-20                 |
| DAE4                            | SN: 601            | 30-Apr-19 (No: DAE4-601_Apr19)    | Apr-20                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: B830612475     | 30-Oct-14 (in house check Feb-18) | in house check: Oct-20 |
| Power sensor HP 8481A           | SN: USS7292783     | 07-Oct-15 (in house check Oct-18) | in house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | in house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | in house check: Oct-20 |
| Network Analyzer Agilent E8558A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | in house check: Oct-19 |

Calibrated by: Name: Claudio Leubner Function: Laboratory Technician

Approved by: Name: Kadija Pckovic Function: Technical Manager

Issued: May 27, 2019

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Certificate No: D5GHzV2-1134\_May19

Page 1 of 16

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

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:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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

**Measurement Conditions**

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

|                              |                                                                                                                      |                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------|
| DASY Version                 | DASY5                                                                                                                | V52.10.2                         |
| Extrapolation                | Advanced Extrapolation                                                                                               |                                  |
| Phantom                      | Modular Flat Phantom V5.0                                                                                            |                                  |
| Distance Dipole Center - TSL | 10 mm                                                                                                                | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 0.0 mm, dz = 1.4 mm                                                                                         | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5200 MHz $\pm$ 1 MHz<br>5300 MHz $\pm$ 1 MHz<br>5500 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5800 MHz $\pm$ 1 MHz |                                  |

**Head TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 36.0           | 4.66 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 35.4 $\pm$ 6 % | 4.47 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | $\leq$ 0.5 °C       | —              | —                    |

**SAR result with Head TSL at 5200 MHz**

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 100 mW input power | 7.94 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 79.0 W/kg $\pm$ 19.9 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 100 mW input power | 2.27 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.6 W/kg $\pm$ 19.5 % (k=2) |

**Head TSL parameters at 5300 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.9         | 4.76 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.3 ± 6 %   | 4.57 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Head TSL at 5300 MHz**

| SAR averaged over 1 cm <sup>3</sup> (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   | 82.3 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.36 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.4 W/kg ± 19.5 % (k=2) |

**Head TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.6         | 4.96 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.0 ± 6 %   | 4.77 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Head TSL at 5500 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 8.55 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 85.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.42 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.0 W/kg ± 19.5 % (k=2) |

**Head TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.9 ± 6 %   | 4.87 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Head TSL at 5600 MHz**

|                                                       |                    |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
| SAR measured                                          | 100 mW input power | 8.57 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 85.3 W/kg ± 19.9 % (k=2) |

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
| SAR measured                                            | 100 mW input power | 2.44 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.2 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         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.6 ± 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 <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
| SAR measured                                          | 100 mW input power | 7.97 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 79.2 W/kg ± 19.9 % (k=2) |

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

**Body TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 49.0         | 5.30 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 47.2 ± 6 %   | 5.45 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Body TSL at 5200 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.56 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 75.0 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.11 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.9 W/kg ± 19.5 % (k=2) |

**Body TSL parameters at 5300 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.9         | 5.42 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 47.0 ± 6 %   | 5.58 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Body TSL at 5300 MHz**

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.56 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 75.0 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.10 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.8 W/kg ± 19.5 % (k=2) |

**Body TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.6         | 5.65 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 48.6 ± 6 %   | 5.85 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Body TSL at 5500 MHz**

| SAR averaged over 1 cm <sup>2</sup> (1 g) of Body TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.80 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 78.4 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>2</sup> (10 g) of Body TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.18 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.6 W/kg ± 19.5 % (k=2) |

**Body TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.5         | 5.77 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 48.5 ± 6 %   | 5.99 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | —            | —                |

**SAR result with Body TSL at 5600 MHz**

| SAR averaged over 1 cm <sup>2</sup> (1 g) of Body TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 8.02 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 79.6 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>2</sup> (10 g) of Body TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.23 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 22.1 W/kg ± 19.5 % (k=2) |

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Report No.:  
KR19-SPF0032-A  
Page (269) of (308)

**KCTL****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         | 8.00 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.1 ± 6 %   | 6.27 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 <sup>2</sup> (1 g) of Body TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.44 W/kg                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 73.9 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>2</sup> (10 g) of Body TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.06 W/kg                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.4 W/kg ± 19.5 % (k=2) |

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

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $48.0 \Omega - 9.5 j\Omega$ |
| Return Loss                          | $\sim 20.2 \text{ dB}$      |

**Antenna Parameters with Head TSL at 5300 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $46.8 \Omega - 6.5 j\Omega$ |
| Return Loss                          | $\sim 23.5 \text{ dB}$      |

**Antenna Parameters with Head TSL at 5500 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $50.1 \Omega - 4.1 j\Omega$ |
| Return Loss                          | $\sim 27.8 \text{ dB}$      |

**Antenna Parameters with Head TSL at 5600 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $54.1 \Omega - 2.6 j\Omega$ |
| Return Loss                          | $\sim 26.5 \text{ dB}$      |

**Antenna Parameters with Head TSL at 5800 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $55.2 \Omega - 4.0 j\Omega$ |
| Return Loss                          | $\sim 24.1 \text{ dB}$      |

**Antenna Parameters with Body TSL at 5200 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $49.7 \Omega - 7.9 j\Omega$ |
| Return Loss                          | $\sim 22.0 \text{ dB}$      |

**Antenna Parameters with Body TSL at 5300 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $49.5 \Omega - 5.3 j\Omega$ |
| Return Loss                          | $\sim 25.5 \text{ dB}$      |

**Antenna Parameters with Body TSL at 5500 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $52.1 \Omega - 2.6 j\Omega$ |
| Return Loss                          | $\sim 29.8 \text{ dB}$      |

**Antenna Parameters with Body TSL at 5600 MHz**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $55.6 \Omega - 1.7 j\Omega$ |
| Return Loss                          | $\sim 25.1 \text{ dB}$      |

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Report No.:  
KR19-SPF0032-A  
Page (271) of (308)

**Antenna Parameters with Body TSL at 5800 MHz**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 55.5 $\Omega$ - 3.2 j $\Omega$ |
| Return Loss                          | - 24.4 dB                      |

**General Antenna Parameters and Design**

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

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

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

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

**Additional EUT Data**

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



**DASY5 Validation Report for Head TSL**

Date: 22.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.47$  S/m;  $\epsilon_r = 35.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.57$  S/m;  $\epsilon_r = 35.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.77$  S/m;  $\epsilon_r = 35$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.87$  S/m;  $\epsilon_r = 34.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.07$  S/m;  $\epsilon_r = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

**DASY52 Configuration:**

- Probe: EX3DV4 - SN3503; ConvF(5.64, 5.64, 5.64) @ 5200 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(4.96, 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 A/A; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**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 = 76.08 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.27 W/kg

Maximum value of SAR (measured) = 18.2 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 = 77.28 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 29.7 W/kg

SAR(1 g) = 8.27 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 19.2 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 = 76.91 V/m; Power Drift = 0.04 dB

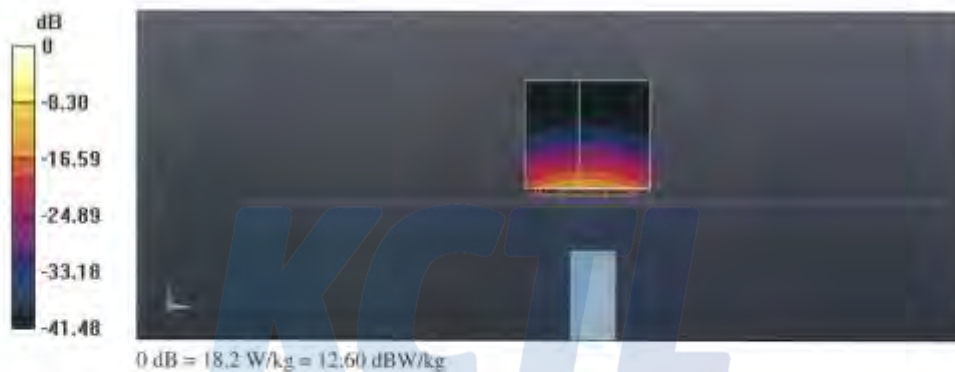
Peak SAR (extrapolated) = 33.2 W/kg

SAR(1 g) = 8.55 W/kg; SAR(10 g) = 2.42 W/kg

Maximum value of SAR (measured) = 20.1 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 77.68 V/m; Power Drift = 0.02 dB  
Peak SAR (extrapolated) = 32.2 W/kg  
**SAR(1 g) = 8.57 W/kg; SAR(10 g) = 2.44 W/kg**  
Maximum value of SAR (measured) = 20.2 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 = 74.08 V/m; Power Drift = 0.02 dB  
Peak SAR (extrapolated) = 32.0 W/kg  
**SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.26 W/kg**  
Maximum value of SAR (measured) = 19.1 W/kg



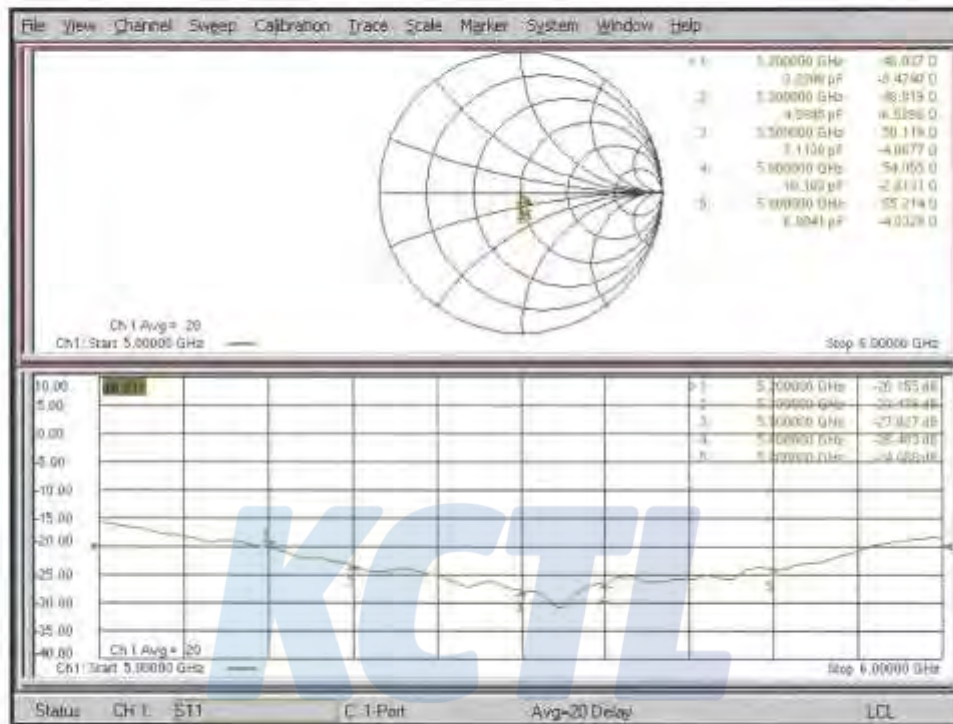
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Report No.:  
KR19-SPF0032-A  
Page (274) of (308)



## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 23.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz  
Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.45$  S/m;  $\epsilon_r = 47.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.58$  S/m;  $\epsilon_r = 47$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.85$  S/m;  $\epsilon_r = 46.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.99$  S/m;  $\epsilon_r = 46.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.27$  S/m;  $\epsilon_r = 46.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14) @ 5200 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) @ 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(1495); SEMCAD X 14.6.12(7450)

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm  
Reference Value = 69.01 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 28.7 W/kg  
**SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.11 W/kg**  
Maximum value of SAR (measured) = 17.5 W/kg

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

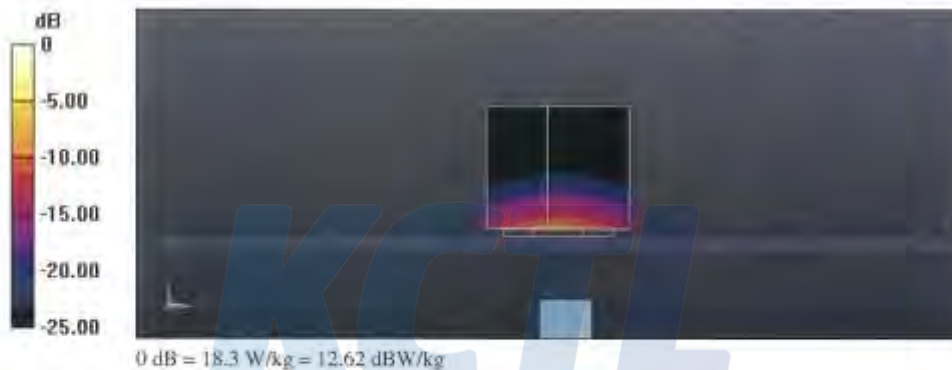
Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm  
Reference Value = 67.76 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 30.0 W/kg  
**SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.1 W/kg**  
Maximum value of SAR (measured) = 17.9 W/kg

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

Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm  
Reference Value = 68.53 V/m; Power Drift = -0.00 dB  
Peak SAR (extrapolated) = 33.2 W/kg  
**SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.18 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 = 68.29 V/m; Power Drift = 0.05 dB  
Peak SAR (extrapolated) = 34.8 W/kg  
**SAR(1 g) = 8.02 W/kg; SAR(10 g) = 2.23 W/kg**  
Maximum value of SAR (measured) = 19.7 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 = 65.93 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 32.8 W/kg  
**SAR(1 g) = 7.44 W/kg; SAR(10 g) = 2.06 W/kg**  
Maximum value of SAR (measured) = 18.3 W/kg



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Report No.:  
KR19-SPF0032-A  
Page (277) of (308)



## Impedance Measurement Plot for Body TSL



**Appendix A.11 Justification for Extended SAR Dipole Calibrations**

Instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements

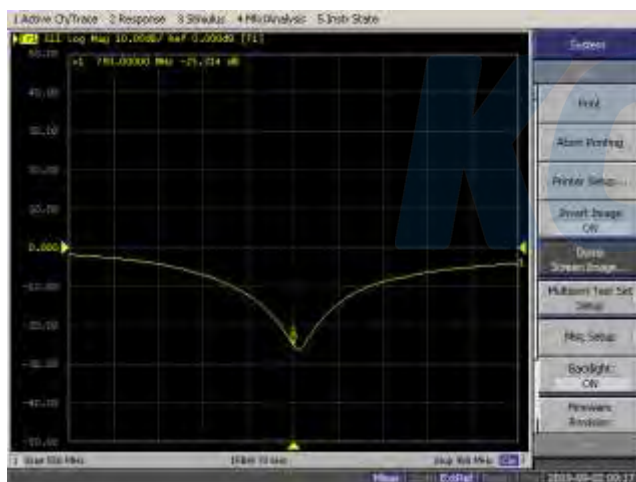
KDB 865664 D01v01r04 requirements

a) Return loss: < - 20 dB, within 20 % of previous measurement

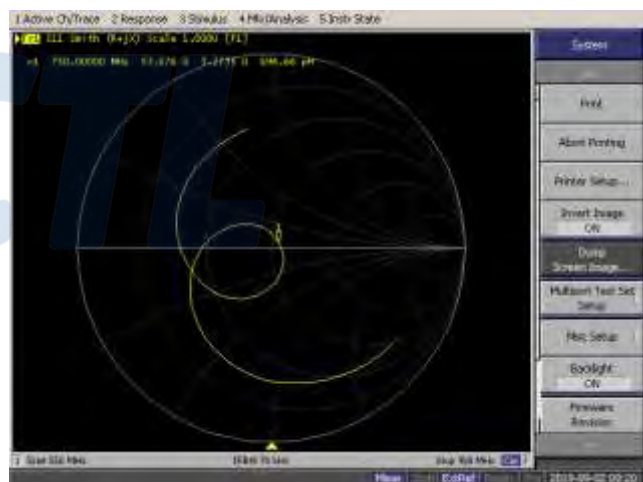
b) Impedance: within 5  $\Omega$  from previous measurement.

750 MHz

| Dipole Antenna    | Head/Body | Date of Measurement | Return Loss (dB) | $\Delta$ % | Impedance ( $\Omega$ ) | $\Delta$ $\Omega$ |
|-------------------|-----------|---------------------|------------------|------------|------------------------|-------------------|
| D750V3<br>SN 1183 | Head      | 2018.09.03          | -26.9            | 5.9        | 54.2                   | 0.5               |
|                   |           | 2019.09.02          | -25.3            |            | 53.7                   |                   |



< Figure 1. Measurement result of Head Return Loss>



< Figure 2. Measurement result of Head Impedance>

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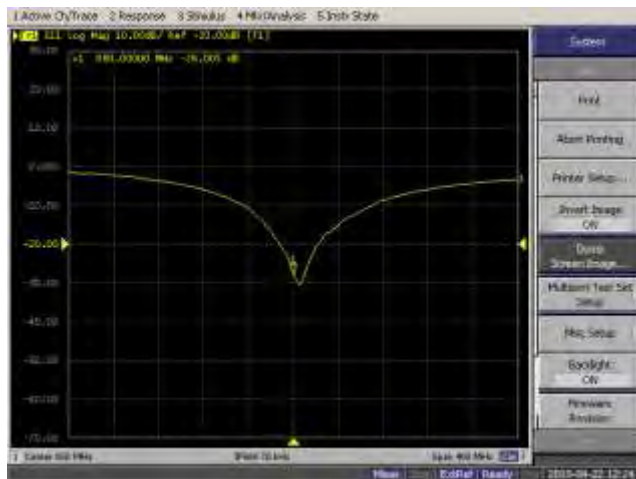
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Report No.:  
KR19-SPF0032-A  
Page (279) of (308)



## 850 MHz

| Dipole Antenna    | Head/Body | Date of Measurement | Return Loss (dB) | $\Delta$ % | Impedance ( $\Omega$ ) | $\Delta$ $\Omega$ |
|-------------------|-----------|---------------------|------------------|------------|------------------------|-------------------|
| D850V3<br>SN 1006 | Head      | 2018.04.20          | -28.7            | 2.4        | 52.5                   | 2.5               |
|                   |           | 2019.04.22          | -28.0            |            | 50.0                   |                   |



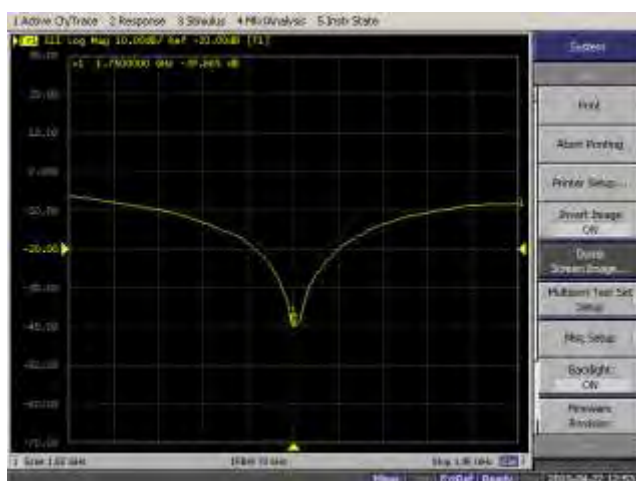
< Figure 1. Measurement result of Head Return Loss >



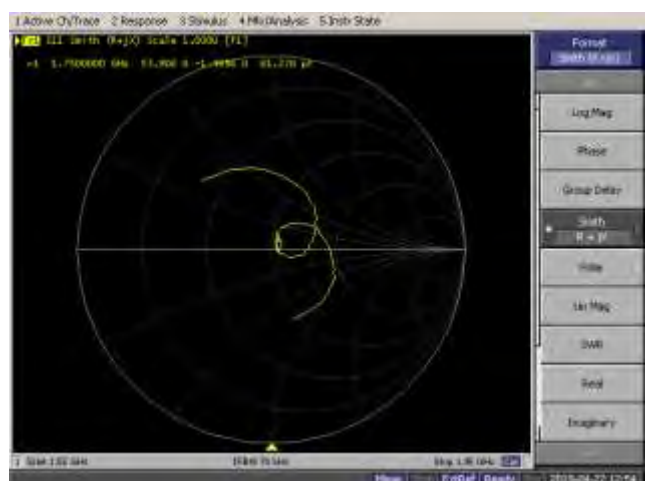
< Figure 2. Measurement result of Head Impedance >

## 1750 MHz

| Dipole Antenna     | Head/Body | Date of Measurement | Return Loss (dB) | $\Delta$ % | Impedance ( $\Omega$ ) | $\Delta$ $\Omega$ |
|--------------------|-----------|---------------------|------------------|------------|------------------------|-------------------|
| D1750V3<br>SN 1072 | Head      | 2018.04.19          | -44.8            | 11.0       | 50.5                   | 3.4               |
|                    |           | 2019.04.22          | -39.9            |            | 53.9                   |                   |



< Figure 1. Measurement result of Head Return Loss >



< Figure 2. Measurement result of Head Impedance >

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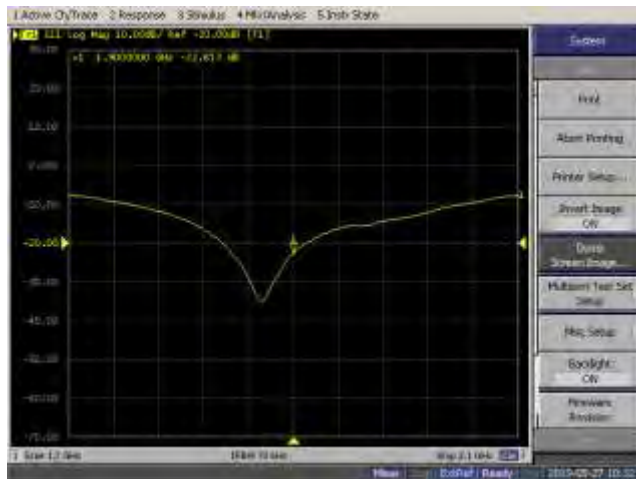
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Report No.:  
KR19-SPF0032-A  
Page (280) of (308)

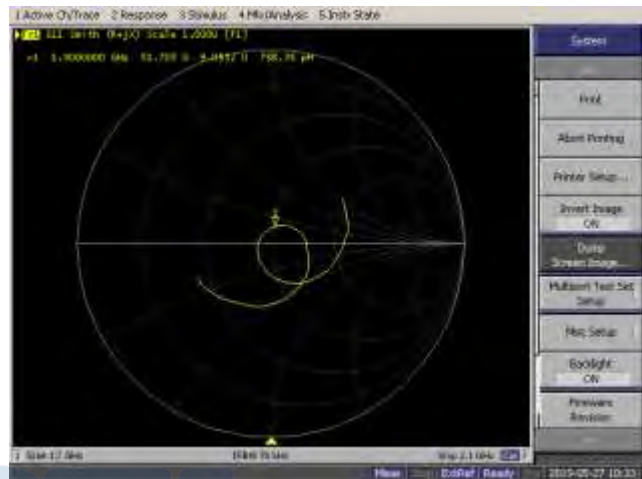


## 1900 MHz

| Dipole Antenna   | Head/Body | Date of Measurement | Return Loss (dB) | $\Delta$ % | Impedance ( $\Omega$ ) | $\Delta$ $\Omega$ |
|------------------|-----------|---------------------|------------------|------------|------------------------|-------------------|
| D1900V2<br>5d160 | Head      | 2018.04.25          | -25.0            | 8.7        | 51.1                   | 0.6               |
|                  |           | 2019.05.27          | -22.8            |            | 51.7                   |                   |



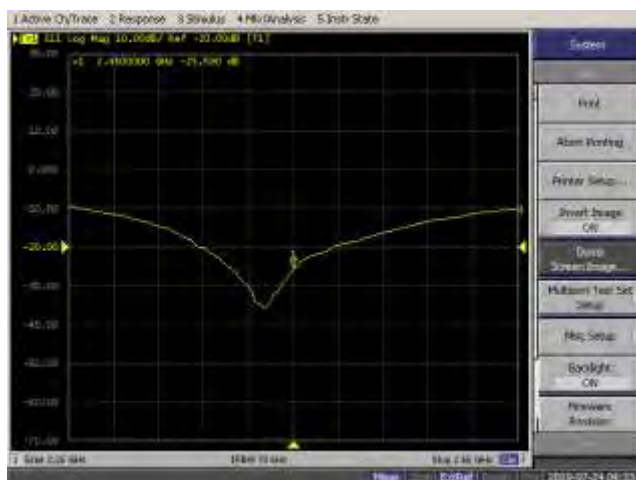
< Figure 1. Measurement result of Head Return Loss>



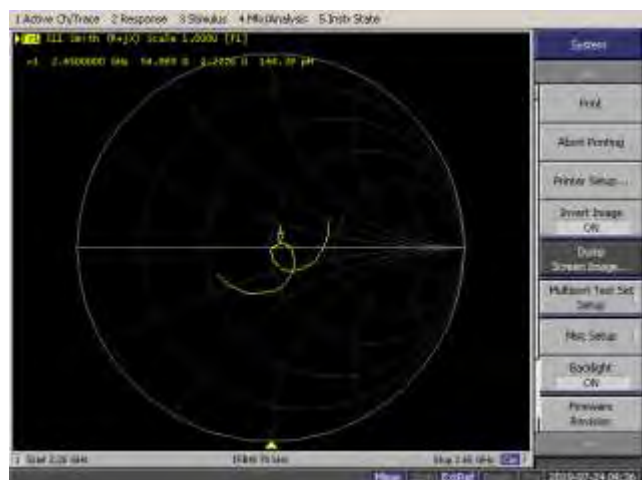
< Figure 2. Measurement result of Head Impedance>

## 2450 MHz

| Dipole Antenna | Head/Body | Date of Measurement | Return Loss (dB) | $\Delta$ % | Impedance ( $\Omega$ ) | $\Delta$ $\Omega$ |
|----------------|-----------|---------------------|------------------|------------|------------------------|-------------------|
| D2450V2<br>895 | Head      | 2018.07.24          | -27.9            | 8.3        | 53.8                   | 1.2               |
|                |           | 2019.07.24          | -25.6            |            | 55.0                   |                   |



< Figure 1. Measurement result of Head Return Loss>



< Figure 2. Measurement result of Head Impedance>

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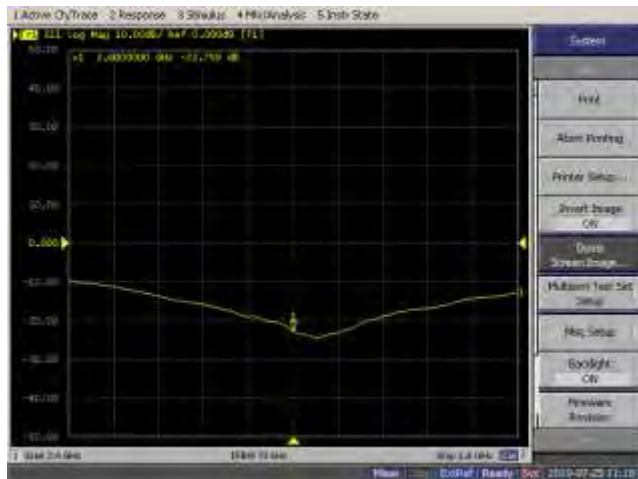
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Report No.:  
KR19-SPF0032-A  
Page (281) of (308)



## 2600 MHz

| Dipole Antenna     | Head/Body | Date of Measurement | Return Loss (dB) | $\Delta$ % | Impedance ( $\Omega$ ) | $\Delta$ $\Omega$ |
|--------------------|-----------|---------------------|------------------|------------|------------------------|-------------------|
| D2600V2<br>SN 1050 | Head      | 2018.07.26          | -22.3            | 2.24       | 48.7                   | 0.8               |
|                    |           | 2019.07.25          | -22.8            |            | 47.9                   |                   |



< Figure 1. Measurement result of Head Return Loss>



< Figure 2. Measurement result of Head Impedance>

c) Extrapolated peak SAR: within 15% of that reported in the calibration data

#### 750 MHz

| Dipole Antenna    | Head/Body | Date of Measurement | Extrapolated peak SAR (W/kg) | Δ % |
|-------------------|-----------|---------------------|------------------------------|-----|
| D750V2<br>SN 1183 | Head      | 2018.09.03          | 12.32                        | -   |
|                   |           | 2019.10.28          | 12.12                        | 1.6 |
|                   |           | 2019.10.29          | 12.12                        | 1.6 |

#### 850 MHz

| Dipole Antenna    | Head/Body | Date of Measurement | Extrapolated peak SAR (W/kg) | Δ % |
|-------------------|-----------|---------------------|------------------------------|-----|
| D850V2<br>SN 1006 | Head      | 2018.04.20          | 15.36                        | -   |
|                   |           | 2019.10.24          | 14.88                        | 3.1 |
|                   |           | 2019.10.25          | 15.08                        | 1.8 |
|                   |           | 2019.10.26          | 14.24                        | 7.3 |
|                   |           | 2019.10.31          | 14.44                        | 6.0 |

#### 1750 MHz

| Dipole Antenna     | Head/Body | Date of Measurement | Extrapolated peak SAR (W/kg) | Δ %  |
|--------------------|-----------|---------------------|------------------------------|------|
| D1750V3<br>SN 1072 | Head      | 2018.04.19          | 67.2                         | -    |
|                    |           | 2019.10.29          | 76.8                         | 14.3 |
|                    |           | 2019.11.03          | 70.4                         | 4.8  |

#### 1900 MHz

| Dipole Antenna      | Head/Body | Date of Measurement | Extrapolated peak SAR (W/kg) | Δ %  |
|---------------------|-----------|---------------------|------------------------------|------|
| D1900V2<br>SN 5d160 | Head      | 2018.04.25          | 72.0                         | -    |
|                     |           | 2019.10.30          | 82.4                         | 14.4 |
|                     |           | 2019.10.31          | 82.0                         | 13.9 |
|                     |           | 2019.11.01          | 80.8                         | 12.2 |

#### 2450 MHz

| Dipole Antenna    | Head/Body | Date of Measurement | Extrapolated peak SAR (W/kg) | Δ %  |
|-------------------|-----------|---------------------|------------------------------|------|
| D2450V2<br>SN 895 | Head      | 2018.07.24          | 104.4                        | -    |
|                   |           | 2019.11.13          | 118.0                        | 13.0 |
|                   |           | 2019.11.14          | 116.0                        | 11.1 |

#### 2600 MHz

| Dipole Antenna     | Head/Body | Date of Measurement | Extrapolated peak SAR (W/kg) | Δ %  |
|--------------------|-----------|---------------------|------------------------------|------|
| D2600V2<br>SN 1050 | Head      | 2018.07.26          | 115.6                        | -    |
|                    |           | 2019.11.12          | 132.0                        | 14.2 |
|                    |           | 2019.11.13          | 132.0                        | 14.2 |
|                    |           | 2019.11.14          | 132.0                        | 14.2 |

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Report No.:  
KR19-SPF0032-A  
Page (283) of (308)



## 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 |
| <b>Tissue parameter target by C. Gabriel and G. Harts grove.</b>                             |             |       |       |       |                             |       |       |       |               |       |
| 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. Downlink LTE CA RF Conducted Power

### C.1 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 |
|----------------------------------|------------|--------------|--------------------------------------------|
| <b>Intra-Band Contiguous</b>     |            |              |                                            |
| 2CC #1                           | CA_2C      | N/A          | NO                                         |
| 2CC #2                           | CA_5B      | N/A          | NO                                         |
| 2CC #3                           | CA_41C     | N/A          | NO                                         |
| 2CC #4                           | CA_66B     | N/A          | NO                                         |
| 2CC #5                           | CA_66C     | N/A          | NO                                         |
| <b>Intra-Band Non Contiguous</b> |            |              |                                            |
| 2CC #6                           | CA_2A-2A   | N/A          | NO                                         |
| 2CC #7                           | CA_4A-4A   | N/A          | NO                                         |
| 2CC #8                           | CA_5A-5A   | N/A          | NO                                         |
| 2CC #9                           | CA_41A-41A | N/A          | NO                                         |
| 2CC #10                          | CA_66A-66A | N/A          | NO                                         |
| <b>Inter-Band</b>                |            |              |                                            |
| 2CC #11                          | CA_2A-5A   | N/A          | NO                                         |
| 2CC #12                          | CA_2A-12A  | N/A          | NO                                         |
| 2CC #13                          | CA_2A-13A  | N/A          | NO                                         |
| 2CC #14                          | CA_2A-17A  | N/A          | NO                                         |
| 2CC #16                          | CA_4A-5A   | N/A          | NO                                         |
| 2CC #17                          | CA_4A-12A  | N/A          | NO                                         |
| 2CC #18                          | CA_4A-13A  | N/A          | NO                                         |
| 2CC #19                          | CA_4A-17A  | N/A          | NO                                         |
| 2CC #20                          | CA_5A-41A  | B41 SCC Only | NO                                         |
| 2CC #21                          | CA_12A-66A | N/A          | NO                                         |

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.

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Report No.:  
KR19-SPF0032-A  
Page (285) of (308)

**C.2 Downlink Carrier Aggregation RF Conducted Powers****C.2.1 LTE Band 2 as PCC**

| Combination      | PCC    |          |          |                  |      |              |                |          |                  | SCC     |          |          |                  | 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] | LTE Tx. Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_2C (0)        | LTE B2 | 20       | 18700    | 1860.0           | QPSK | 1            | 0              | 700      | 1940.0           | LTE B2  | 20       | 898      | 1959.8           | 23.66                                  | 23.71                             |
| CA_2A-2A (0)     | LTE B2 | 20       | 18700    | 1860.0           | QPSK | 1            | 0              | 700      | 1940.0           | LTE B2  | 20       | 1100     | 1980.0           | 23.63                                  | 23.71                             |
| CA_2A-5A (0)     | LTE B2 | 20       | 18700    | 1860.0           | QPSK | 1            | 0              | 700      | 1940.0           | LTE B5  | 10       | 2525     | 881.5            | 23.62                                  | 23.71                             |
| CA_2A-5A (1)     | LTE B2 | 10       | 18900    | 1880.0           | QPSK | 1            | 0              | 900      | 1960.0           | LTE B5  | 10       | 2525     | 881.5            | 23.60                                  | 23.65                             |
| CA_2A-12A (0)(1) | LTE B2 | 20       | 18700    | 1860.0           | QPSK | 1            | 0              | 700      | 1940.0           | LTE B12 | 10       | 5095     | 737.5            | 23.65                                  | 23.71                             |
| CA_2A-12A (2)    | LTE B2 | 10       | 18900    | 1880.0           | QPSK | 1            | 0              | 900      | 1960.0           | LTE B12 | 10       | 5095     | 737.5            | 23.61                                  | 23.65                             |
| CA_2A-13A (0)    | LTE B2 | 20       | 18700    | 1860.0           | QPSK | 1            | 0              | 700      | 1940.0           | LTE B13 | 10       | 5230     | 751.0            | 23.67                                  | 23.71                             |
| CA_2A-13A (1)    | LTE B2 | 10       | 18900    | 1880.0           | QPSK | 1            | 0              | 900      | 1960.0           | LTE B13 | 10       | 5230     | 751.0            | 23.58                                  | 23.65                             |
| CA_2A-17A (0)    | LTE B2 | 10       | 18900    | 1880.0           | QPSK | 1            | 0              | 900      | 1960.0           | LTE B17 | 10       | 5790     | 740.0            | 23.57                                  | 23.65                             |

**C.2.2 LTE Band 4 as PCC**

| Combination         | PCC    |          |          |                  |      |              |                |          |                  | SCC     |          |          |                  | 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] | LTE Tx. Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_4A-4A (0)        | LTE B4 | 20       | 20175    | 1732.5           | QPSK | 1            | 0              | 2175     | 2132.5           | LTE B4  | 20       | 2300     | 2145.0           | 22.72                                  | 22.79                             |
| CA_4A-4A (1)        | LTE B4 | 10       | 20350    | 1750.0           | QPSK | 1            | 0              | 2350     | 2150.0           | LTE B4  | 10       | 2000     | 2115.0           | 22.70                                  | 22.75                             |
| CA_4A-5A (0)        | LTE B4 | 10       | 20350    | 1750.0           | QPSK | 1            | 0              | 2350     | 2150.0           | LTE B5  | 10       | 2525     | 881.5            | 22.68                                  | 22.75                             |
| CA_4A-5A (1)        | LTE B4 | 20       | 20175    | 1732.5           | QPSK | 1            | 0              | 2175     | 2132.5           | LTE B5  | 10       | 2525     | 881.5            | 22.70                                  | 22.79                             |
| CA_4A-12A (0)(3)    | LTE B4 | 10       | 20350    | 1750.0           | QPSK | 1            | 0              | 2350     | 2150.0           | LTE B12 | 10       | 5095     | 737.5            | 22.66                                  | 22.75                             |
| CA_4A-12A (1)(2)(4) | LTE B4 | 20       | 20175    | 1732.5           | QPSK | 1            | 0              | 2175     | 2132.5           | LTE B12 | 10       | 5095     | 737.5            | 22.69                                  | 22.79                             |
| CA_4A-12A (5)       | LTE B4 | 15       | 20325    | 1747.5           | QPSK | 1            | 36             | 2325     | 2147.5           | LTE B12 | 5        | 5095     | 737.5            | 22.61                                  | 22.68                             |
| CA_4A-13A (0)       | LTE B4 | 20       | 20175    | 1732.5           | QPSK | 1            | 0              | 2175     | 2132.5           | LTE B13 | 10       | 5230     | 751.0            | 22.72                                  | 22.79                             |
| CA_4A-13A (1)       | LTE B4 | 10       | 20350    | 1750.0           | QPSK | 1            | 0              | 2350     | 2150.0           | LTE B13 | 10       | 5230     | 751.0            | 22.70                                  | 22.75                             |
| CA_4A-17A (0)       | LTE B4 | 5        | 20375    | 1752.5           | QPSK | 1            | 0              | 2375     | 2152.5           | LTE B17 | 5        | 5790     | 740.0            | 22.69                                  | 22.75                             |

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Report No.:  
KR19-SPF0032-A  
Page (286) of (308)

**C.2.3 LTE Band 5 as PCC**

| Combination   | PCC    |          |          |                  |      |              |                |          |                  | SCC     |          |          |                  | 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] | LTE Tx. Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_5B (0)     | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B5  | 5        | 2597     | 888.7            | 24.41                                  | 24.45                             |
| CA_5B (1)     | LTE B5 | 5        | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B5  | 3        | 2564     | 885.4            | 24.35                                  | 24.41                             |
| CA_2A-5A (0)  | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B2  | 20       | 900      | 1960.0           | 24.39                                  | 24.45                             |
| CA_2A-5A (1)  | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B2  | 10       | 900      | 1960.0           | 24.42                                  | 24.45                             |
| CA_4A-5A (0)  | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B4  | 10       | 2175     | 2132.5           | 24.40                                  | 24.45                             |
| CA_4A-5A (1)  | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B4  | 20       | 2175     | 2132.5           | 24.41                                  | 24.45                             |
| CA_5A-5A (0)  | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B5  | 5        | 2625     | 891.5            | 24.42                                  | 24.45                             |
| CA_5A-5A (1)  | LTE B5 | 5        | 20525    | 836.5            | QPSK | 1            | 24             | 2525     | 881.5            | LTE B5  | 3        | 2635     | 892.5            | 24.36                                  | 24.41                             |
| CA_5A-41A (0) | LTE B5 | 10       | 20525    | 836.5            | QPSK | 1            | 0              | 2525     | 881.5            | LTE B41 | 20       | 40620    | 2593.0           | 24.42                                  | 24.45                             |

**C.2.4 LTE Band 12 as PCC**

| Combination          | PCC     |          |          |                  |      |              |                |          |                  | SCC     |          |          |                  | 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] | LTE Tx. Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_12A-66A (0)(3)    | LTE B12 | 10       | 23095    | 707.5            | QPSK | 1            | 0              | 5095     | 737.5            | LTE B66 | 10       | 66786    | 2145.0           | 24.23                                  | 24.28                             |
| CA_12A-66A (1)(2)(4) | LTE B12 | 10       | 23095    | 707.5            | QPSK | 1            | 0              | 5095     | 737.5            | LTE B66 | 20       | 66786    | 2145.0           | 24.22                                  | 24.28                             |
| CA_12A-66A (5)       | LTE B12 | 5        | 23035    | 701.5            | QPSK | 1            | 12             | 5035     | 731.5            | LTE B66 | 15       | 66786    | 2145.0           | 24.20                                  | 24.27                             |
| CA_2A-12A (0)(1)     | LTE B12 | 10       | 23095    | 707.5            | QPSK | 1            | 0              | 5095     | 737.5            | LTE B2  | 20       | 900      | 1960.0           | 24.21                                  | 24.28                             |
| CA_2A-12A (2)        | LTE B12 | 10       | 23095    | 707.5            | QPSK | 1            | 0              | 5095     | 737.5            | LTE B2  | 10       | 900      | 1960.0           | 24.23                                  | 24.28                             |
| CA_4A-12A (0)(3)     | LTE B12 | 10       | 23095    | 707.5            | QPSK | 1            | 0              | 5095     | 737.5            | LTE B4  | 10       | 2175     | 2132.5           | 24.25                                  | 24.28                             |
| CA_4A-12A (1)(2)(4)  | LTE B12 | 10       | 23095    | 707.5            | QPSK | 1            | 0              | 5095     | 737.5            | LTE B4  | 20       | 2175     | 2132.5           | 24.21                                  | 24.28                             |
| CA_4A-12A (5)        | LTE B12 | 5        | 23035    | 701.5            | QPSK | 1            | 12             | 5035     | 731.5            | LTE B4  | 15       | 2175     | 2132.5           | 24.19                                  | 24.27                             |

**D.2.5 LTE Band 41 as PCC**

| Combination         | PCC     |          |          |                  |      |              |                |          |                  | SCC     |          |          |                  | 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] | LTE Tx. Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA_41C (0)(1)(2)(3) | LTE B41 | 20       | 40620    | 2593.0           | QPSK | 1            | 0              | 40620    | 2593.0           | LTE B41 | 20       | 40818    | 2612.8           | 24.11                                  | 24.15                             |
| CA_41A-41A (0)(1)   | LTE B41 | 20       | 40620    | 2593.0           | QPSK | 1            | 0              | 40620    | 2593.0           | LTE B41 | 20       | 41490    | 2680.0           | 24.09                                  | 24.15                             |

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Report No.:  
KR19-SPF0032-A  
Page (287) of (308)

**C.2.6 LTE Band 66 as PCC**

| Combination             | PCC        |             |             |                     |      |                    |                      |             |                        | SCC        |             |             |                     | Power                                        |                                         |
|-------------------------|------------|-------------|-------------|---------------------|------|--------------------|----------------------|-------------|------------------------|------------|-------------|-------------|---------------------|----------------------------------------------|-----------------------------------------|
|                         | Band       | BW<br>[MHz] | (UL)<br>Ch. | (UL)<br>Freq. [MHz] | Mod. | (UL)<br>RB<br>Size | (UL)<br>RB<br>Offset | (DL)<br>Ch. | (DL)<br>Freq.<br>[MHz] | Band       | BW<br>[MHz] | (DL)<br>Ch. | (DL)<br>Freq. [MHz] | LTE Tx. Power<br>with DL CA<br>Enabled (dBm) | LTE Single<br>Carrier Tx Power<br>(dBm) |
| CA_66B<br>(0)           | LTE<br>B66 | 15          | 132597      | 1772.5              | QPSK | 1                  | 74                   | 67061       | 2172.5                 | LTE<br>B66 | 5           | 66968       | 2163.2              | 23.30                                        | 23.38                                   |
| CA_66C<br>(0)           | LTE<br>B66 | 20          | 132072      | 1720.0              | QPSK | 1                  | 0                    | 66536       | 2120.0                 | LTE<br>B66 | 20          | 66734       | 2139.8              | 23.44                                        | 23.49                                   |
| CA_66A-66A<br>(0)       | LTE<br>B66 | 20          | 132072      | 1720.0              | QPSK | 1                  | 0                    | 66536       | 2120.0                 | LTE<br>B66 | 20          | 66536       | 2120.0              | 23.45                                        | 23.49                                   |
| CA_12A-66A<br>(0)(3)    | LTE<br>B66 | 10          | 132022      | 1715.0              | QPSK | 1                  | 49                   | 66486       | 2115.0                 | LTE<br>B12 | 10          | 5095        | 737.5               | 23.41                                        | 23.47                                   |
| CA_12A-66A<br>(1)(2)(4) | LTE<br>B66 | 20          | 132072      | 1720.0              | QPSK | 1                  | 0                    | 66536       | 2170.0                 | LTE<br>B12 | 10          | 5095        | 737.5               | 23.45                                        | 23.49                                   |
| CA_12A-66A<br>(5)       | LTE<br>B66 | 15          | 132597      | 1772.5              | QPSK | 1                  | 74                   | 67061       | 2172.5                 | LTE<br>B12 | 5           | 5095        | 737.5               | 23.32                                        | 23.38                                   |