

Test Laboratory: Huatongwei International Inspection Co., Ltd.,SAR Lab

Date: 6/26/2019

**LTE Band 5-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 829 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 829$  MHz;  $\sigma = 0.929$  S/m;  $\epsilon_r = 43.943$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.1°C;Liquid Temperature:21.9°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.41, 10.41, 10.41) @ 829 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 20450/Area Scan (61x131x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.123 W/kg

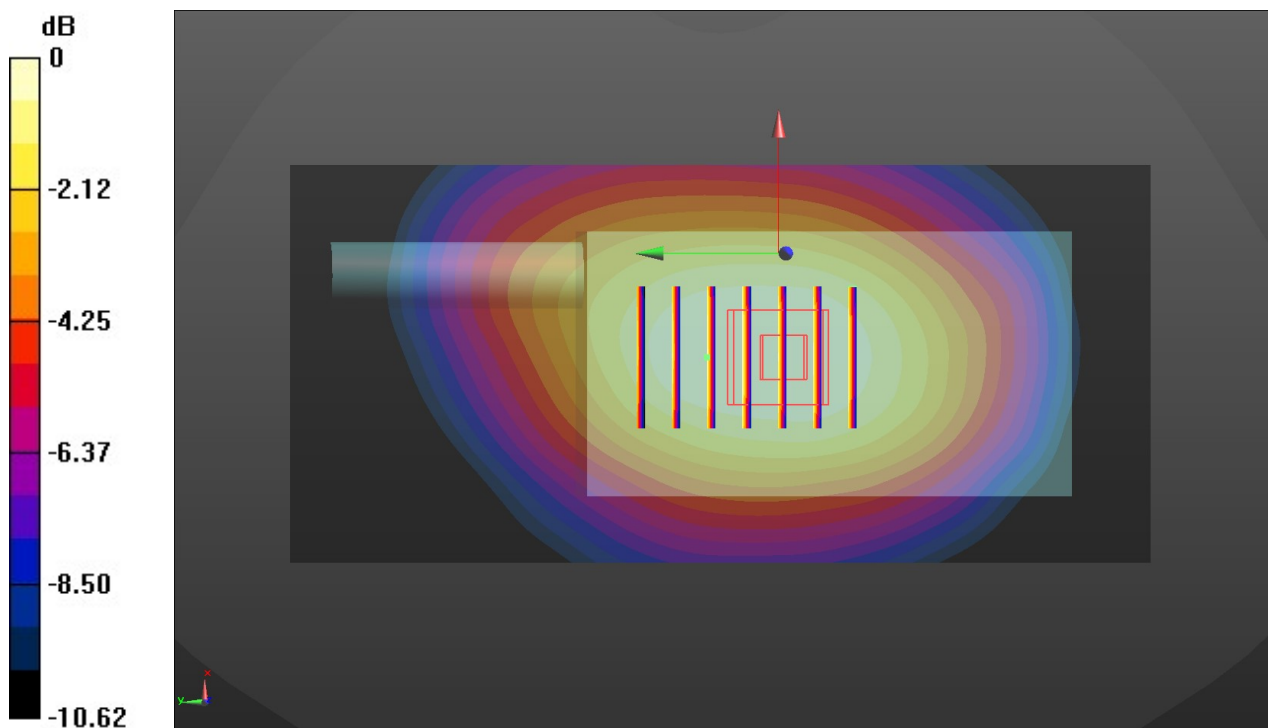
**Rear/CH 20450/Zoom Scan (5x7x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.17 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 0.131 W/kg

**SAR(1 g) = 0.091 W/kg; SAR(10 g) = 0.065 W/kg**[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.116 W/kg



0 dB = 0.116 W/kg = -9.36 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd.,SAR Lab

Date: 7/2/2019

**LTE Band 7-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 2510 MHz;Duty Cycle: 1:1

Medium parameters used:  $f = 2510$  MHz;  $\sigma = 1.898$  S/m;  $\epsilon_r = 40.794$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.0°C;Liquid Temperature:21.8°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(7.9, 7.9, 7.9) @ 2510 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 20850/Area Scan (81x161x1):** Interpolated grid:  $dx=1.200$  mm,  $dy=1.200$  mm  
 Maximum value of SAR (interpolated) = 0.0992 W/kg

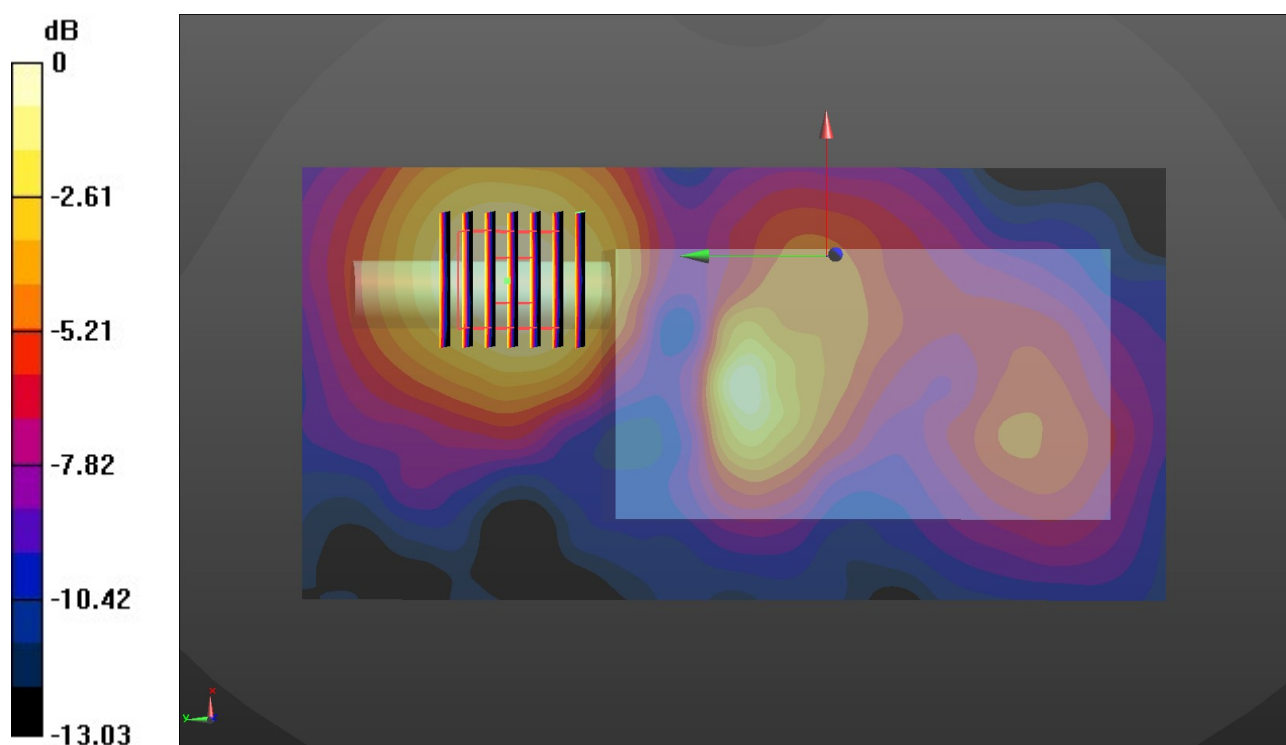
**Rear/CH 20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 7.001 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 0.117 W/kg

**SAR(1 g) = 0.063 W/kg; SAR(10 g) = 0.035 W/kg**

Maximum value of SAR (measured) = 0.0964 W/kg



0 dB = 0.0964 W/kg = -10.16 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd.,SAR Lab

Date: 7/1/2019

**LTE Band 12-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 711$  MHz;  $\sigma = 0.883$  S/m;  $\epsilon_r = 44.331$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:21.9°C;Liquid Temperature:21.7°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.74, 10.74, 10.74) @ 711 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 23130/Area Scan (61x131x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0561 W/kg

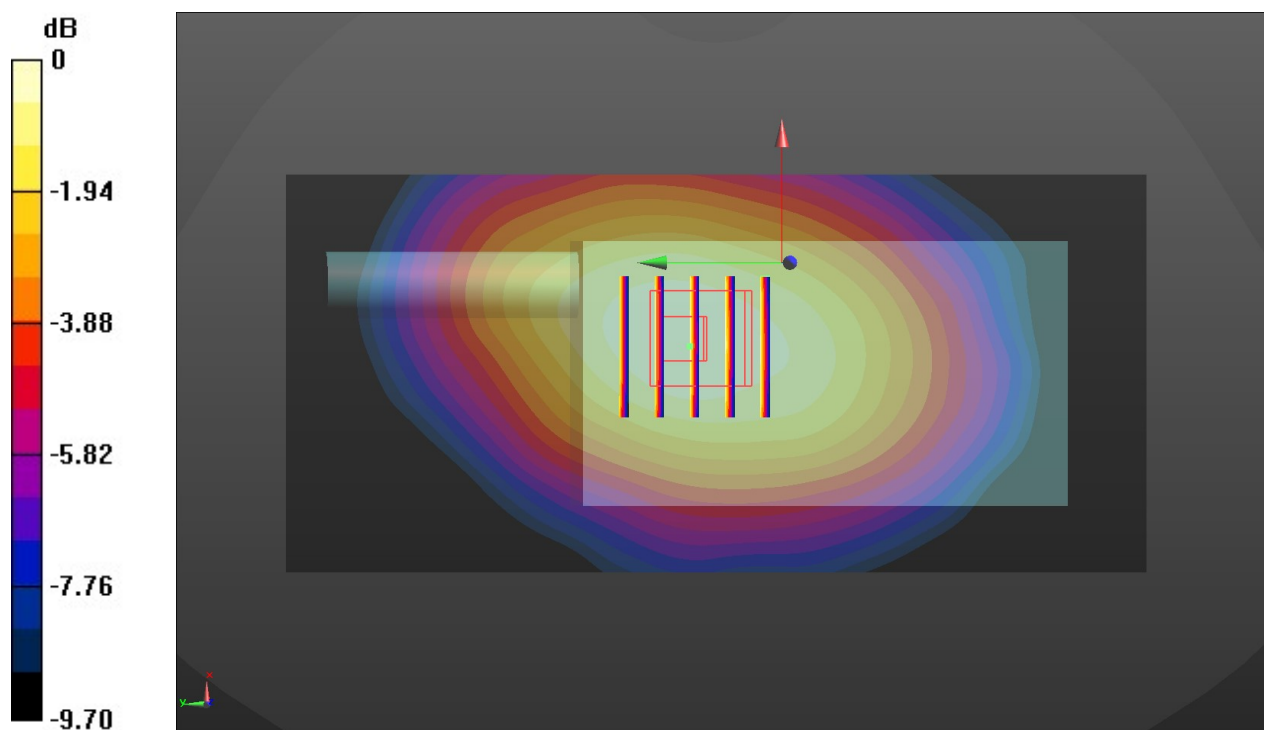
**Rear/CH 23130/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.704 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.0630 W/kg

**SAR(1 g) = 0.043 W/kg; SAR(10 g) = 0.031 W/kg**[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0555 W/kg



0 dB = 0.0555 W/kg = -12.56 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd., SAR Lab

Date: 7/1/2019

**LTE Band 13-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 782 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 782$  MHz;  $\sigma = 0.911$  S/m;  $\epsilon_r = 44.168$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.1°C; Liquid Temperature: 21.9°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.74, 10.74, 10.74) @ 782 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 23230/Area Scan (61x131x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.111 W/kg

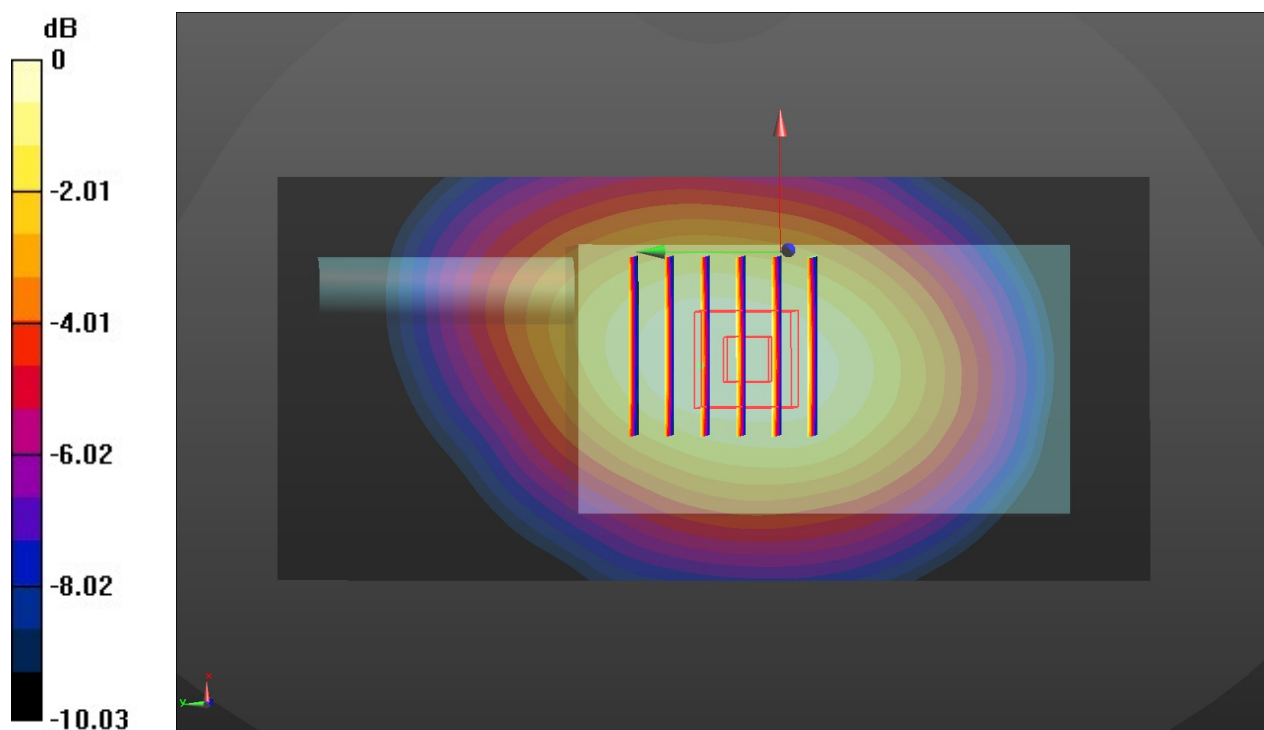
**Rear/CH 23230/Zoom Scan (6x6x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.91 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.122 W/kg

**SAR(1 g) = 0.085 W/kg; SAR(10 g) = 0.061 W/kg**[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.108 W/kg



0 dB = 0.108 W/kg = -9.67 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd.,SAR Lab

Date: 7/1/2019

**LTE Band 17-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 711$  MHz;  $\sigma = 0.883$  S/m;  $\epsilon_r = 44.331$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.2°C;Liquid Temperature:21.9°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.74, 10.74, 10.74) @ 711 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 23800/Area Scan (61x131x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0603 W/kg

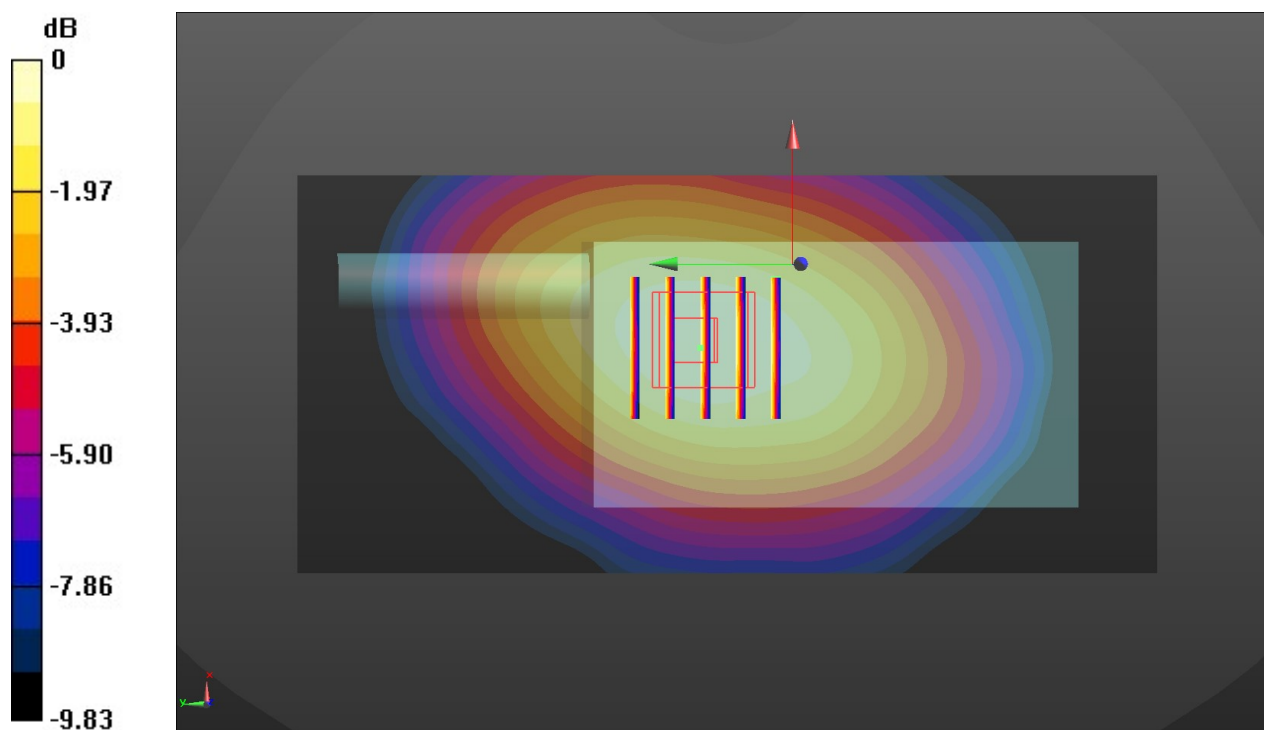
**Rear/CH 23800/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.088 V/m; Power Drift = -0.18 dB

Peak SAR (extrapolated) = 0.0670 W/kg

**SAR(1 g) = 0.046 W/kg; SAR(10 g) = 0.033 W/kg**[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0589 W/kg



0 dB = 0.0589 W/kg = -12.30 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd.,SAR Lab

Date: 7/1/2019

**LTE Band 25-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 1860 MHz;Duty Cycle: 1:1  
 Medium parameters used:  $f = 1860$  MHz;  $\sigma = 1.443$  S/m;  $\epsilon_r = 41.755$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.3°C;Liquid Temperature:22.0°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.57, 8.57, 8.57) @ 1860 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 26140/Area Scan (61x131x1):** Interpolated grid:  $dx=1.500$  mm,  $dy=1.500$  mm  
 Maximum value of SAR (interpolated) = 0.113 W/kg

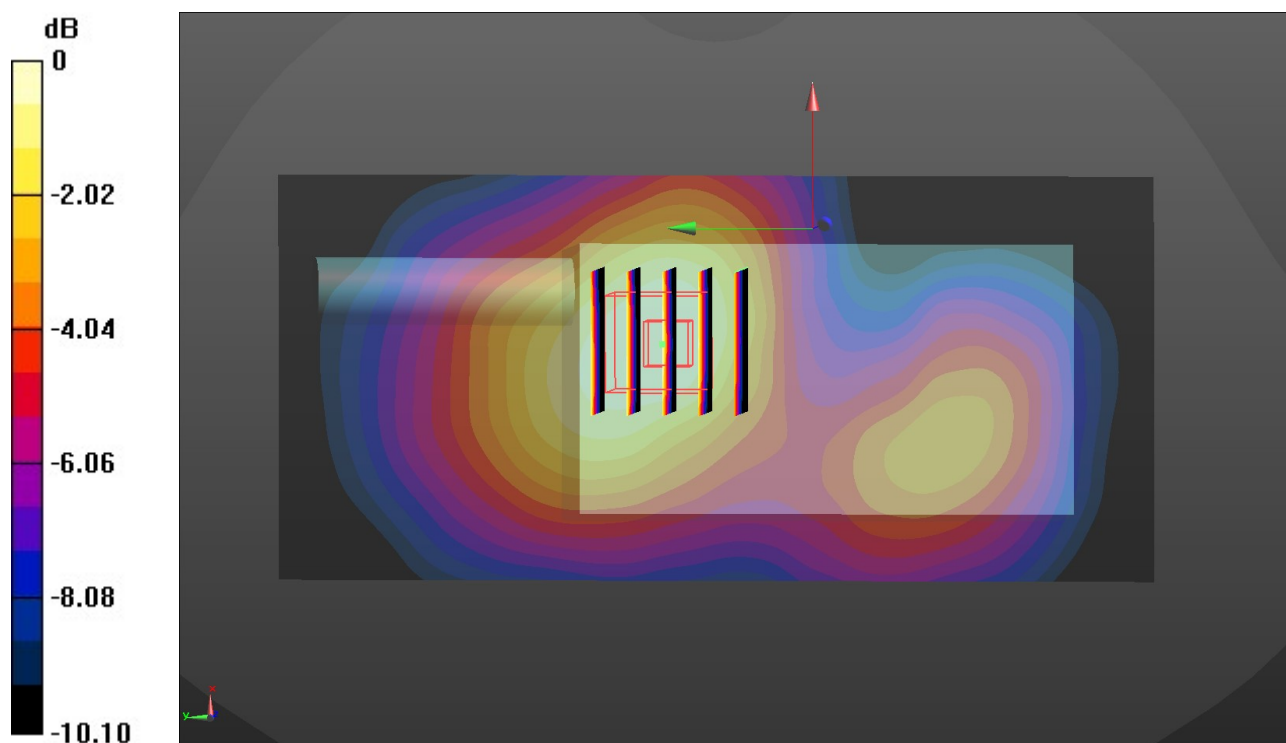
**Rear/CH 26140/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 7.684 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 0.123 W/kg

**SAR(1 g) = 0.074 W/kg; SAR(10 g) = 0.046 W/kg**

Maximum value of SAR (measured) = 0.106 W/kg



0 dB = 0.106 W/kg = -9.75 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd., SAR Lab

Date: 6/26/2019

**LTE Band 26-Body**

Communication System: UID 0, Generic LTE-FDD (0); Frequency: 831.5 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 831.5$  MHz;  $\sigma = 0.917$  S/m;  $\epsilon_r = 42.986$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.2°C; Liquid Temperature: 21.9°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.41, 10.41, 10.41) @ 831.5 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 26775/Area Scan (61x131x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.102 W/kg

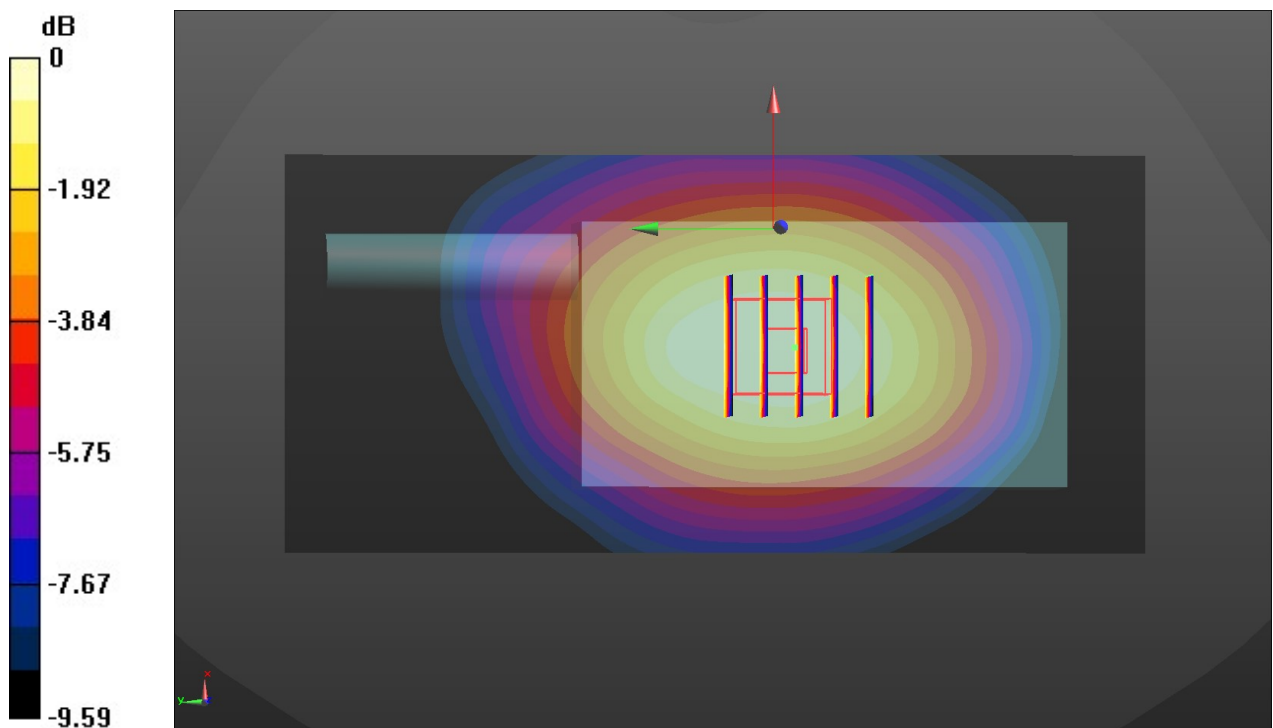
**Rear/CH 26775/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.967 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 0.113 W/kg

**SAR(1 g) = 0.083 W/kg; SAR(10 g) = 0.056 W/kg**[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.100 W/kg



0 dB = 0.100 W/kg = -10.00 dBW/kg

Test Laboratory: Huatongwei International Inspection Co., Ltd.,SAR Lab

Date: 7/2/2019

**WiFi 2.4G-Body**

Communication System: UID 0, Generic WIFI (0); Frequency: 2462 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2462$  MHz;  $\sigma = 1.852$  S/m;  $\epsilon_r = 40.886$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.3°C;Liquid Temperature:22.1°C;

DASY Configuration:

- Probe: EX3DV4 - SN7494; ConvF(7.9, 7.9, 7.9) @ 2462 MHz; Calibrated: 3/25/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/19/2019
- Phantom: Twin-SAM V8.0 ; Type: QD 000 P41 AA; Serial: 1974
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**Rear/CH 11/Area Scan (81x161x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0197 W/kg

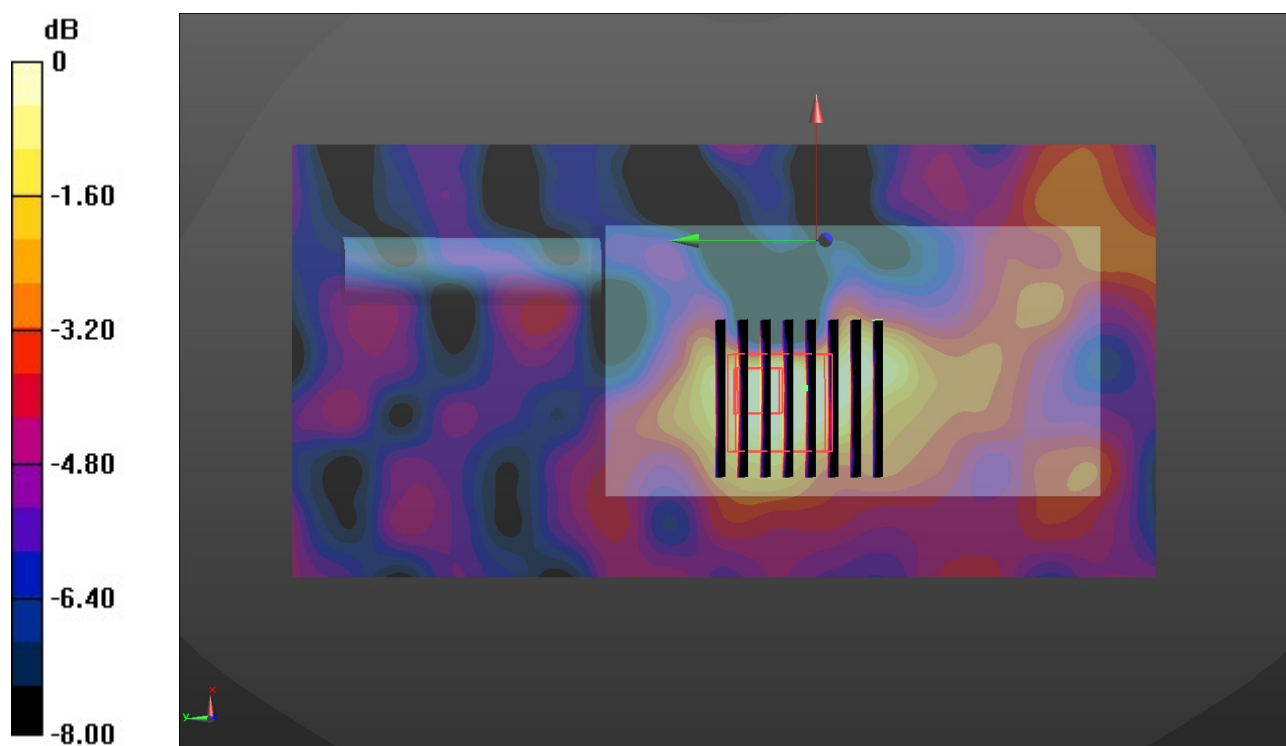
**Rear/CH 11/Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.754 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.0220 W/kg

**SAR(1 g) = 0.011 W/kg; SAR(10 g) = 0.00539 W/kg**[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0171 W/kg



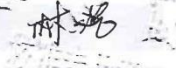
0 dB = 0.0171 W/kg = -17.67 dBW/kg

## 1.1. DAE4 Calibration Certificate

In Collaboration withCALIBRATION LABORATORY中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
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E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client : **HTW** Certificate No: **Z19-60066**

| CALIBRATION CERTIFICATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                    |                                          |                                                                                       |                   |      |                                          |                       |                        |         |                                |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------|-------------------|------|------------------------------------------|-----------------------|------------------------|---------|--------------------------------|---------|
| Object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | DAE4 - SN: 1549                                                                    |                                          |                                                                                       |                   |      |                                          |                       |                        |         |                                |         |
| Calibration Procedure(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | FF-Z11-002-01<br>Calibration Procedure for the Data Acquisition Electronics (DAEx) |                                          |                                                                                       |                   |      |                                          |                       |                        |         |                                |         |
| Calibration date:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | March 19, 2019                                                                     |                                          |                                                                                       |                   |      |                                          |                       |                        |         |                                |         |
| <p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"><thead><tr><th>Primary Standards</th><th>ID #</th><th>Cal Date(Calibrated by, Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Process Calibrator 753</td><td>1971018</td><td>20-Jun-18 (CTTL, No.J18X05034)</td><td>June-19</td></tr></tbody></table> |                                                                                    |                                          |                                                                                       | Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration | Process Calibrator 753 | 1971018 | 20-Jun-18 (CTTL, No.J18X05034) | June-19 |
| Primary Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ID #                                                                               | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration                                                                 |                   |      |                                          |                       |                        |         |                                |         |
| Process Calibrator 753                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1971018                                                                            | 20-Jun-18 (CTTL, No.J18X05034)           | June-19                                                                               |                   |      |                                          |                       |                        |         |                                |         |
| Calibrated by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Name                                                                               | Function                                 | Signature                                                                             |                   |      |                                          |                       |                        |         |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yu Zongying                                                                        | SAR Test Engineer                        |  |                   |      |                                          |                       |                        |         |                                |         |
| Reviewed by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Lin Hao                                                                            | SAR Test Engineer                        |  |                   |      |                                          |                       |                        |         |                                |         |
| Approved by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Qi Dianyuan                                                                        | SAR Project Leader                       |  |                   |      |                                          |                       |                        |         |                                |         |
| Issued: March 20, 2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                    |                                          |                                                                                       |                   |      |                                          |                       |                        |         |                                |         |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                    |                                          |                                                                                       |                   |      |                                          |                       |                        |         |                                |         |



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E-mail: cttl@chinattl.com Http://www.chinattl.cn

**Glossary:**

DAE data acquisition electronics  
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



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### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X                     | Y                     | Z                     |
|---------------------|-----------------------|-----------------------|-----------------------|
| High Range          | 406.354 ± 0.15% (k=2) | 406.056 ± 0.15% (k=2) | 406.182 ± 0.15% (k=2) |
| Low Range           | 3.98644 ± 0.7% (k=2)  | 3.99365 ± 0.7% (k=2)  | 3.99469 ± 0.7% (k=2)  |

### Connector Angle

|                                           |           |
|-------------------------------------------|-----------|
| Connector Angle to be used in DASY system | 18° ± 1 ° |
|-------------------------------------------|-----------|

## 1.2. Probe Calibration Certificate



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中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

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E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

Client

HTW

Certificate No: Z19-60065

**CALIBRATION CERTIFICATE**

Object EX3DV4 - SN:7494

Calibration Procedure(s) FF-Z11-004-01  
Calibration Procedures for Dosimetric E-field Probes

Calibration date: March 25, 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( $22\pm 3$ )°C and humidity<70%.

Calibration Equipment used (M&amp;TE critical for calibration)

| Primary Standards       | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|-------------|------------------------------------------|-----------------------|
| Power Meter NRP2        | 101919      | 20-Jun-18 (CTTL, No.J18X05032)           | Jun-19                |
| Power sensor NRP-Z91    | 101547      | 20-Jun-18 (CTTL, No.J18X05032)           | Jun-19                |
| Power sensor NRP-Z91    | 101548      | 20-Jun-18 (CTTL, No.J18X05032)           | Jun-19                |
| Reference10dBAttenuator | 18N50W-10dB | 09-Feb-18(CTTL, No.J18X01133)            | Feb-20                |
| Reference20dBAttenuator | 18N50W-20dB | 09-Feb-18(CTTL, No.J18X01132)            | Feb-20                |
| Reference Probe EX3DV4  | SN 7514     | 27-Aug-18(SPEAG,No.EX3-7514_Aug18/2)     | Aug-19                |
| DAE4                    | SN 1555     | 20-Aug-18(SPEAG, No.DAE4-1555_Aug18)     | Aug -19               |
| Secondary Standards     | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGeneratorMG3700A  | 6201052605  | 21-Jun-18 (CTTL, No.J18X05033)           | Jun-19                |
| Network Analyzer E5071C | MY46110673  | 24-Jan-19 (CTTL, No.J19X00547)           | Jan -20               |

|                |             |                    |           |
|----------------|-------------|--------------------|-----------|
|                | Name        | Function           | Signature |
| Calibrated by: | Yu Zongying | SAR Test Engineer  |           |
| Reviewed by:   | Lin Hao     | SAR Test Engineer  |           |
| Approved by:   | Qi Dianyuan | SAR Project Leader |           |

Issued: March 27, 2019

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Certificate No: Z19-60065

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**Glossary:**

|                       |                                                                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                   | tissue 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 $\Phi$   | $\Phi$ rotation around probe axis                                                                                                           |
| Polarization $\theta$ | $\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i<br>$\theta=0$ 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<sub>x,y,z</sub>:** Assessed for E-field polarization  $\theta=0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -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 (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>; VR<sub>x,y,z</sub>:** A,B,C 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  $f \leq 800\text{MHz}$ ) and inside waveguide using analytical field distributions based on power measurements for  $f > 800\text{MHz}$ . The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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  $\pm 50\text{MHz}$  to  $\pm 100\text{MHz}$ .
- 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<sub>x</sub> (no uncertainty required).



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# Probe EX3DV4

## SN: 7494

Calibrated: March 25, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



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## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7494

### Basic Calibration Parameters

|                                                          | Sensor X | Sensor Y | Sensor Z | Unc (k=2)    |
|----------------------------------------------------------|----------|----------|----------|--------------|
| Norm( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 0.40     | 0.47     | 0.40     | $\pm 10.0\%$ |
| DCP(mV) <sup>B</sup>                                     | 97.1     | 100.4    | 98.3     |              |

### Modulation Calibration Parameters

| UID | Communication System Name |   | A<br>dB | B<br>dB $\sqrt{\mu\text{V}}$ | C   | D<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-----|---------------------------|---|---------|------------------------------|-----|---------|----------|---------------------------|
| 0   | CW                        | X | 0.0     | 0.0                          | 1.0 | 0.00    | 151.5    | $\pm 2.8\%$               |
|     |                           | Y | 0.0     | 0.0                          | 1.0 |         | 167.5    |                           |
|     |                           | Z | 0.0     | 0.0                          | 1.0 |         | 150.7    |                           |

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 Page 5 and Page 6).

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

<sup>E</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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## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7494

### 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 <sup>G</sup> (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 750                  | 41.9                               | 0.89                            | 10.74   | 10.74   | 10.74   | 0.23               | 1.10                    | ± 12.1%     |
| 835                  | 41.5                               | 0.90                            | 10.41   | 10.41   | 10.41   | 0.12               | 1.50                    | ± 12.1%     |
| 1750                 | 40.1                               | 1.37                            | 8.91    | 8.91    | 8.91    | 0.25               | 0.96                    | ± 12.1%     |
| 1900                 | 40.0                               | 1.40                            | 8.57    | 8.57    | 8.57    | 0.27               | 0.94                    | ± 12.1%     |
| 2300                 | 39.5                               | 1.67                            | 8.22    | 8.22    | 8.22    | 0.49               | 0.73                    | ± 12.1%     |
| 2450                 | 39.2                               | 1.80                            | 7.90    | 7.90    | 7.90    | 0.51               | 0.75                    | ± 12.1%     |
| 2600                 | 39.0                               | 1.96                            | 7.69    | 7.69    | 7.69    | 0.45               | 0.83                    | ± 12.1%     |
| 5200                 | 36.0                               | 4.66                            | 5.56    | 5.56    | 5.56    | 0.40               | 1.50                    | ± 13.3%     |
| 5300                 | 35.9                               | 4.76                            | 5.37    | 5.37    | 5.37    | 0.40               | 1.40                    | ± 13.3%     |
| 5500                 | 35.6                               | 4.96                            | 5.00    | 5.00    | 5.00    | 0.40               | 1.35                    | ± 13.3%     |
| 5600                 | 35.5                               | 5.07                            | 4.89    | 4.89    | 4.89    | 0.40               | 1.50                    | ± 13.3%     |
| 5800                 | 35.3                               | 5.27                            | 4.85    | 4.85    | 4.85    | 0.40               | 1.45                    | ± 13.3%     |

<sup>C</sup> Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.