

## DASY5 Validation Report for Head TSL

Date: 08.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1097**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.9 \text{ S/m}$ ;  $\epsilon_r = 41.2$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.49, 10.49, 10.49); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:**

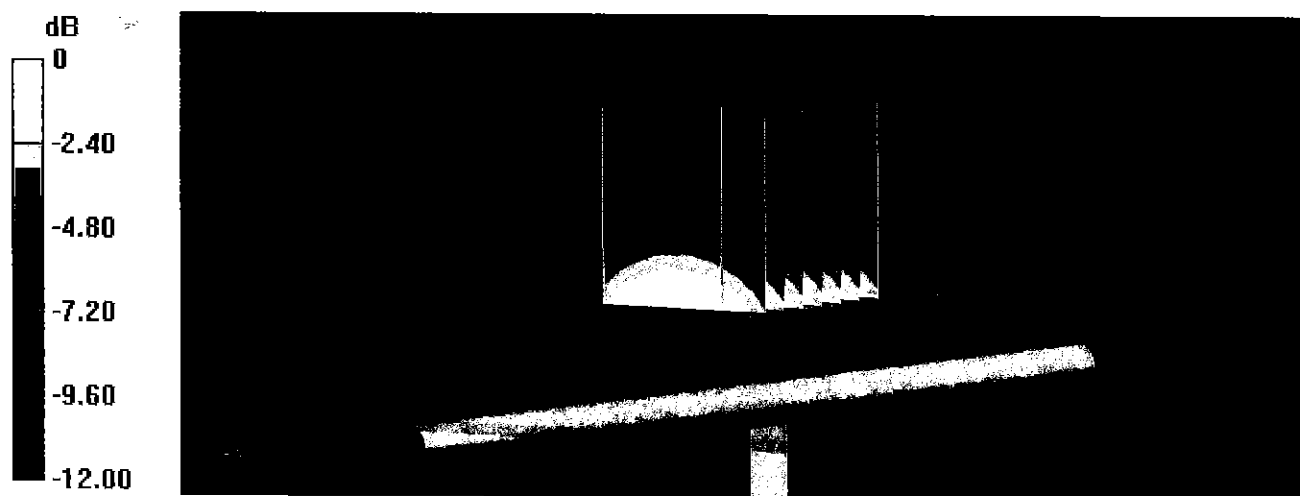
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.59 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

**SAR(1 g) = 2.08 W/kg; SAR(10 g) = 1.36 W/kg**

Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

# Impedance Measurement Plot for Head TSL

8 Sep 2017 13:09:24  
 CH1 S11 1 U FS 1: 54.383  $\Omega$  -552.73 m $\Omega$  383.92 pF 750.000 000 MHz

\*

De1

CA

Avg  
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.463 dB 750.000 000 MHz

CA

Avg  
16

H1d

START 550.000 000 MHz

STOP 950.000 000 MHz

## DASY5 Validation Report for Body TSL

Date: 08.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1097**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 55.5$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.35, 10.35, 10.35); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

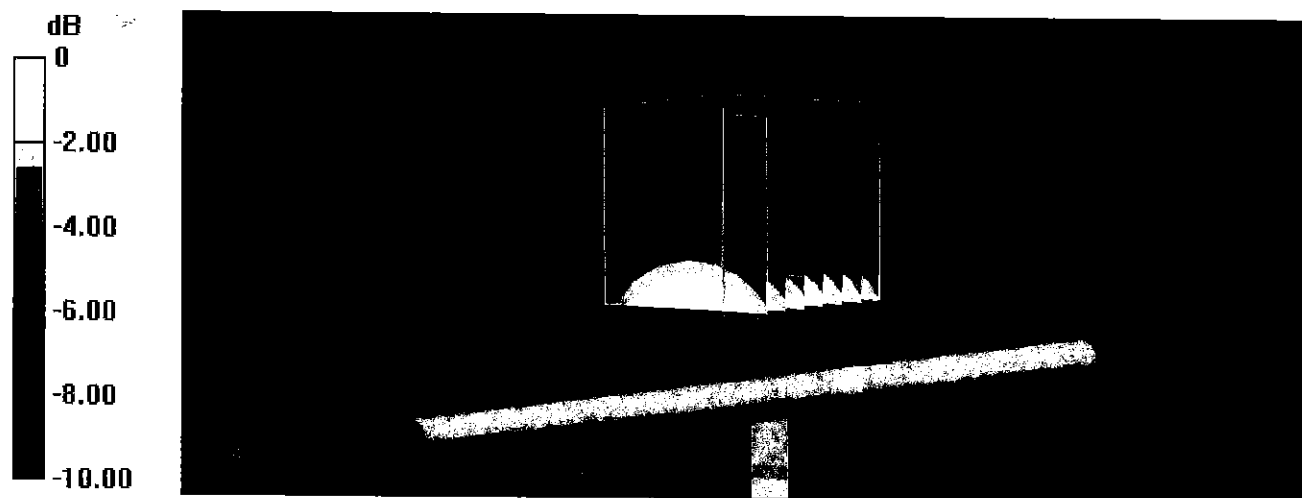
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.96 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.16 W/kg

**SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.42 W/kg**

Maximum value of SAR (measured) = 2.81 W/kg



0 dB = 2.81 W/kg = 4.49 dBW/kg

# Impedance Measurement Plot for Body TSL

8 Sep 2017 13:08:43  
 CH1 S11 1 U FS 1: 49.951  $\Omega$  -3.6172  $\Omega$  58.666 pF 750.000 000 MHz

\*

De1

CA

Avg  
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -28.833 dB 750.000 000 MHz

CA

Avg  
16

H1d

START 550.000 000 MHz

STOP 950.000 000 MHz

# Certification of Calibration

Object D750V3 – SN: 1097

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

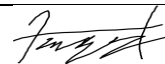
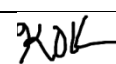
Extended Calibration date: September 08, 2018

Description: SAR Validation Dipole at 750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 9/14/2017  | Annual       | 9/14/2018  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 3/19/2018  | Annual       | 3/19/2019  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2496A   | Power Meter                                             | 10/9/2017  | Annual       | 10/9/2018  | 1138001       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/15/2017 | Annual       | 11/15/2018 | 1339007       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/22/2017 | Annual       | 11/22/2018 | 1339008       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/14/2017  | Biennial     | 2/14/2019  | 170112507     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | PE5011-1  | Torque Wrench                                           | 7/19/2017  | Biennial     | 7/19/2019  | N/A           |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 5/15/2018  | Annual       | 5/15/2019  | 1070          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 9/18/2017  | Annual       | 9/18/2018  | 3287          |
| SPEAG                 | DAE4      | Data Acquisition Electronics                            | 1/26/2018  | Annual       | 1/26/2019  | 1533          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 7/20/2018  | Annual       | 7/20/2019  | 7416          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 1/18/2018  | Annual       | 1/18/2019  | 793           |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name            | Function                 | Signature                                                                             |
|----------------|-----------------|--------------------------|---------------------------------------------------------------------------------------|
| Calibrated By: | Sangmin Cha     | Team Lead Engineer       |  |
| Approved By:   | Kaitlin O'Keefe | Senior Technical Manager |  |

# DIPOLE CALIBRATION EXTENSION

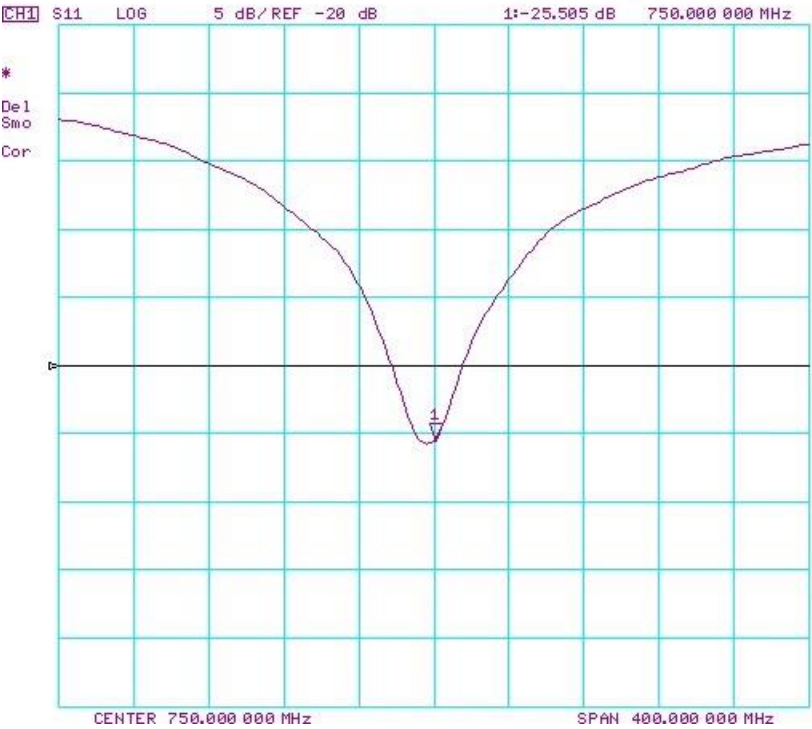
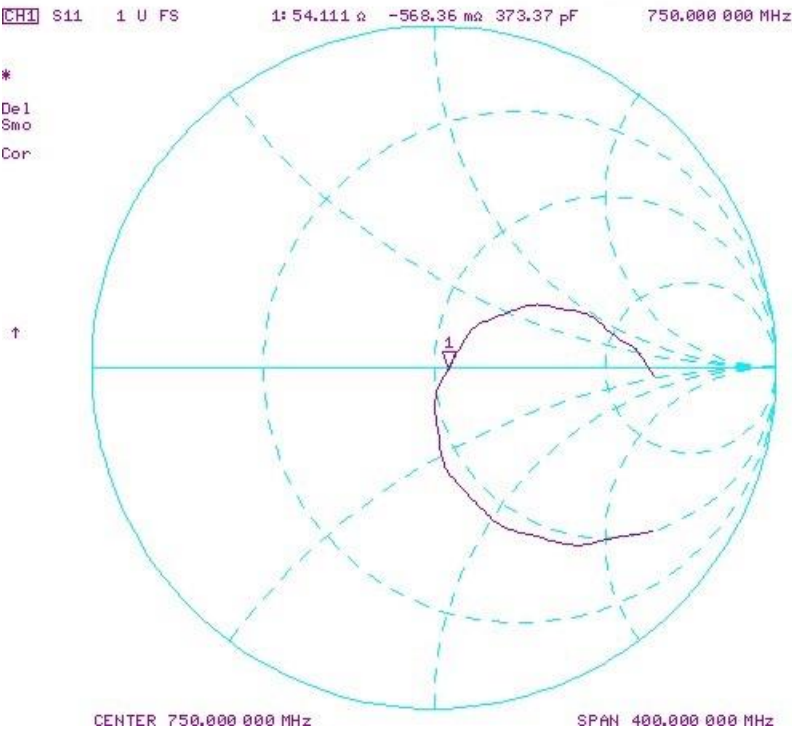
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

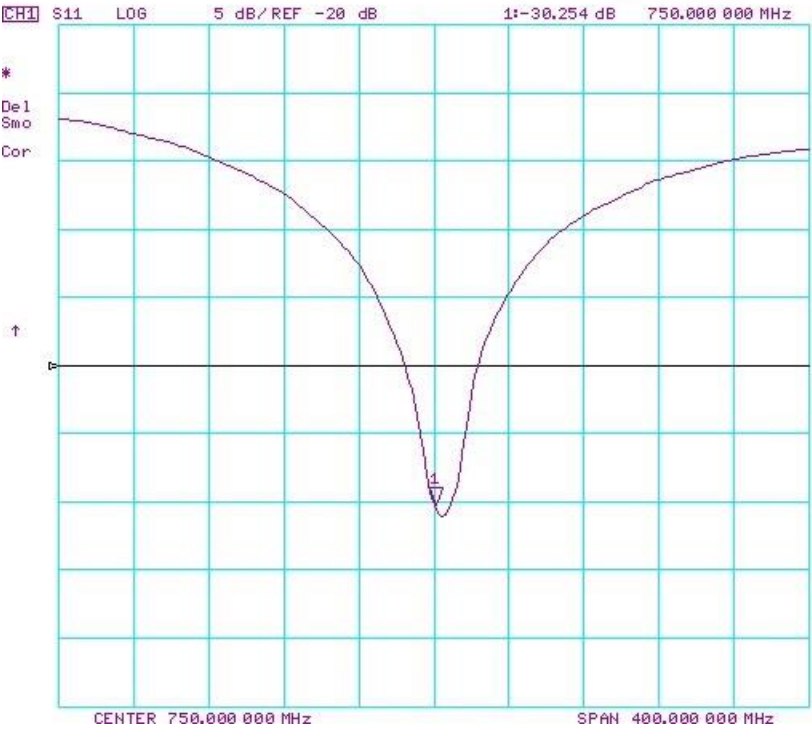
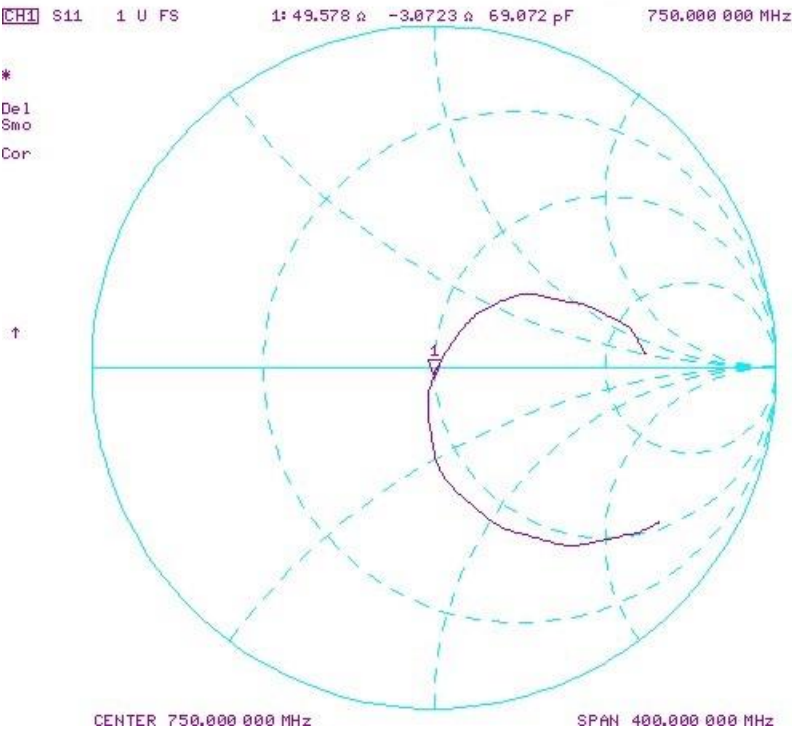
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 23.0 dBm | Measured Head SAR (1g) W/kg @ 23.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 23.0 dBm | Measured Body SAR (10g) W/kg @ 23.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/8/2017         | 9/8/2018       | 1.034                             | 1.644                                            | 1.7                                    | 3.41%            | 1.078                                             | 1.12                                    | 3.90%             | 54.4                                  | 54.1                               | 0.3                   | -0.6                                       | -0.6                                    | 0                          | -27.5                             | -25.5                          | 7.30%         | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 23.0 dBm | Measured Body SAR (1g) W/kg @ 23.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 23.0 dBm | Measured Body SAR (10g) W/kg @ 23.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 9/8/2017         | 9/8/2018       | 1.034                             | 1.712                                            | 1.78                                   | 3.97%            | 1.136                                             | 1.17                                    | 2.99%             | 50                                    | 49.6                               | 0.4                   | -3.6                                       | -3.1                                    | 0.5                        | -28.8                             | -30.3                          | -5.20%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 **PC Test**

Certificate No: **D835V2-4d180\_May18**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d180**

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

SCV  
 5/31/2018

Calibration date: **May 18, 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 ( $22 \pm 3$ )°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: 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: 100972     | 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: **Manu Seitz** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Issued: May 22, 2018

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



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.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.1    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 15 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 835 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 41.5           | 0.90 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 40.8 $\pm$ 6 % | 0.92 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 2.45 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>9.60 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 1.58 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>6.22 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 55.2           | 0.97 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 54.6 $\pm$ 6 % | 0.99 mho/m $\pm$ 6 % |
| <b>Body TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 2.44 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>9.59 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 1.60 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>6.31 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.7 $\Omega$ - 5.1 j $\Omega$ |
| Return Loss                          | - 25.9 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.2 $\Omega$ - 8.2 j $\Omega$ |
| Return Loss                          | - 21.1 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.396 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 24, 2014 |

## DASY5 Validation Report for Head TSL

Date: 17.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d180**

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 40.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.9, 9.9, 9.9) @ 835 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:

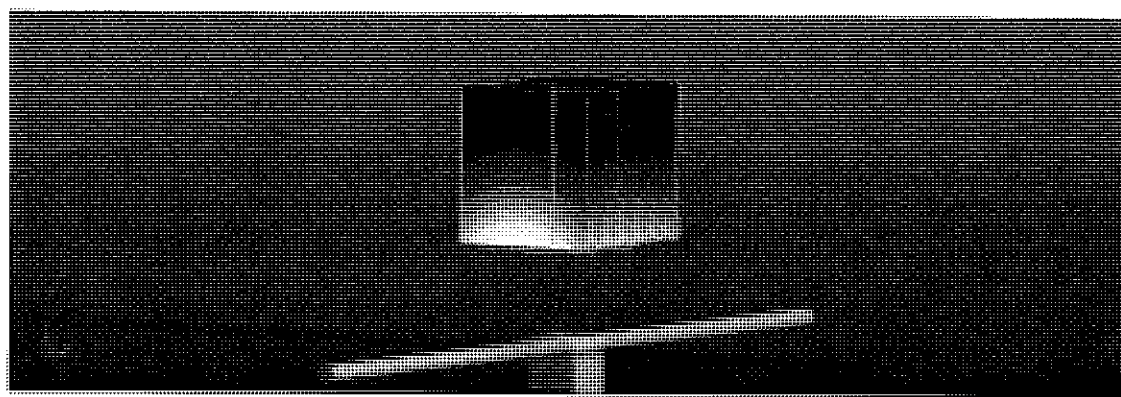
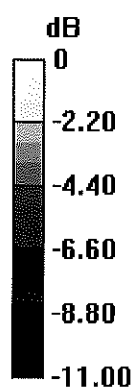
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 65.39 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 3.78 W/kg

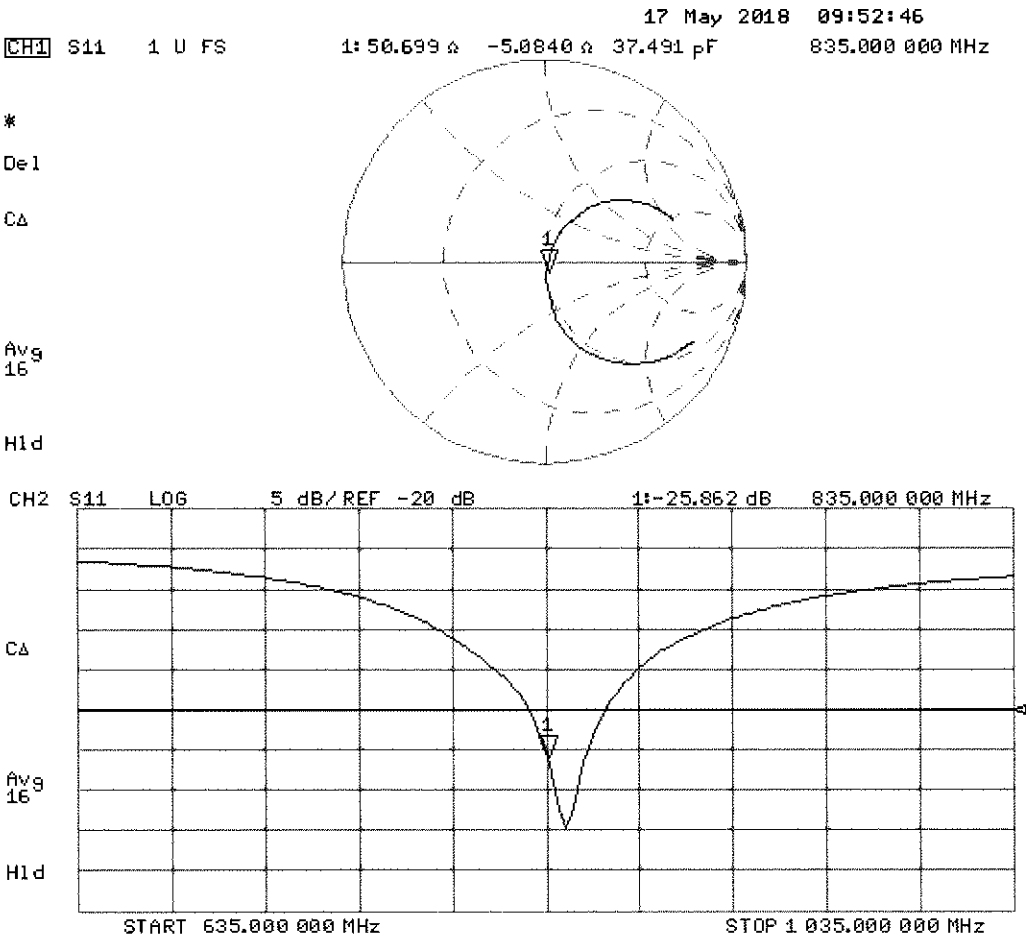
**SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.58 W/kg**

Maximum value of SAR (measured) = 3.32 W/kg



0 dB = 3.32 W/kg = 5.21 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 18.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d180**

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.99$  S/m;  $\epsilon_r = 54.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.05, 10.05, 10.05) @ 835 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:**

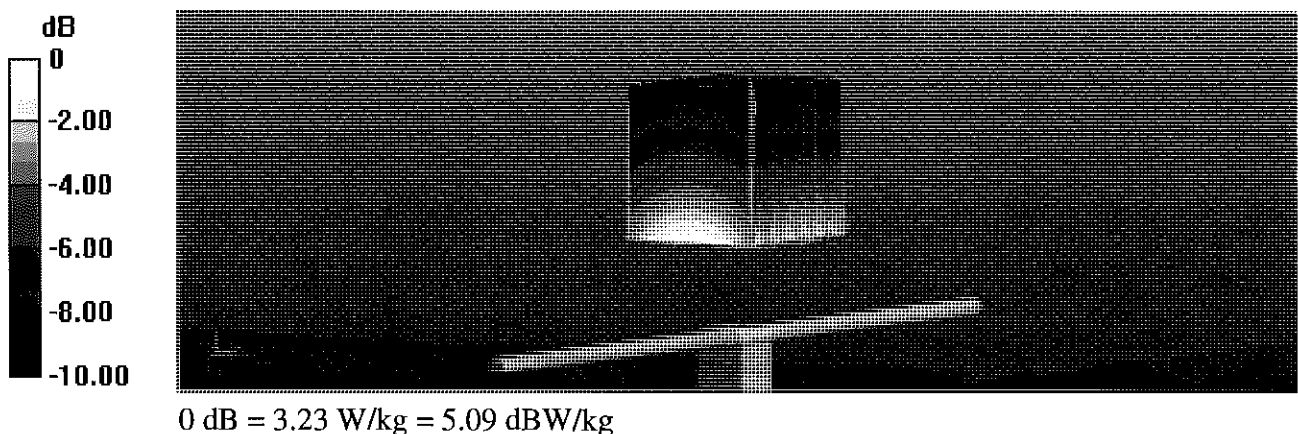
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.80 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.62 W/kg

**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.6 W/kg**

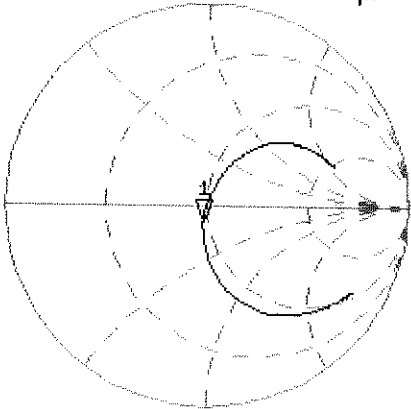
Maximum value of SAR (measured) = 3.23 W/kg



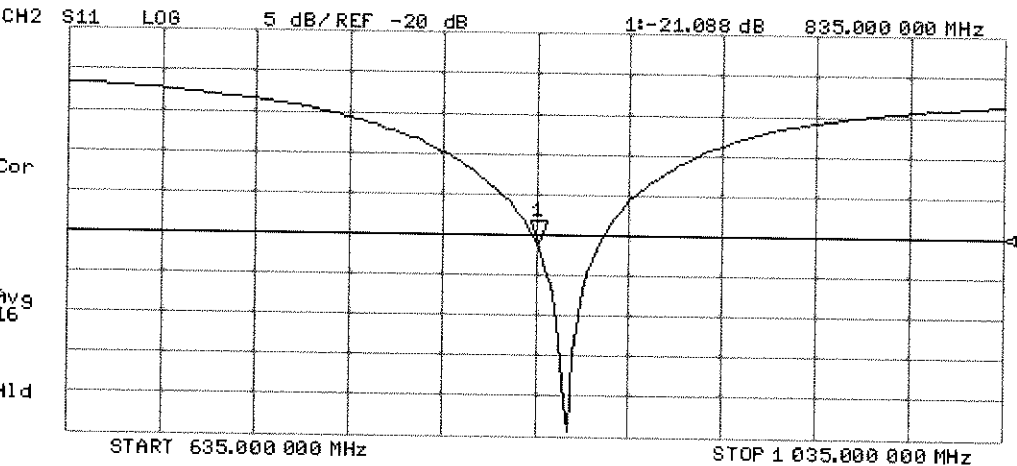
Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS 18 May 2018 10:19:30  
1: 47.234  $\Omega$  -8.1504  $\Omega$  23.386 pF 835.000 000 MHz

\*  
Del  
Cor



Avg  
16  
H1d



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



**S** Schweizerischer Kallbrierdienst  
**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 **PC Test**

Certificate No: **D1750V2-1104\_Sep17**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1104**

Calibration procedure(s) **QA CAL-05.v9**  
 Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **September 07, 2017**

SC ✓  
 10/03/2017

SC ✓  
 9/11/2018

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 ( $22 \pm 3$ )°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-17 (No. 217-02521/02522)   | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)         | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)         | Apr-18                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)         | Apr-18                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)         | Apr-18                 |
| Reference Probe EX3DV4      | SN: 7349           | 31-May-17 (No. EX3-7349_May17)    | May-18                 |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)    | Mar-18                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A        | SN: GB97480704     | 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: 100972         | 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-16) | In house check: Oct-17 |

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

Approved by: **Katja Pokovic** Technical Manager

Signature

*M. Weber*

*K. Pokovic*

Issued: September 7, 2017

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



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   | 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 | 39.1 $\pm$ 6 % | 1.36 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.11 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>36.4 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 4.81 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>19.2 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## 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 | 53.8 $\pm$ 6 % | 1.46 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 9.03 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>36.6 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 4.85 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>19.6 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.8 $\Omega$ - 0.2 j $\Omega$ |
| Return Loss                          | - 41.5 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.5 $\Omega$ - 0.7 j $\Omega$ |
| Return Loss                          | - 28.7 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.217 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 16, 2013 |

## DASY5 Validation Report for Head TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1104**

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

Medium parameters used:  $f = 1750 \text{ MHz}$ ;  $\sigma = 1.36 \text{ S/m}$ ;  $\epsilon_r = 39.1$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.73, 8.73, 8.73); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

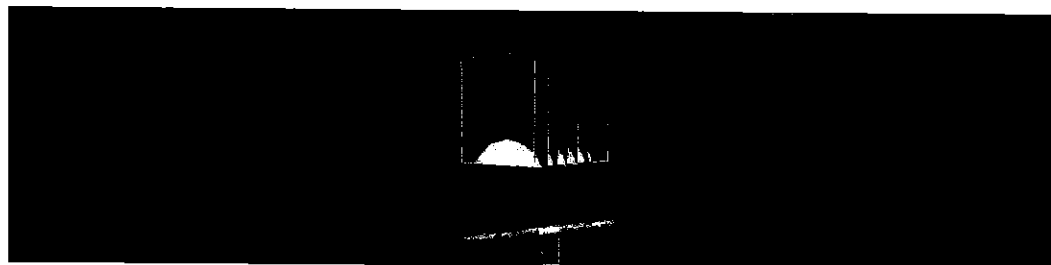
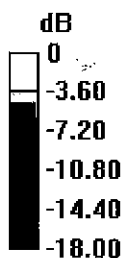
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 104.9 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.0 W/kg

**SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.81 W/kg**

Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

# Impedance Measurement Plot for Head TSL

7 Sep 2017 12:19:31  
 CH1 S11 1 U FS 1: 50.834  $\Omega$  -150.39 m $\Omega$  604.73 pF 1 750.000 000 MHz

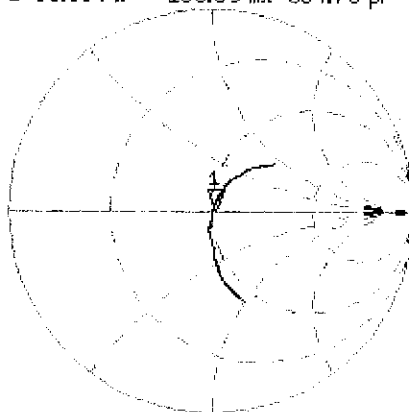
\*

De1

CA

Avg  
16

H1d

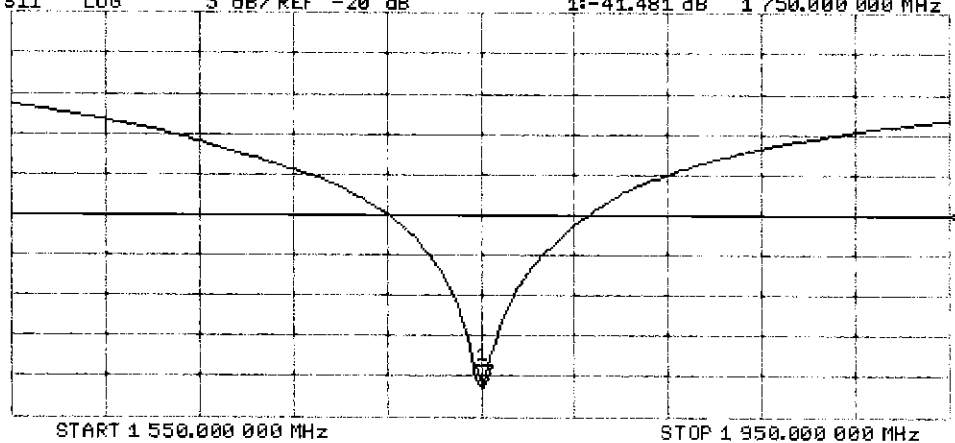


CH2 S11 LOG 5 dB/REF -20 dB 1:-41.481 dB 1 750.000 000 MHz

CA

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1104**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  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(8.46, 8.46, 8.46); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

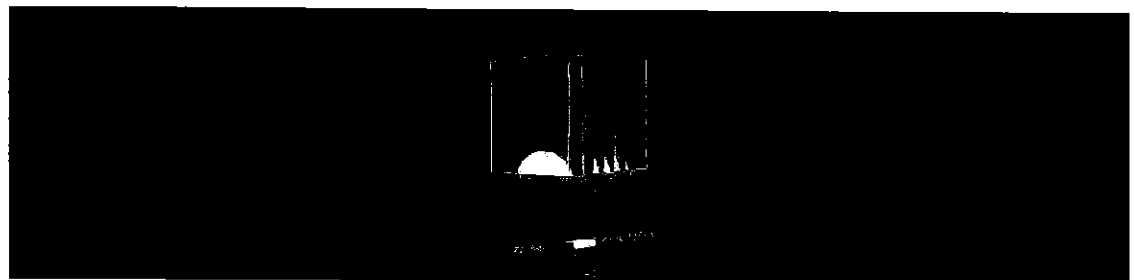
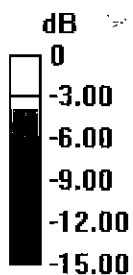
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.30 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 15.6 W/kg

**SAR(1 g) = 9.03 W/kg; SAR(10 g) = 4.85 W/kg**

Maximum value of SAR (measured) = 12.9 W/kg

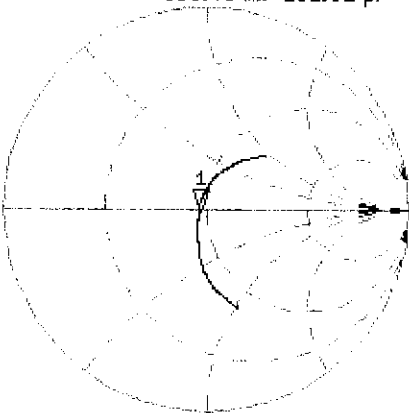


0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL

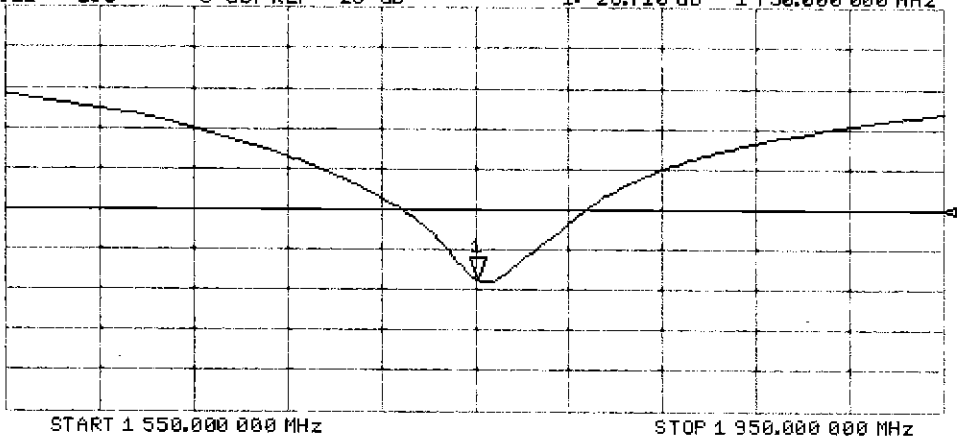
7 Sep 2017 12:18:38  
CH1 S11 1 U FS 1: 46.527  $\Omega$  -689.45 m $\Omega$  131.91 pF 1 750.000 000 MHz

\*  
Del  
CA  
Avg  
16  
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -28.710 dB 1 750.000 000 MHz

CA  
Avg  
16  
H1d



# Certification of Calibration

Object D1750V2 – SN: 1104

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

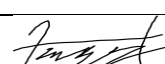
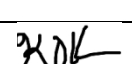
Extended Calibration date: September 07, 2018

Description: SAR Validation Dipole at 1750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 9/14/2017  | Annual       | 9/14/2018  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 3/19/2018  | Annual       | 3/19/2019  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2496A   | Power Meter                                             | 10/9/2017  | Annual       | 10/9/2018  | 1138001       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/15/2017 | Annual       | 11/15/2018 | 1339007       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/22/2017 | Annual       | 11/22/2018 | 1339008       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/14/2017  | Biennial     | 2/14/2019  | 170112507     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | PE5011-1  | Torque Wrench                                           | 7/19/2017  | Biennial     | 7/19/2019  | N/A           |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 5/15/2018  | Annual       | 5/15/2019  | 1070          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 9/18/2017  | Annual       | 9/18/2018  | 3287          |
| SPEAG                 | DAE4      | Data Acquisition Electronics                            | 1/26/2018  | Annual       | 1/26/2019  | 1533          |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name            | Function                 | Signature                                                                             |
|----------------|-----------------|--------------------------|---------------------------------------------------------------------------------------|
| Calibrated By: | Sangmin Cha     | Team Lead Engineer       |  |
| Approved By:   | Kaitlin O'Keefe | Senior Technical Manager |  |

# DIPOLE CALIBRATION EXTENSION

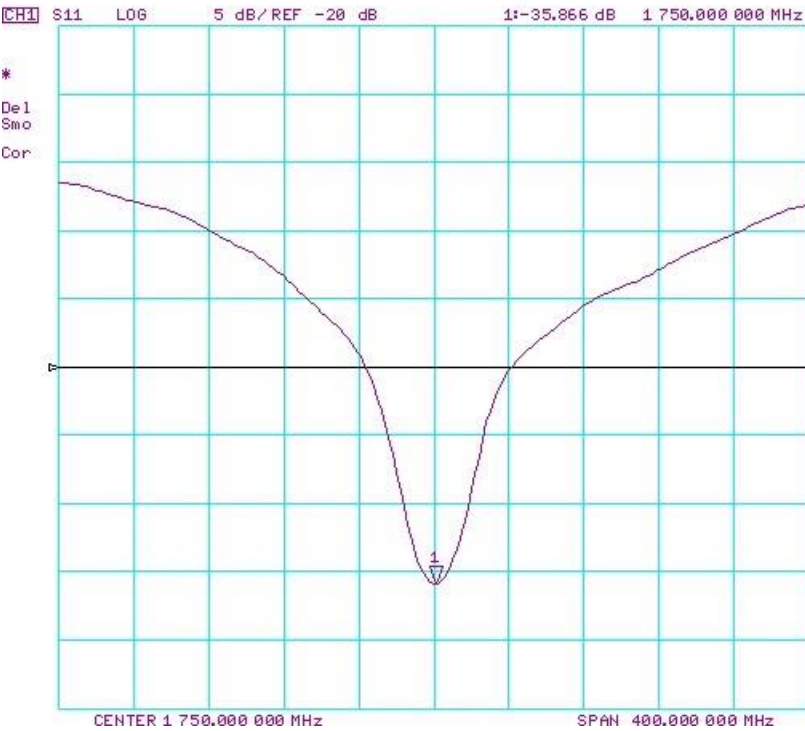
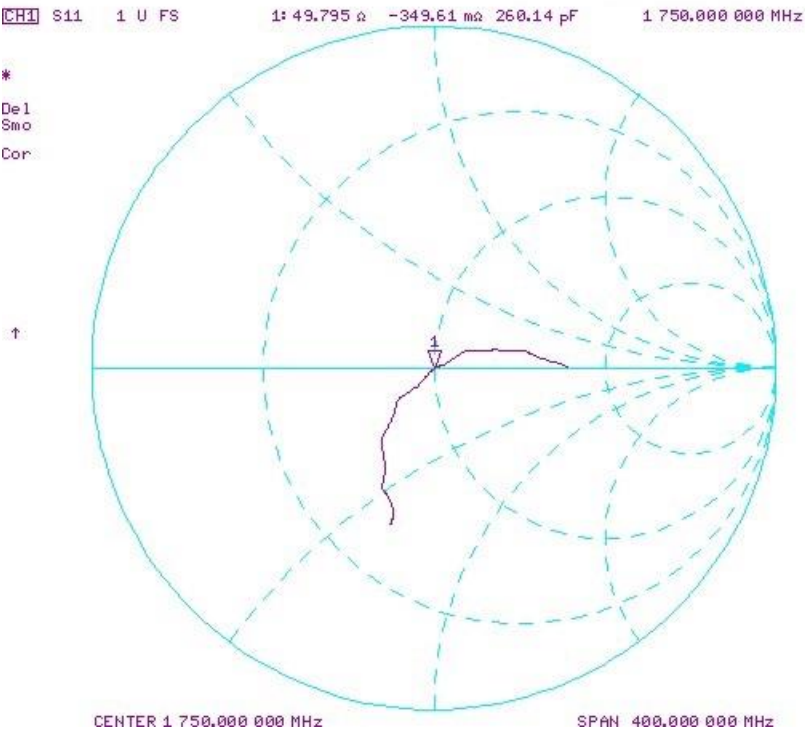
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

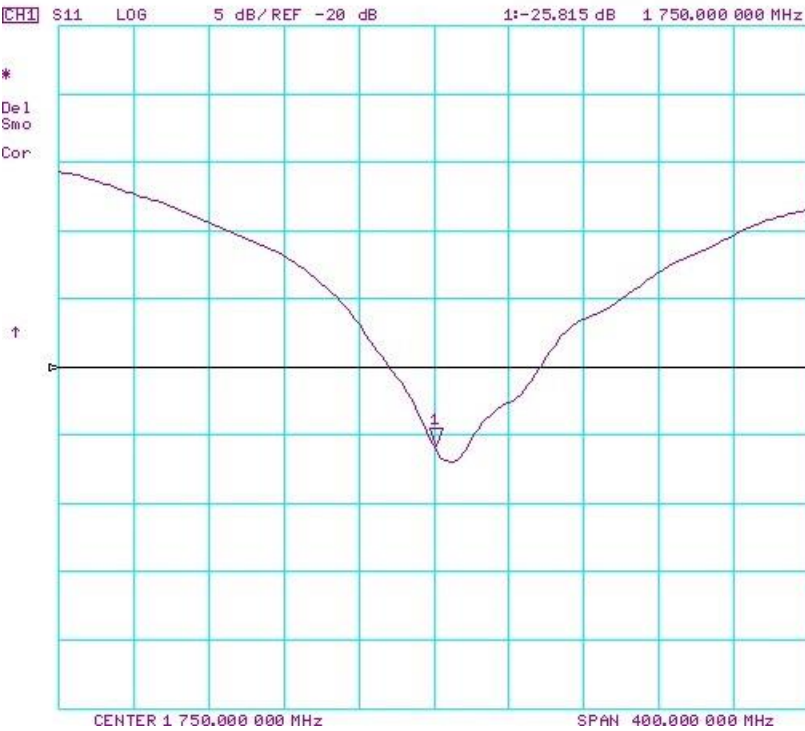
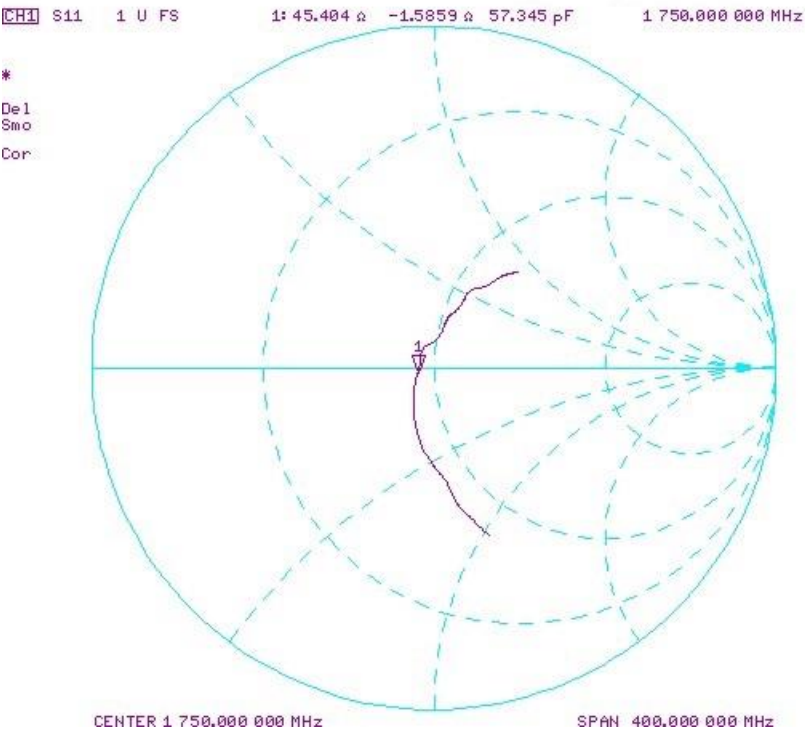
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/7/2017         | 9/7/2018       | 1.217                             | 3.64                                             | 3.62                                   | -0.55%           | 1.92                                              | 1.94                                    | 1.04%             | 50.8                                  | 49.8                               | 1                     | -0.2                                       | -0.3                                    | 0.1                        | -41.5                             | -35.9                          | 13.50%        | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 9/7/2017         | 9/7/2018       | 1.217                             | 3.66                                             | 3.84                                   | 4.92%            | 1.96                                              | 2.07                                    | 5.61%             | 46.527                                | 45.4                               | 1.1                   | -0.69                                      | -1.6                                    | 0.9                        | -28.7                             | -25.8                          | 10.10%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 **PC Test**

Certificate No: **D1900V2-5d180\_Aug17**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d180**

Calibration procedure(s) **QA CAL-05.v9**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **August 16, 2017**

*PMV*  
*8/27/17*  
*SLV*  
*8/1/18*

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-17 (No. 217-02521/02522) | Apr-18                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)       | Apr-18                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)       | Apr-18                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)       | Apr-18                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)       | Apr-18                |
| Reference Probe EX3DV4      | SN: 7349           | 31-May-17 (No. EX3-7349_May17)  | May-18                |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)  | Mar-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: 100972     | 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-16) | In house check: Oct-17 |

Calibrated by: **Johannes Kurikka** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Issued: August 16, 2017

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



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                  | V52.10.0    |
| 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 | 40.6 $\pm$ 6 % | 1.36 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 | 9.60 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 39.2 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 | 5.09 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 20.6 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 | 54.1 $\pm$ 6 % | 1.48 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 | 9.68 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 39.5 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 | 5.17 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.9 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 | $54.0 \Omega + 5.7 j\Omega$ |
| Return Loss                          | - 23.5 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $49.6 \Omega + 6.5 j\Omega$ |
| Return Loss                          | - 23.7 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           |
| Manufactured on | August 23, 2013 |

## DASY5 Validation Report for Head TSL

Date: 16.08.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d180**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.36$  S/m;  $\epsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

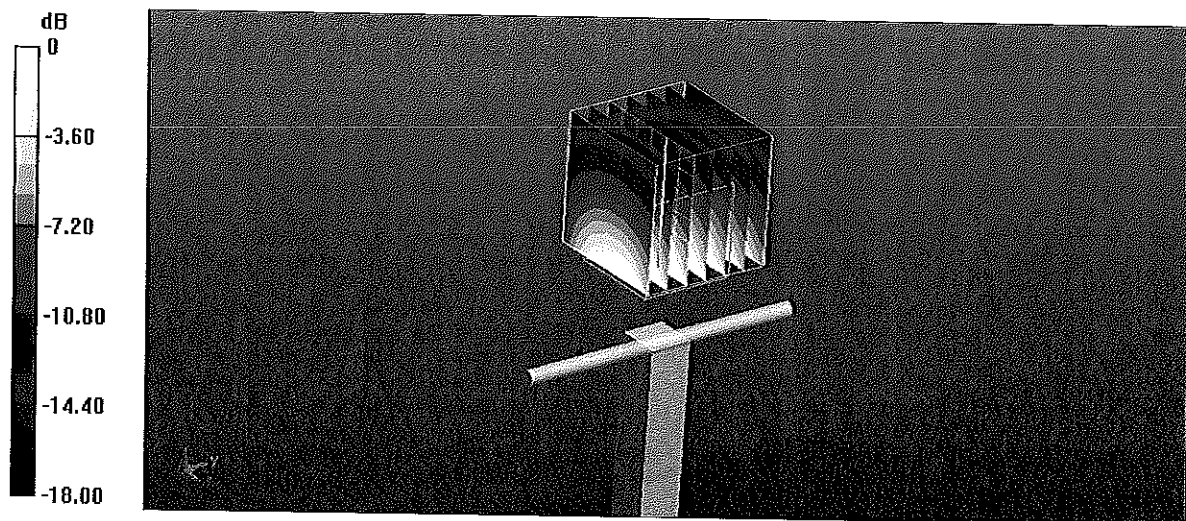
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.7 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 9.6 W/kg; SAR(10 g) = 5.09 W/kg**

Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg

## Impedance Measurement Plot for Head TSL

16 Aug 2017 13:06:53  
CH1 S11 1 U FS 1: 54.041  $\Omega$  5.7129  $\Omega$  478.54  $\mu\text{H}$  1 900.000 000 MHz

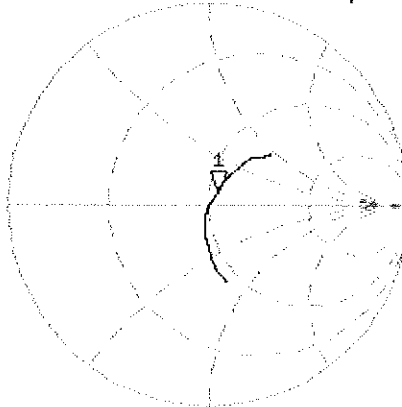
\*

Del

CA

Avg  
16

H1d

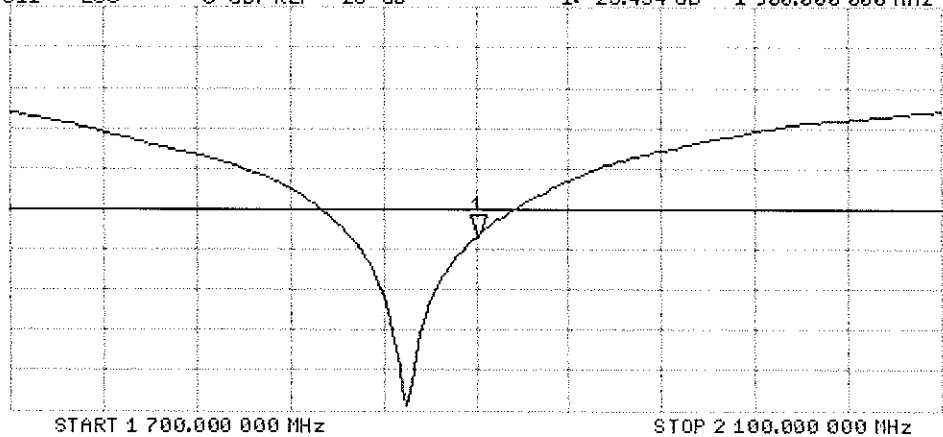


CH2 S11 LOG 5 dB/REF -20 dB 1: -23.454 dB 1 900.000 000 MHz

CA

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 16.08.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d180**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.48$  S/m;  $\epsilon_r = 54.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

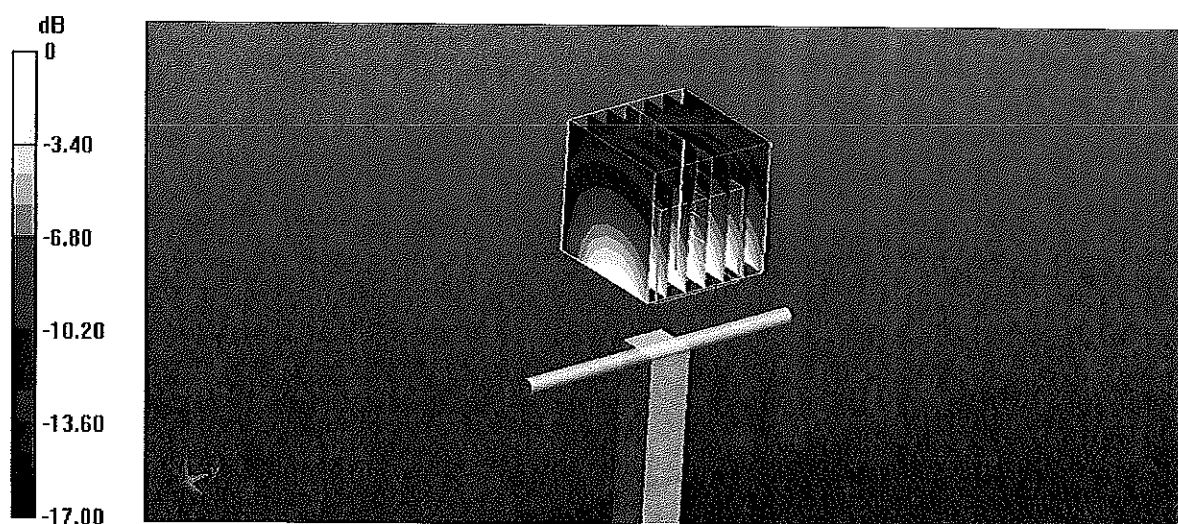
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.33 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 16.9 W/kg

**SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.17 W/kg**

Maximum value of SAR (measured) = 14.1 W/kg

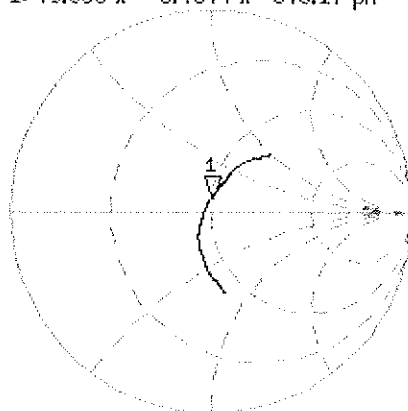


0 dB = 14.1 W/kg = 11.49 dBW/kg

## Impedance Measurement Plot for Body TSL

16 Aug 2017 13:06:08  
[CH1] S11 1 U FS 1: 49.605  $\Omega$  6.4844  $\Omega$  543.17  $\mu\text{H}$  1 900.000 000 MHz

\*  
De1  
CA



Avg  
16

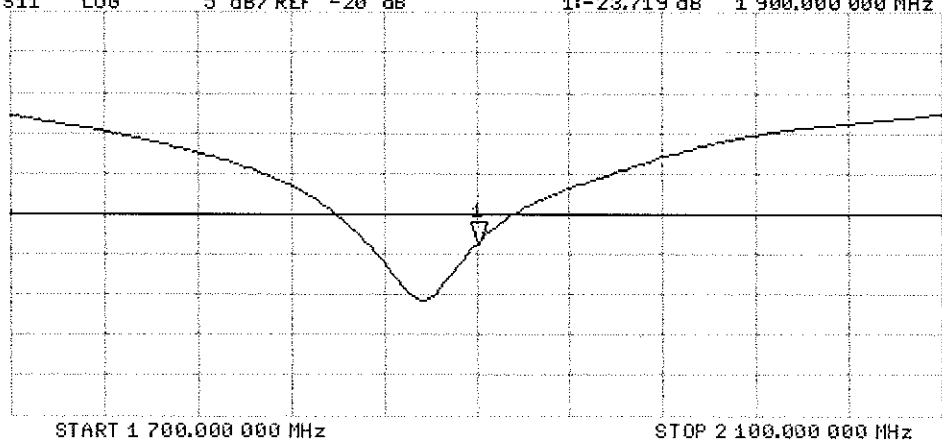
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.719 dB 1 900.000 000 MHz

CA

Avg  
16

H1d



# Certification of Calibration

Object D1900V2 – SN: 5d180

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

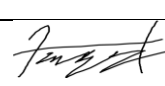
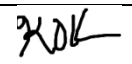
Extended Calibration date: August 01, 2018

Description: SAR Validation Dipole at 1900 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 9/14/2017  | Annual       | 9/14/2018  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 3/19/2018  | Annual       | 3/19/2019  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2496A   | Power Meter                                             | 10/9/2017  | Annual       | 10/9/2018  | 1138001       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/15/2017 | Annual       | 11/15/2018 | 1339007       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/22/2017 | Annual       | 11/22/2018 | 1339008       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/14/2017  | Biennial     | 2/14/2019  | 170112507     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | PE5011-1  | Torque Wrench                                           | 7/19/2017  | Biennial     | 7/19/2019  | N/A           |
| SPEAG                 | DAKS-3.5  | Portable DAK                                            | 9/5/2017   | Annual       | 9/5/2018   | 1045          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 2/13/2018  | Annual       | 2/13/2019  | 3329          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/8/2018   | Annual       | 2/8/2019   | 1403          |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name            | Function                 | Signature                                                                             |
|----------------|-----------------|--------------------------|---------------------------------------------------------------------------------------|
| Calibrated By: | Sangmin Cha     | Biomedical Engineer II   |  |
| Approved By:   | Kaitlin O'Keefe | Senior Technical Manager |  |

# DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

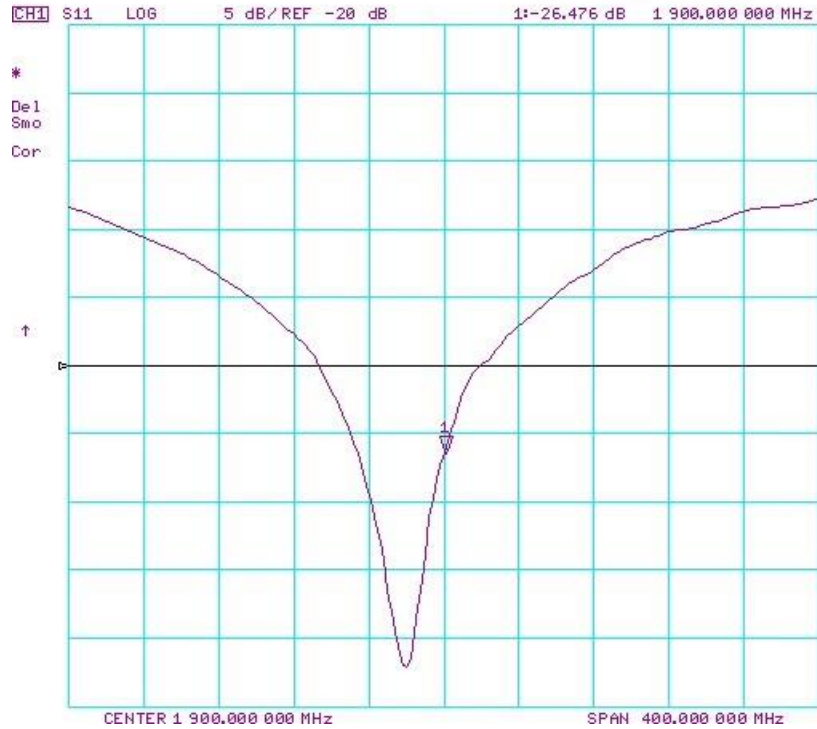
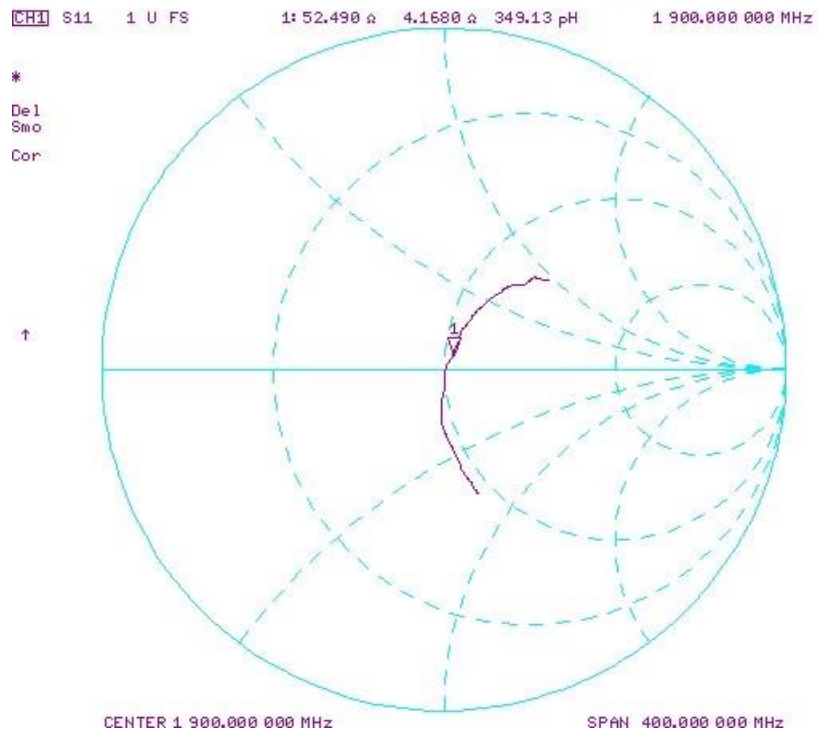
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

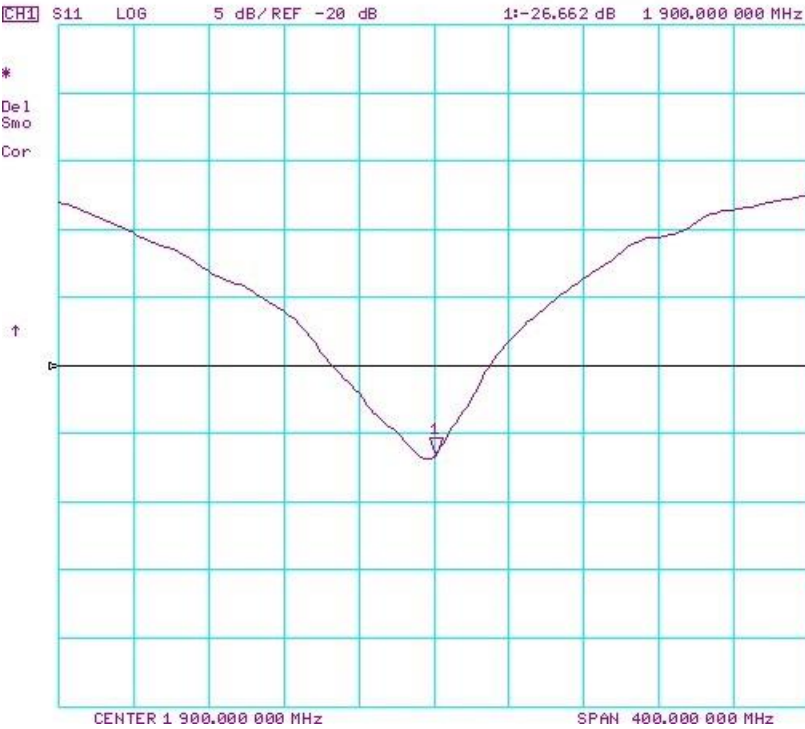
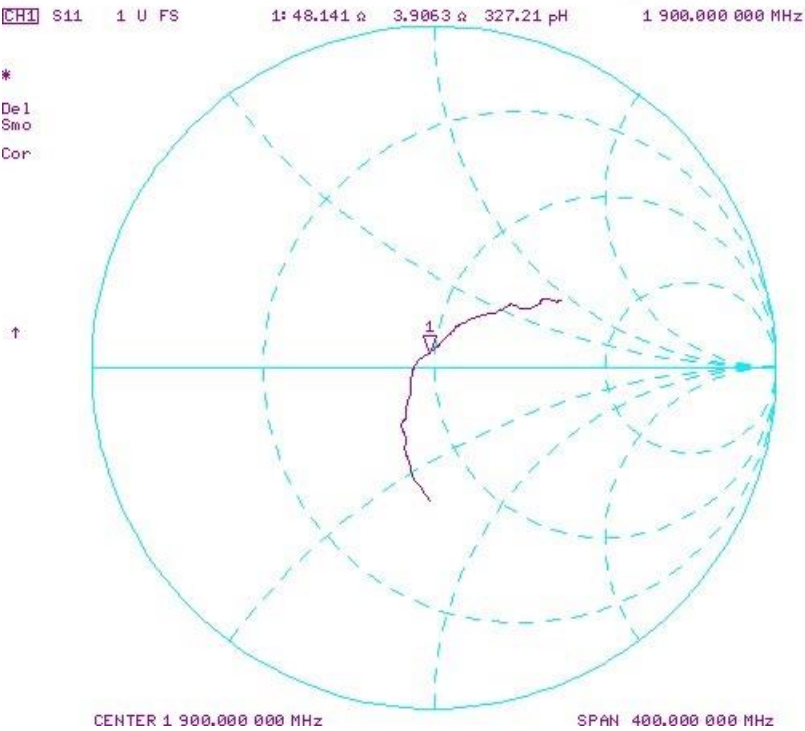
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 8/16/2017        | 8/1/2018       | 1.203                             | 3.92                                             | 3.81                                   | -2.81%           | 2.06                                              | 1.97                                    | -4.37%            | 54                                    | 52.5                               | 1.5                   | 5.7                                        | 4.2                                     | 1.5                        | -23.5                             | -26.5                          | -12.80%       | PASS      |

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 8/16/2017        | 8/1/2018       | 1.203                             | 3.95                                             | 4.29                                   | 8.61%            | 2.09                                              | 2.21                                    | 5.74%             | 49.6                                  | 48.1                               | 1.5                   | 6.5                                        | 3.9                                     | 2.6                        | -23.7                             | -26.7                          | -12.70%       | PASS      |

## Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d181\_Sep17**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d181**

Calibration procedure(s) **QA CAL-05.v9**  
**Calibration procedure for dipole validation kits above 700 MHz**

SC ✓  
10/03/2017

Calibration date: **September 07, 2017**

SC ✓  
9/7/2018

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 ( $22 \pm 3$ )°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-17 (No. 217-02521/02522)   | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)         | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)         | Apr-18                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)         | Apr-18                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)         | Apr-18                 |
| Reference Probe EX3DV4      | SN: 7349           | 31-May-17 (No. EX3-7349_May17)    | May-18                 |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)    | Mar-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: 100972         | 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-16) | In house check: Oct-17 |

Calibrated by: **Jeton Kastrati** Name  
Laboratory Technician Function

Approved by: **Katja Pokovic** Name  
Technical Manager Function

Signature

Issued: September 7, 2017

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



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   | 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 | 39.0 $\pm$ 6 % | 1.38 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 | 9.85 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>39.5 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                                |
| SAR measured                                            | 250 mW input power | 5.15 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.6 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## 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 | 54.3 $\pm$ 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 | 9.65 W/kg                                      |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>39.5 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                                |
| SAR measured                                            | 250 mW input power | 5.14 W/kg                                      |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>20.9 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $53.7 \Omega + 4.6 j\Omega$ |
| Return Loss                          | - 24.9 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $49.2 \Omega + 5.6 j\Omega$ |
| Return Loss                          | - 24.8 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.200 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 | August 23, 2013 |

## DASY5 Validation Report for Head TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d181**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.38$  S/m;  $\epsilon_r = 39$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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 = 106.8 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 18.5 W/kg

**SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.15 W/kg**

Maximum value of SAR (measured) = 14.8 W/kg



0 dB = 14.8 W/kg = 11.70 dBW/kg

# Impedance Measurement Plot for Head TSL

7 Sep 2017 09:10:32  
 CH1 S11 1 U FS 3: 53.668  $\Omega$  4.5957  $\Omega$  384.96 pF 1 900.000 000 MHz

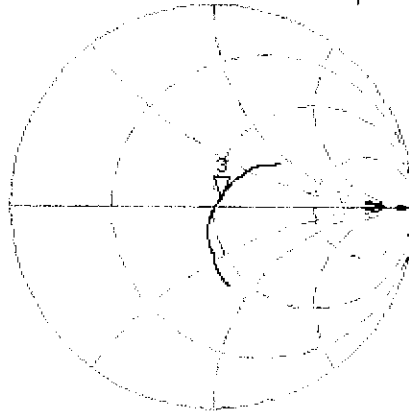
\*

De1

CA

Avg  
16

H1d

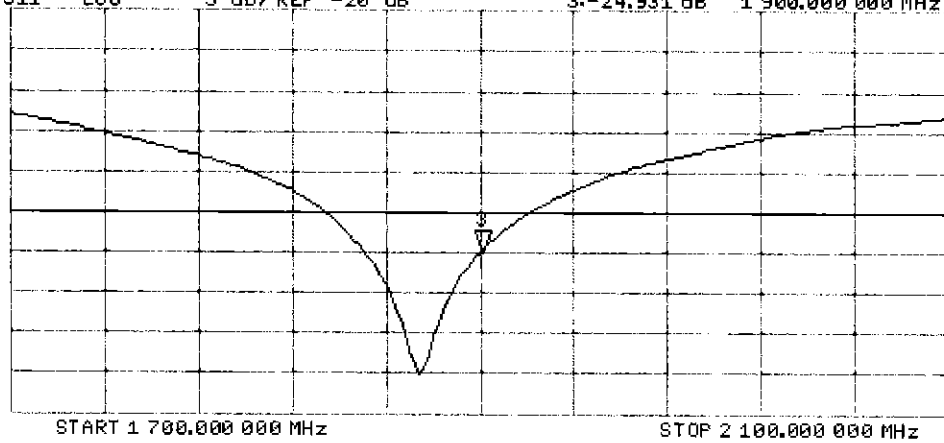


CH2 S11 LOG 5 dB/REF -20 dB 3:-24.931 dB 1 900.000 000 MHz

CA

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d181**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 54.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

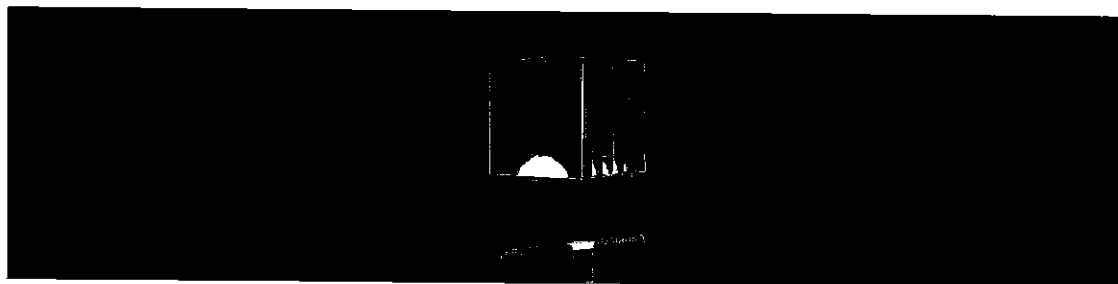
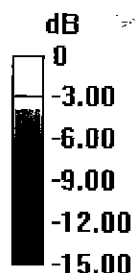
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.4 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.0 W/kg

**SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.14 W/kg**

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

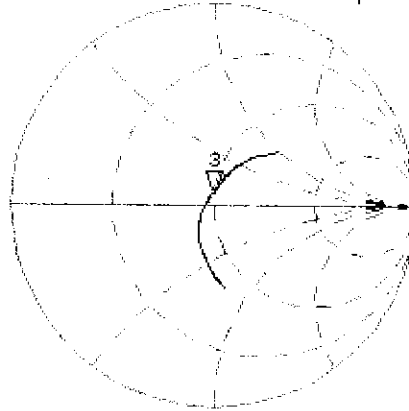


0 dB = 13.8 W/kg = 11.40 dBW/kg

# Impedance Measurement Plot for Body TSL

7 Sep 2017 09:09:41  
 CH1 S11 1 U FS 3: 49.201  $\Omega$  5.6484  $\Omega$  473.15 pF 1 900.000 000 MHz

\*  
 Del  
 CA



Avg  
 15

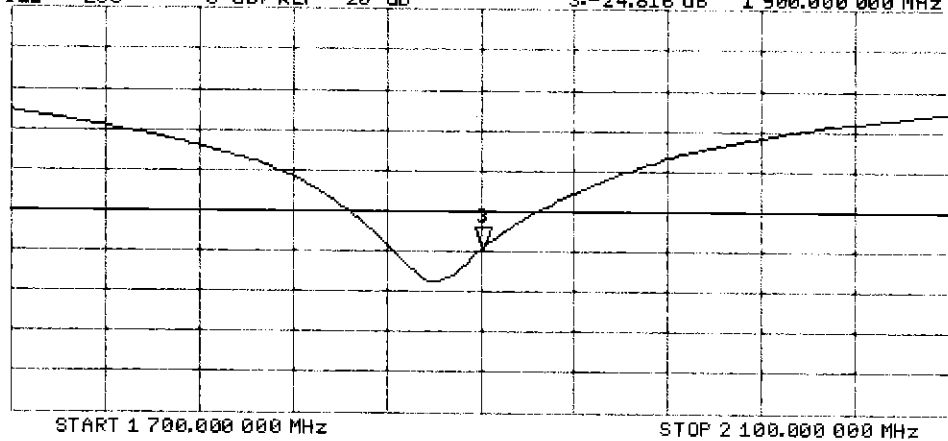
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3: -24.816 dB 1 900.000 000 MHz

CA

Avg  
 15

H1d



# Certification of Calibration

Object D1900V2 – SN: 5d181

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

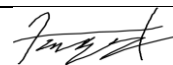
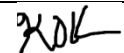
Extended Calibration date: September 07, 2018

Description: SAR Validation Dipole at 1900 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 9/14/2017  | Annual       | 9/14/2018  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 3/19/2018  | Annual       | 3/19/2019  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2496A   | Power Meter                                             | 10/9/2017  | Annual       | 10/9/2018  | 1138001       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/15/2017 | Annual       | 11/15/2018 | 1339007       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/22/2017 | Annual       | 11/22/2018 | 1339008       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/14/2017  | Biennial     | 2/14/2019  | 170112507     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | PE5011-1  | Torque Wrench                                           | 7/19/2017  | Biennial     | 7/19/2019  | N/A           |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 5/15/2018  | Annual       | 5/15/2019  | 1070          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 9/18/2017  | Annual       | 9/18/2018  | 3287          |
| SPEAG                 | DAE4      | Data Acquisition Electronics                            | 1/26/2018  | Annual       | 1/26/2019  | 1533          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 3/13/2018  | Annual       | 3/13/2019  | 3131          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 3/7/2018   | Annual       | 3/7/2019   | 604           |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name            | Function                 | Signature                                                                             |
|----------------|-----------------|--------------------------|---------------------------------------------------------------------------------------|
| Calibrated By: | Sangmin Cha     | Team Lead Engineer       |  |
| Approved By:   | Kaitlin O'Keefe | Senior Technical Manager |  |

# DIPOLE CALIBRATION EXTENSION

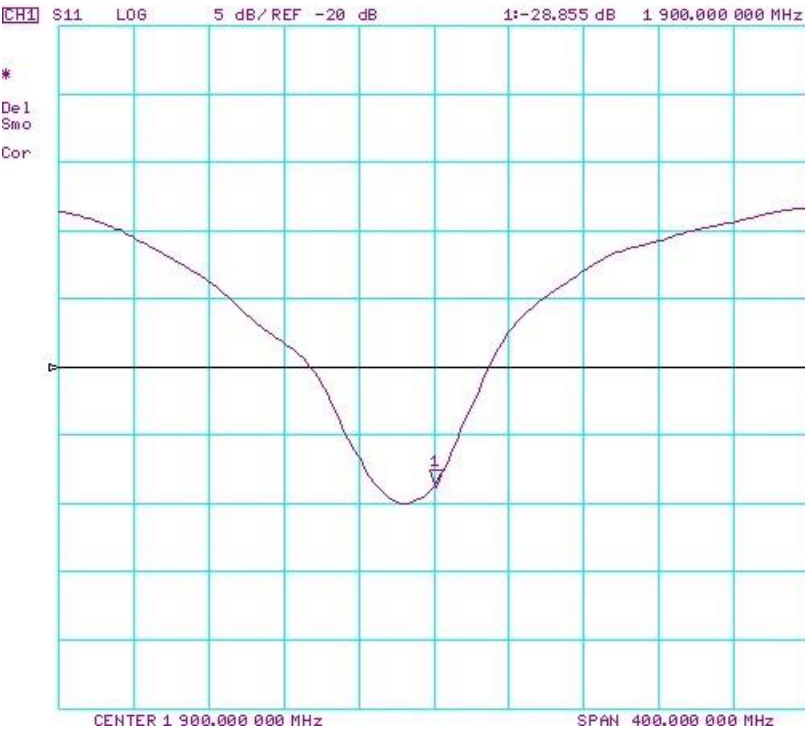
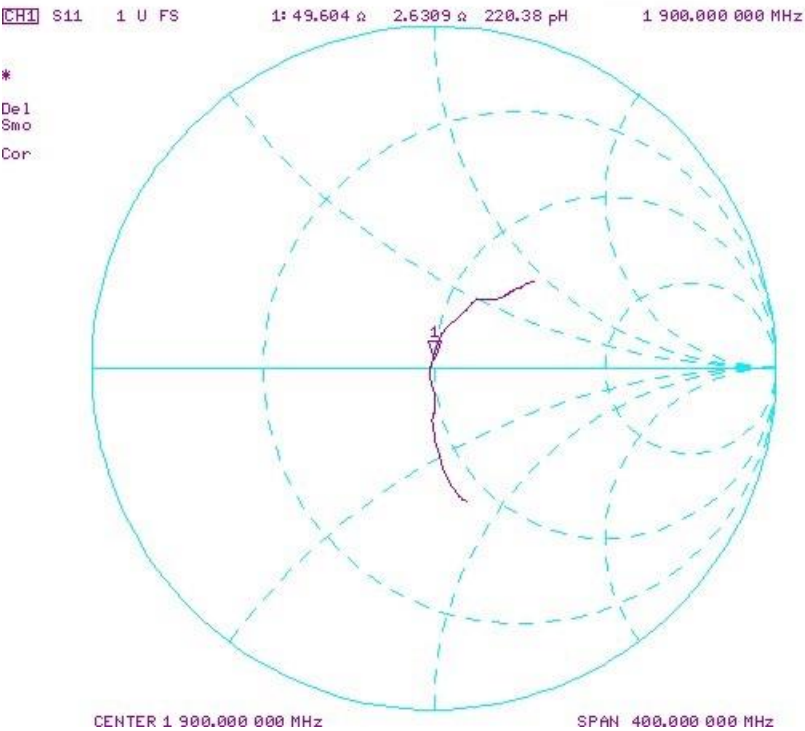
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

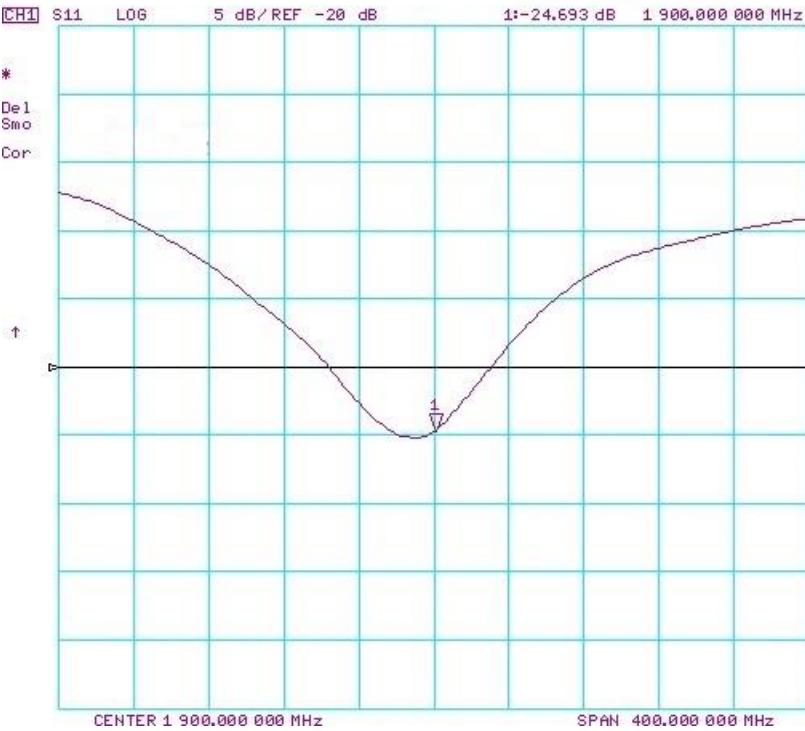
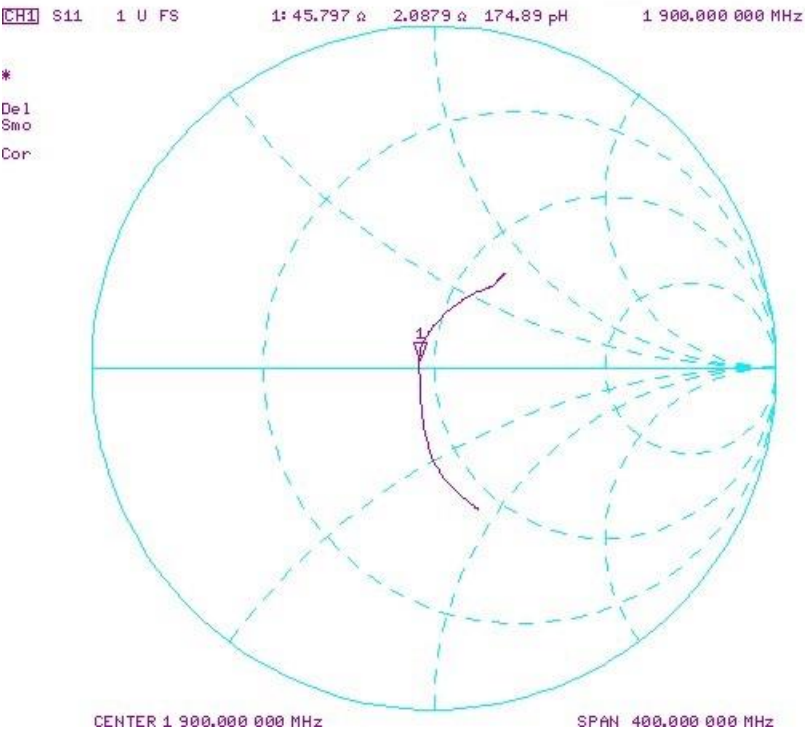
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/7/2017         | 9/7/2018       | 1.2                               | 3.95                                             | 3.99                                   | 1.01%            | 2.06                                              | 2.07                                    | 0.49%             | 53.7                                  | 49.6                               | 4.1                   | 4.6                                        | 2.6                                     | 2                          | -24.9                             | -28.9                          | -16.10%       | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 9/7/2017         | 9/7/2018       | 1.2                               | 3.95                                             | 4.13                                   | 4.56%            | 2.09                                              | 2.14                                    | 2.39%             | 49.2                                  | 45.8                               | 3.4                   | 5.6                                        | 2.1                                     | 3.5                        | -24.8                             | -24.7                          | 0.40%         | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 **PC Test**

Certificate No: **D2300V2-1038\_Mar18**

## CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1038**

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

SC ✓  
 3/21/18

Calibration date: **March 07, 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 ( $22 \pm 3$ )°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-17 (No. 217-02521/02522) | Apr-18                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)       | Apr-18                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)       | Apr-18                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)       | Apr-18                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)       | 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 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: 100972     | 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: **Claudio Leubler**      Name: **Claudio Leubler**      Function: **Laboratory Technician**

Approved by: **Katja Pokovic**      Name: **Katja Pokovic**      Function: **Technical Manager**

Signature

Issued: March 9, 2018

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



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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                  | V52.10.0    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2300 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.5           | 1.67 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 38.6 $\pm$ 6 % | 1.70 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 | 12.5 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>49.3 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                                |
| SAR measured                                            | 250 mW input power | 5.94 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>23.6 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.9           | 1.81 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.6 $\pm$ 6 % | 1.86 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 | 11.9 W/kg                                      |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>46.7 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                         |                    |                                                |
|---------------------------------------------------------|--------------------|------------------------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                                |
| SAR measured                                            | 250 mW input power | 5.69 W/kg                                      |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>22.5 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.8 $\Omega$ - 4.9 j $\Omega$ |
| Return Loss                          | - 25.2 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 45.9 $\Omega$ - 3.4 j $\Omega$ |
| Return Loss                          | - 25.0 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.170 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 | July 02, 2013 |

## DASY5 Validation Report for Head TSL

Date: 07.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1038**

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.7$  S/m;  $\epsilon_r = 38.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08); 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:**

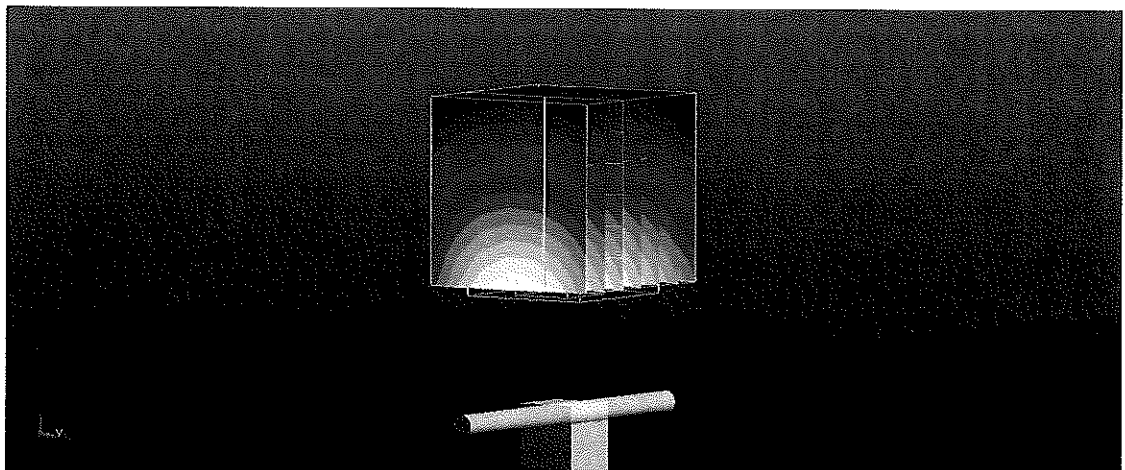
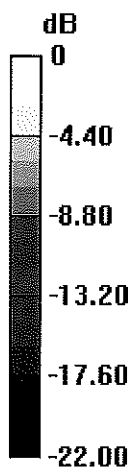
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 112.4 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 24.5 W/kg

**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.94 W/kg**

Maximum value of SAR (measured) = 19.6 W/kg

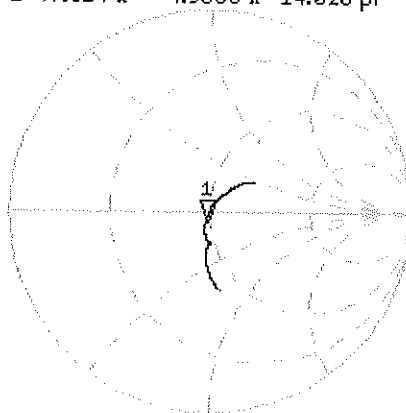


0 dB = 19.6 W/kg = 12.92 dBW/kg

# Impedance Measurement Plot for Head TSL

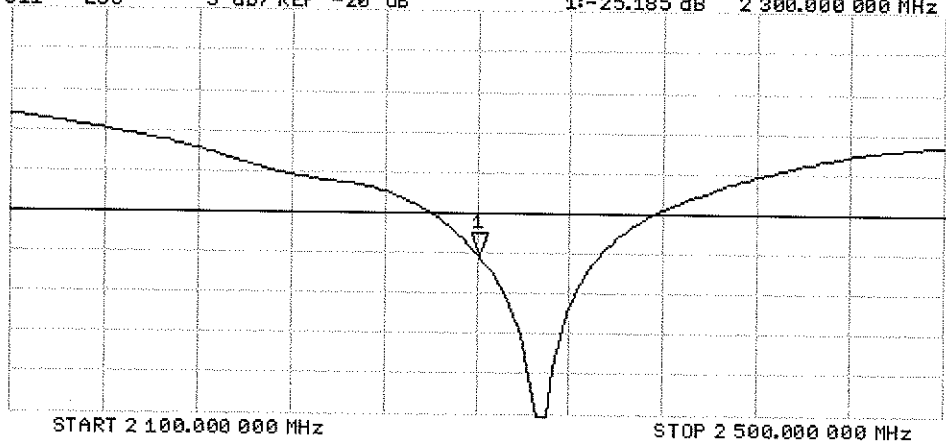
7 Mar 2018 13:16:07  
 CH1 S11 1 U FS 1: 47.824  $\Omega$  -4.9336  $\Omega$  14.026 pF 2 300.000 000 MHz

\*  
 Del  
 Cor  
 Avg  
 16  
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-25.185 dB 2 300.000 000 MHz

Cor  
 Avg  
 16  
 H1d



## DASY5 Validation Report for Body TSL

Date: 07.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1038**

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.86$  S/m;  $\epsilon_r = 51.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08); 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:**

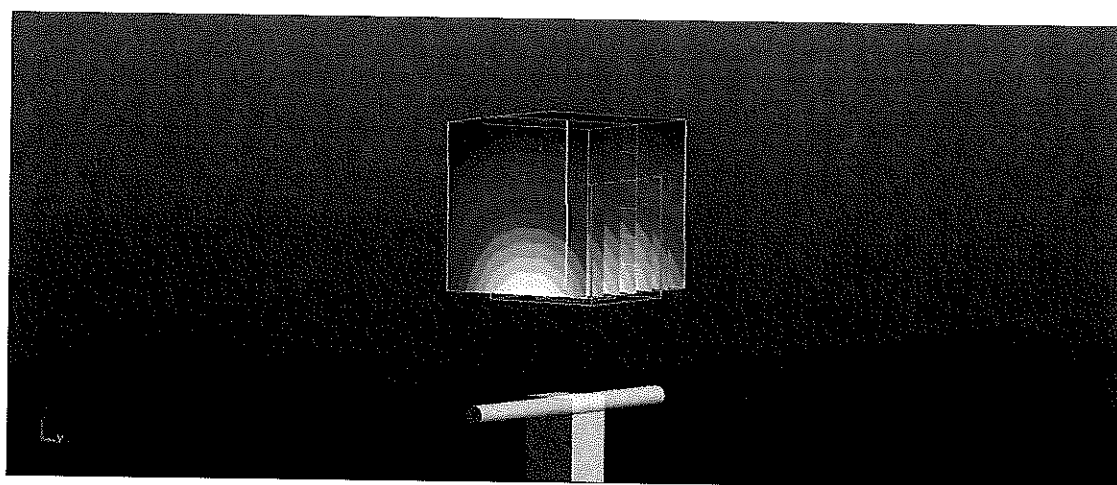
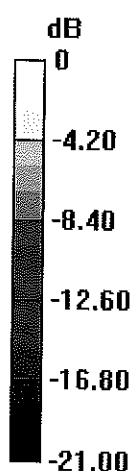
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.5 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 23.0 W/kg

**SAR(1 g) = 11.9 W/kg; SAR(10 g) = 5.69 W/kg**

Maximum value of SAR (measured) = 18.2 W/kg

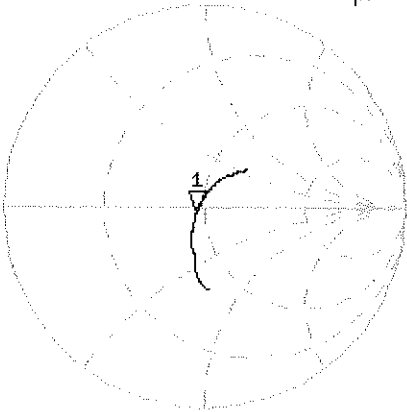


0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Body TSL

7 Mar 2018 13:11:08  
CH1 S11 1 U FS 1: 45.861  $\Omega$  -3.4160  $\Omega$  20.257 pF 2 300.000 000 MHz

\*  
De1  
Cor



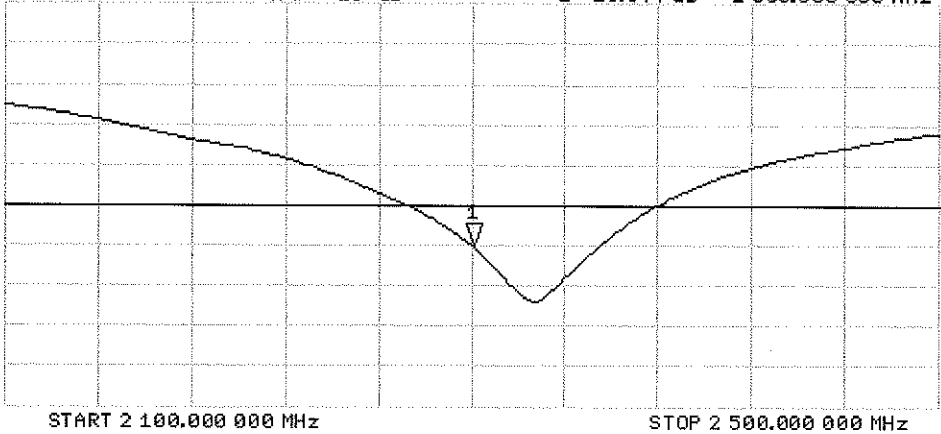
Avg  
16  
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.044 dB 2 300.000 000 MHz

Cor

Avg  
16

H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2450V2-945\_May18**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:945**

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

SC ✓  
 5/31/2018

Calibration date: **May 16, 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 ( $22 \pm 3$ )°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: 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: 100972     | 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 |

|                |               |                       |           |
|----------------|---------------|-----------------------|-----------|
|                | Name          | Function              | Signature |
| Calibrated by: | Manu Seltz    | Laboratory Technician |           |
| Approved by:   | Katja Pokovic | Technical Manager     |           |

Issued: May 17, 2018

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Accreditation No.: **SCS 0108**

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**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.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.1    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 2450 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 38.2 $\pm$ 6 % | 1.85 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 13.0 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>51.0 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 6.02 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.8 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 52.3 $\pm$ 6 % | 1.99 mho/m $\pm$ 6 % |
| <b>Body TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 12.5 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>49.4 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 5.83 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>23.2 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $56.1 \Omega + 3.7 j\Omega$ |
| Return Loss                          | - 23.5 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $51.9 \Omega + 5.0 j\Omega$ |
| Return Loss                          | - 25.7 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.157 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 | March 15, 2014 |

## DASY5 Validation Report for Head TSL

Date: 16.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 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:**

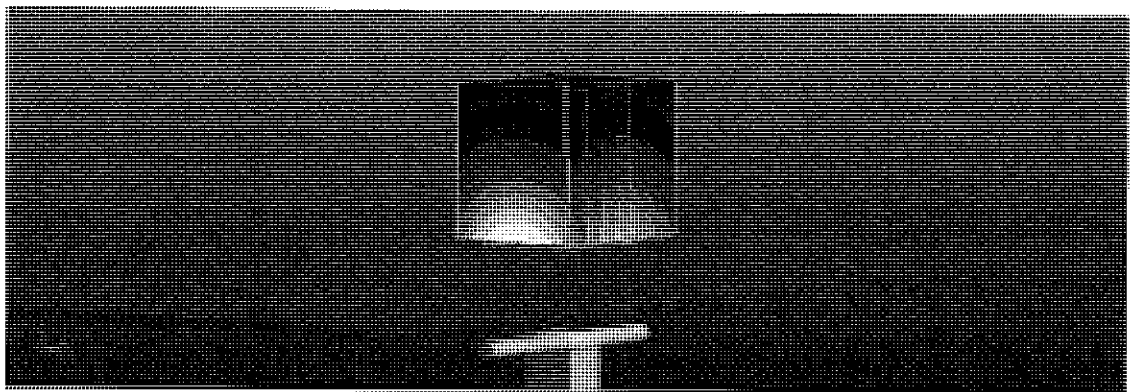
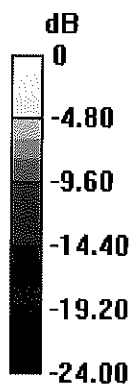
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 114.8 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.9 W/kg

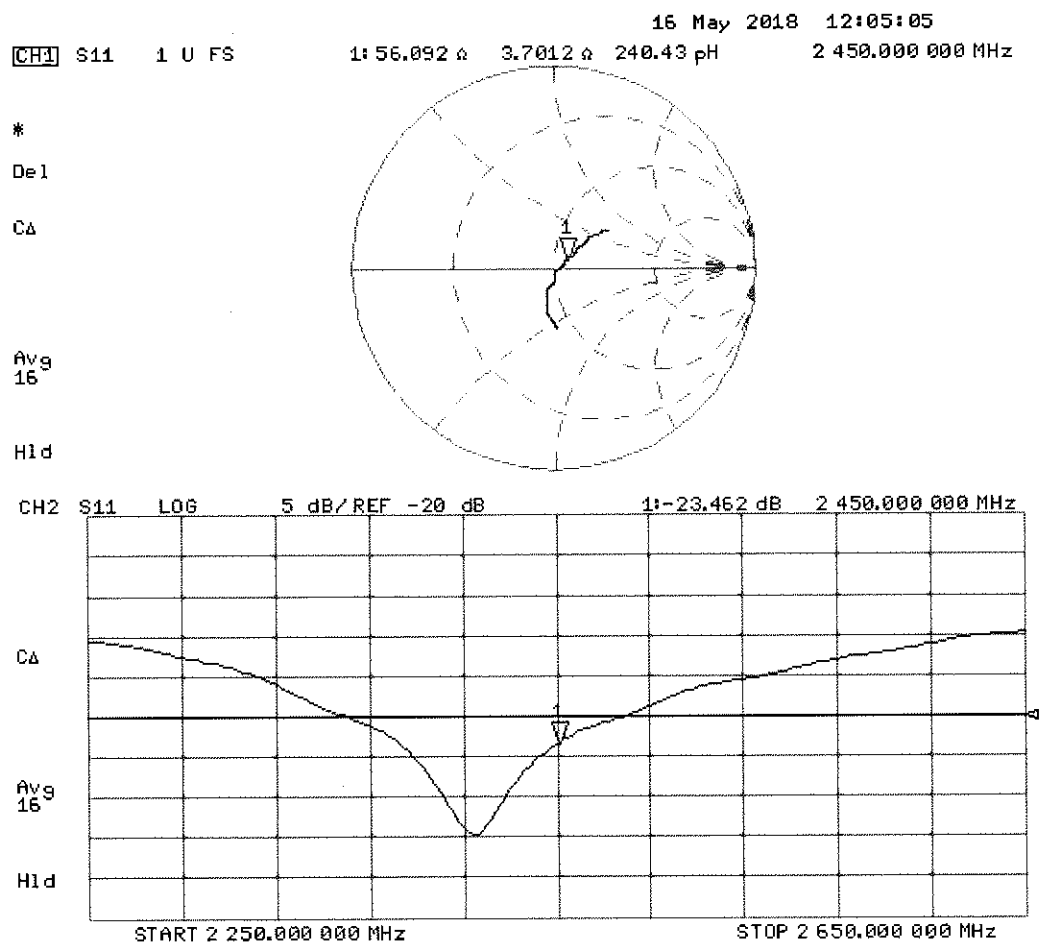
**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.02 W/kg**

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



0 dB = 21.4 W/kg = 13.30 dBW/kg

# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 16.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.99$  S/m;  $\epsilon_r = 52.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 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:**

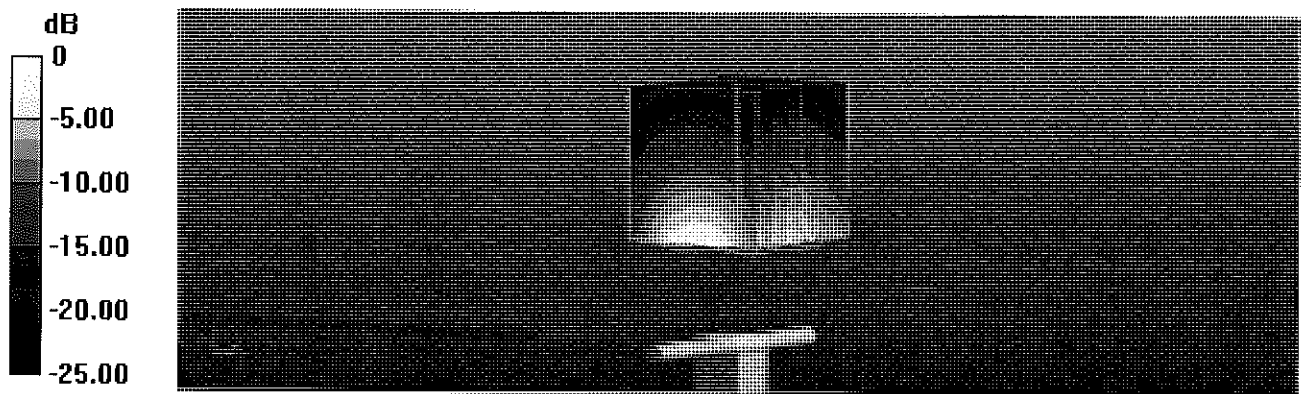
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.8 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 25.0 W/kg

**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.83 W/kg**

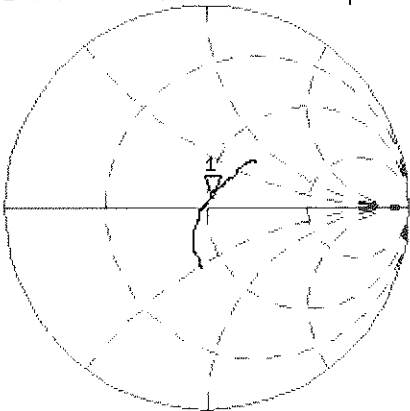
Maximum value of SAR (measured) = 20.2 W/kg



Impedance Measurement Plot for Body TSL

16 May 2018 12:03:43  
[CH1] S11 1 U FS 1: 51.910  $\Omega$  4.9629  $\Omega$  322.40  $\mu$ H 2 450.000 000 MHz

\*  
De1  
CA



Avg  
16

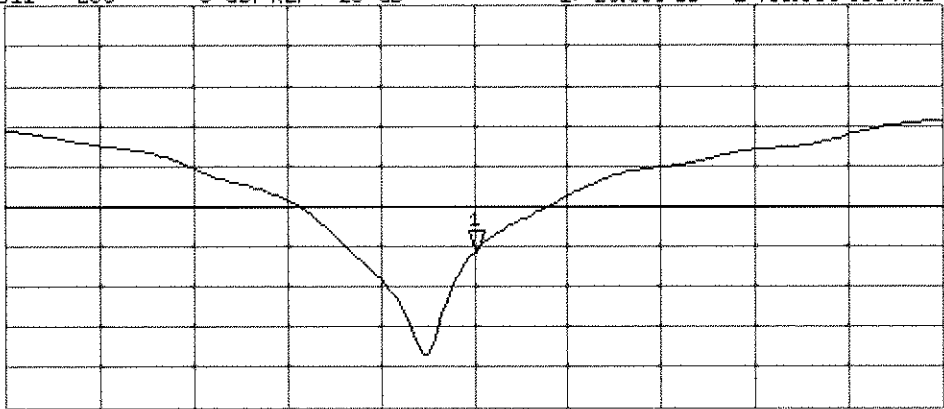
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.659 dB 2 450.000 000 MHz

CA

Avg  
16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz



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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2600V2-1042\_Jun17**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1042**

Calibration procedure(s) **QA CAL-05.v9**  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **June 07, 2017**

*BN✓*  
*8/3/2018*  
*SC✓*  
*6/1/2018*

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 ± 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-17 (No. 217-02521/02522) | Apr-18                |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)       | Apr-18                |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)       | Apr-18                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)       | Apr-18                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)       | Apr-18                |
| Reference Probe EX3DV4      | SN: 7349           | 31-Dec-16 (No. EX3-7349_Dec16)  | Dec-17                |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)  | Mar-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: 100972     | 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-16) | In house check: Oct-17 |

Calibrated by: **Johannes Kurikka**      Function: **Laboratory Technician**

Approved by: **Katja Pokovic**      Technical Manager

Signature

*[Signature]*  
*[Signature]*

Issued: June 8, 2017

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Accreditation No.: **SCS 0108**

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**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                    | 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 | 37.3 $\pm$ 6 % | 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 | 14.7 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 57.4 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 | 6.46 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 25.5 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 | 51.7 $\pm$ 6 % | 2.22 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 | 14.0 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 55.1 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 | 6.19 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.5 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 | 48.0 $\Omega$ - 8.4 j $\Omega$ |
| Return Loss                          | - 21.2 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 45.5 $\Omega$ - 6.2 j $\Omega$ |
| Return Loss                          | - 22.0 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.149 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: 07.06.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1042**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 37.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:**

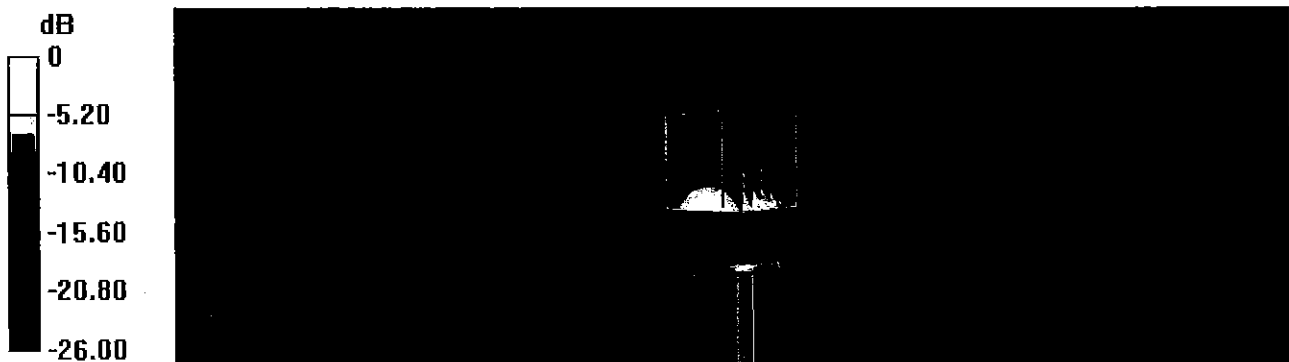
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 113.5 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 32.4 W/kg

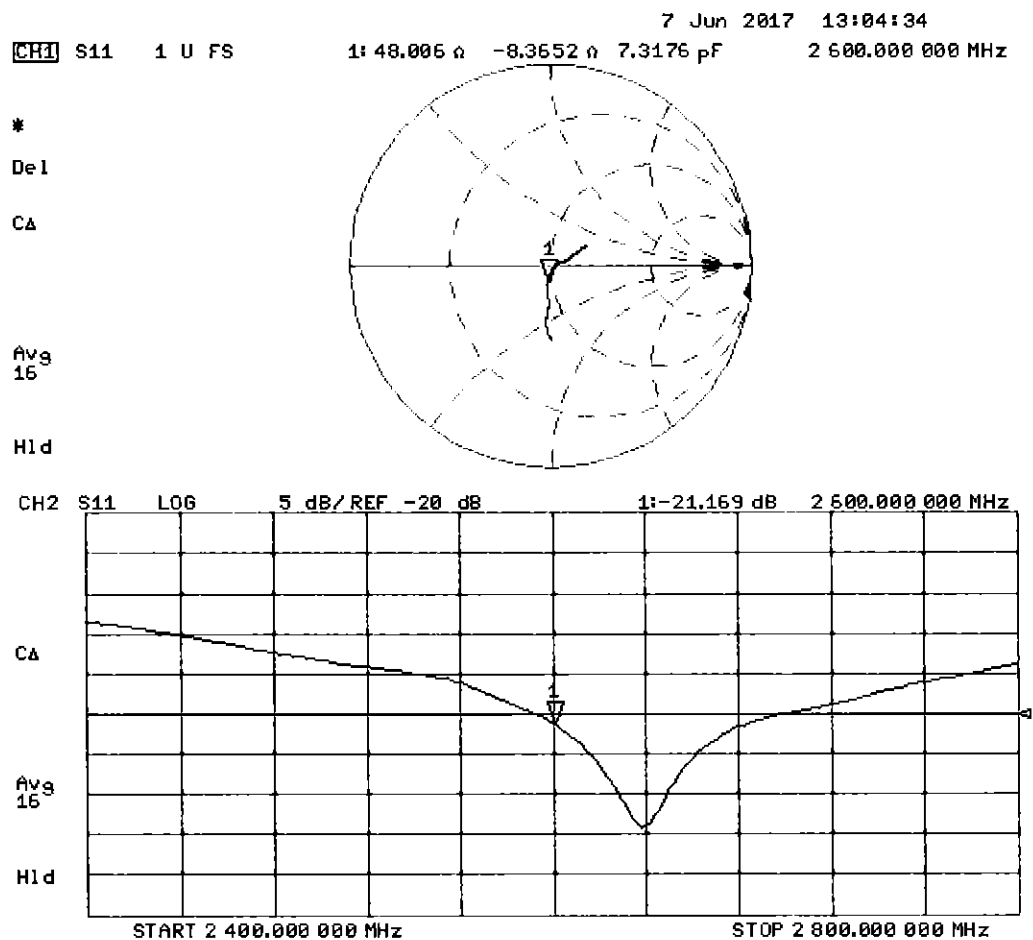
**SAR(1 g) = 14.7 W/kg; SAR(10 g) = 6.46 W/kg**

Maximum value of SAR (measured) = 24.8 W/kg



0 dB = 24.8 W/kg = 13.94 dBW/kg

# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 07.06.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1042**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.22$  S/m;  $\epsilon_r = 51.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:**

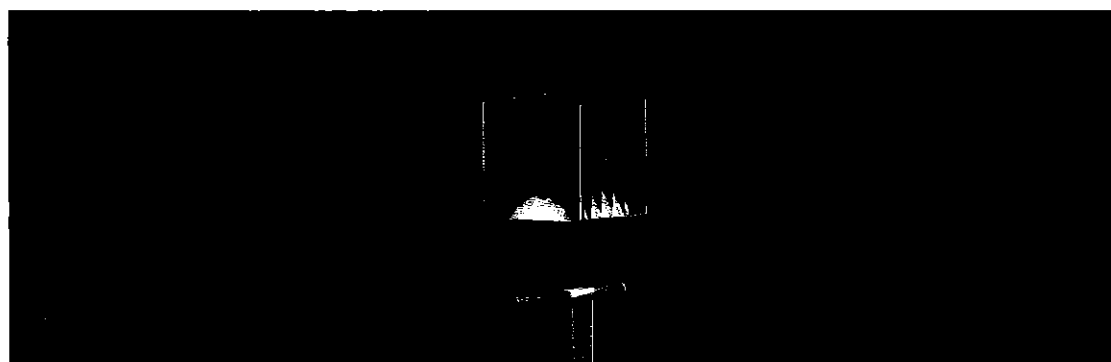
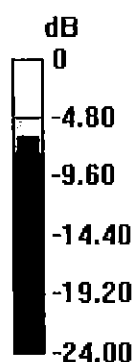
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.5 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 29.8 W/kg

**SAR(1 g) = 14 W/kg; SAR(10 g) = 6.19 W/kg**

Maximum value of SAR (measured) = 22.5 W/kg

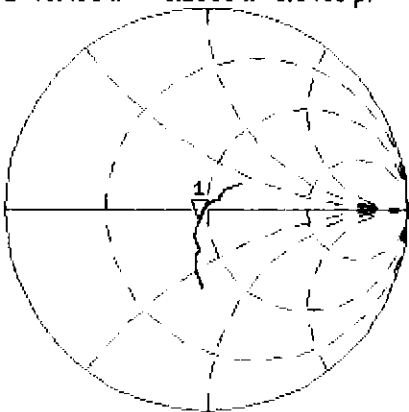


0 dB = 22.5 W/kg = 13.52 dBW/kg

Impedance Measurement Plot for Body TSL

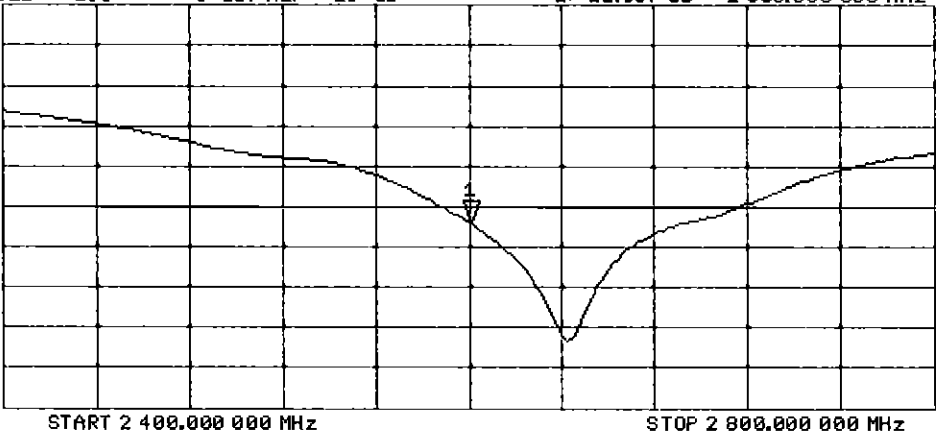
7 Jun 2017 13:03:35  
CH1 S11 1 U FS 1: 45.490  $\Omega$  -6.1563  $\Omega$  9.9433 pF 2 600.000 000 MHz

\*  
De1  
CA  
Avg  
16  
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-21.967 dB 2 600.000 000 MHz

CA  
Avg  
16  
H1d



# Certification of Calibration

Object D2600V2 – SN: 1042

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

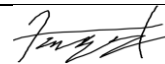
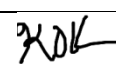
Extended Calibration date: June 01, 2018

Description: SAR Validation Dipole at 2600 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 9/14/2017  | Annual       | 9/14/2018  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 3/19/2018  | Annual       | 3/19/2019  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2496A   | Power Meter                                             | 10/9/2017  | Annual       | 10/9/2018  | 1138001       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/15/2017 | Annual       | 11/15/2018 | 1339007       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/22/2017 | Annual       | 11/22/2018 | 1339008       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/14/2017  | Biennial     | 2/14/2019  | 170112507     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/1/2017   | Annual       | 6/1/2018   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | PE5011-1  | Torque Wrench                                           | 7/19/2017  | Biennial     | 7/19/2019  | N/A           |
| SPEAG                 | DAKS-3.5  | Portable DAK                                            | 9/5/2017   | Annual       | 9/5/2018   | 1045          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 3/13/2018  | Annual       | 3/13/2019  | 3131          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 1/26/2018  | Annual       | 1/26/2019  | 7490          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 3/7/2018   | Annual       | 3/7/2019   | 604           |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 1/26/2018  | Annual       | 1/26/2019  | 1532          |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name            | Function                 | Signature                                                                             |
|----------------|-----------------|--------------------------|---------------------------------------------------------------------------------------|
| Calibrated By: | Sangmin Cha     | Biomedical Engineer II   |  |
| Approved By:   | Kaitlin O'Keefe | Senior Technical Manager |  |

# DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

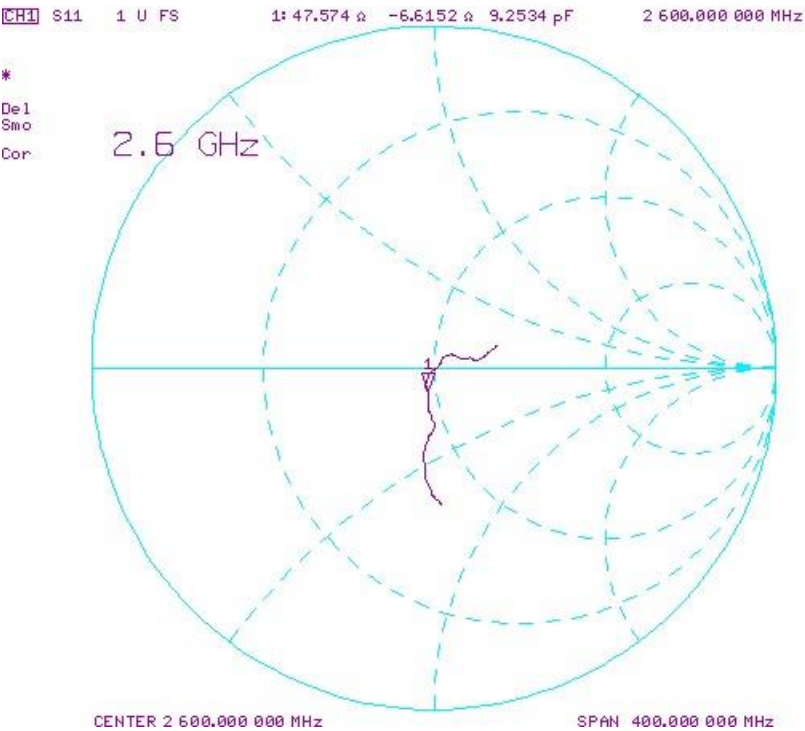
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

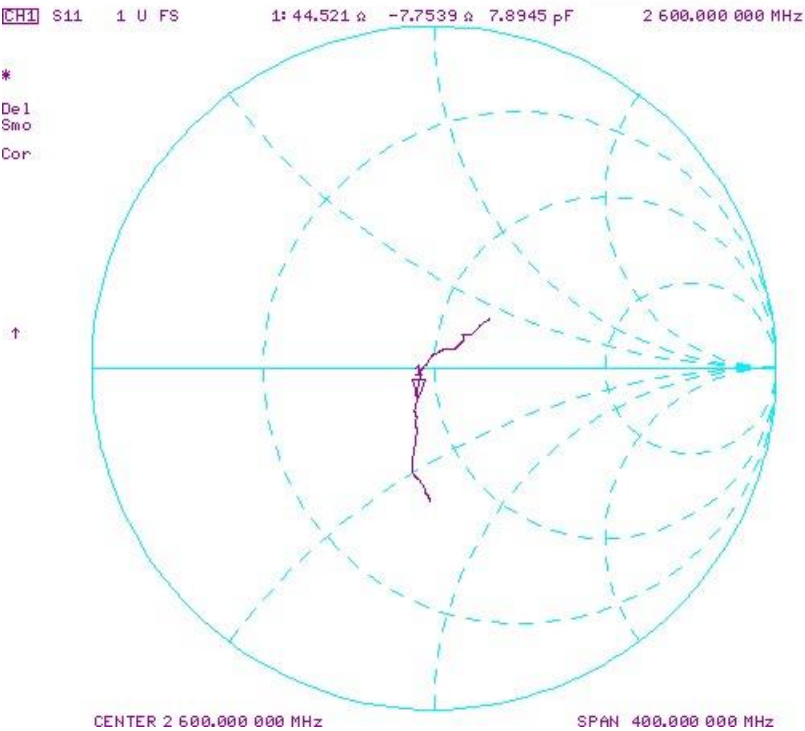
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 6/7/2017         | 6/1/2018       | 1.149                             | 5.74                                             | 6.14                                   | 6.97%            | 2.55                                              | 2.64                                    | 3.53%             | 48                                    | 47.6                               | 0.4                   | -8.4                                       | -6.6                                    | 1.8                        | -21.2                             | -23.6                          | -11.30%       | PASS      |

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 6/7/2017         | 6/1/2018       | 1.149                             | 5.51                                             | 5.3                                    | -3.81%           | 2.45                                              | 2.33                                    | -4.90%            | 45.5                                  | 44.5                               | 1                     | -6.2                                       | -7.8                                    | 1.6                        | -22                               | -21.1                          | 4.10%         | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 **PC Test**

Certificate No: **D2600V2-1069\_Sep17**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1069**

Calibration procedure(s) **QA CAL-05.v9**  
**Calibration procedure for dipole validation kits above 700 MHz**

SCV  
10/03/2017

Calibration date: **September 11, 2017**

SCV  
9/10/2018

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 ( $22 \pm 3$ )°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-17 (No. 217-02521/02522)   | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)         | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)         | Apr-18                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)         | Apr-18                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)         | Apr-18                 |
| Reference Probe EX3DV4      | SN: 7349           | 31-May-17 (No. EX3-7349_May17)    | May-18                 |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)    | Mar-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: 100972         | 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-16) | In house check: Oct-17 |

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

Signature

*M. Weber*

Approved by: **Katja Pokovic** Name  
Function: **Technical Manager**

*Katja Pokovic*

Issued: September 11, 2017

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



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   | 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.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.0    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 2600 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 39.0           | 1.96 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 37.2 $\pm$ 6 % | 2.03 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 14.6 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>56.9 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 6.45 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>25.4 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 52.5           | 2.16 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 51.4 $\pm$ 6 % | 2.23 mho/m $\pm$ 6 % |
| <b>Body TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                             |                    |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                                |
| SAR measured                                                | 250 mW input power | 14.1 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>55.3 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 6.26 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>24.8 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.1 $\Omega$ - 6.1 j $\Omega$ |
| Return Loss                          | - 24.1 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.2 $\Omega$ - 4.7 j $\Omega$ |
| Return Loss                          | - 24.1 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.152 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 | July 17, 2013 |

## DASY5 Validation Report for Head TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1069**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.03$  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(7.96, 7.96, 7.96); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

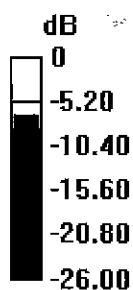
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.4 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.2 W/kg

**SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.45 W/kg**

Maximum value of SAR (measured) = 24.5 W/kg

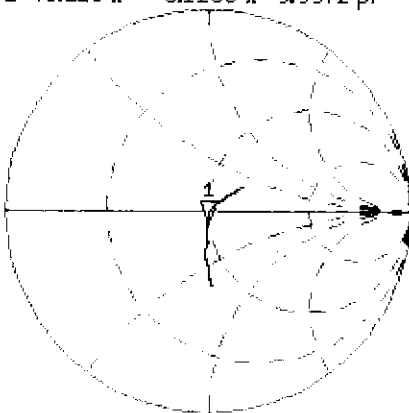


0 dB = 24.5 W/kg = 13.89 dBW/kg

# Impedance Measurement Plot for Head TSL

11 Sep 2017 12:04:09  
 [CH1] S11 1 U FS 1: 49.115  $\Omega$  -6.1230  $\Omega$  9.9972 pF 2 600.000 000 MHz

\*  
 Del  
 CA



Avg  
 16

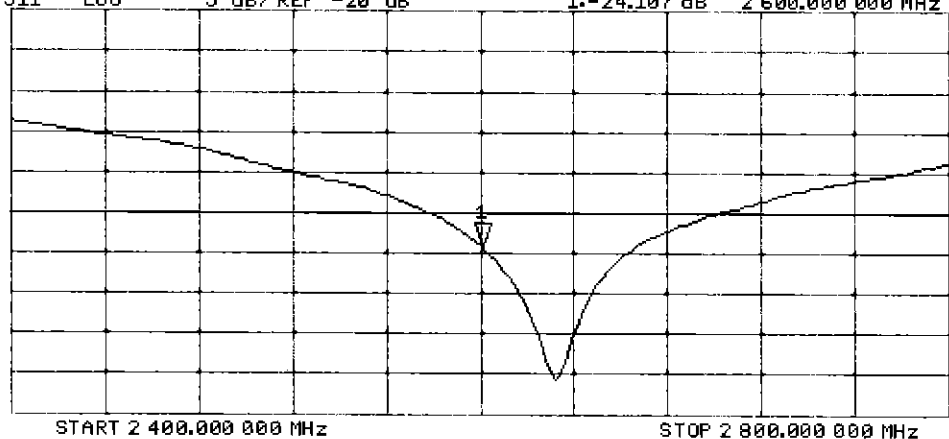
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.107 dB 2 600.000 000 MHz

CA

Avg  
 16

H1d



START 2 400.000 000 MHz

STOP 2 800.000 000 MHz

## DASY5 Validation Report for Body TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1069**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.23$  S/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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:

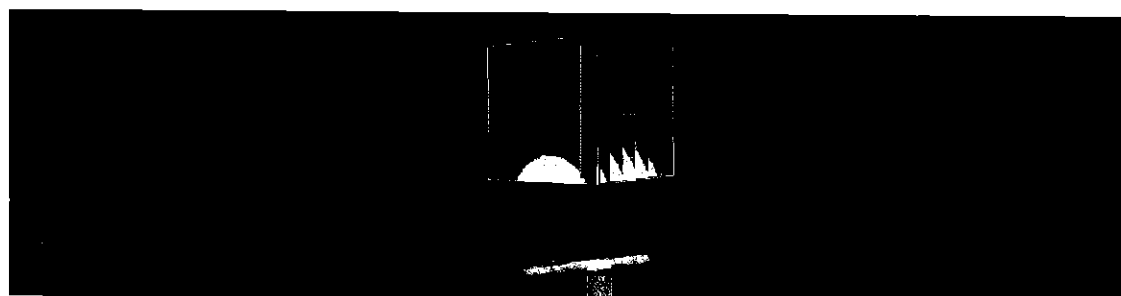
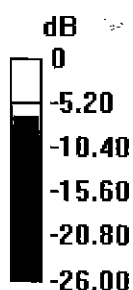
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.7 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 29.9 W/kg

**SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.26 W/kg**

Maximum value of SAR (measured) = 22.9 W/kg

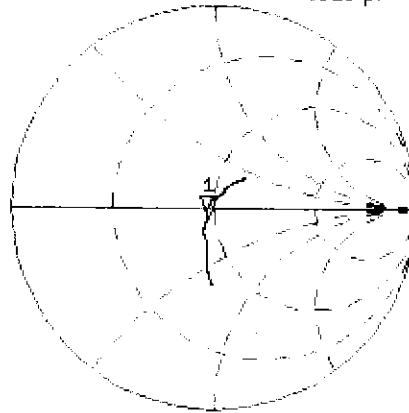


0 dB = 22.9 W/kg = 13.60 dBW/kg

# Impedance Measurement Plot for Body TSL

11 Sep 2017 12:03:28  
 CH1 S11 1 U FS 1: 46.244  $\Omega$  -4.7051  $\Omega$  13.010 pF 2 600.000 000 MHz

\*  
 Del  
 CA



Avg  
 16

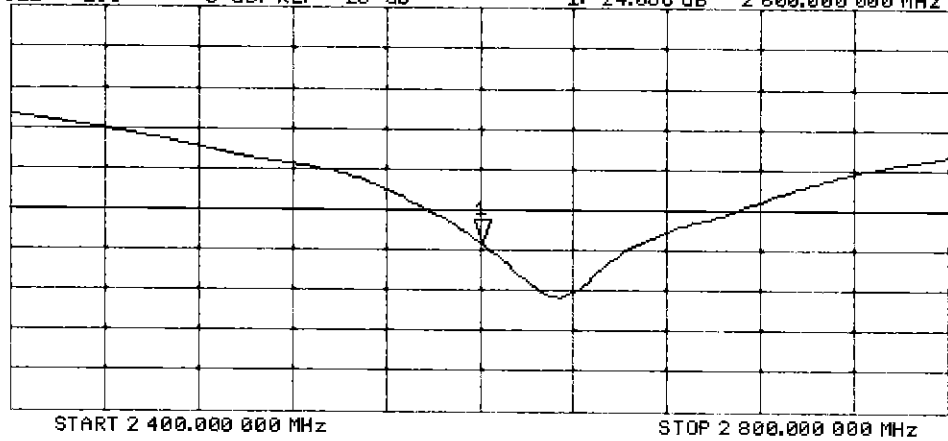
H1d

CH2 S11 L06 5 dB/REF -20 dB 1:-24.086 dB 2 600.000 000 MHz

CA

Avg  
 16

H1d



START 2 400.000 000 MHz

STOP 2 800.000 000 MHz

# Certification of Calibration

Object D2600V2 – SN: 1069

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

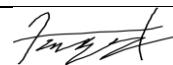
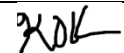
Extended Calibration date: September 10, 2018

Description: SAR Validation Dipole at 2600 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 9/14/2017  | Annual       | 9/14/2018  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 3/19/2018  | Annual       | 3/19/2019  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2496A   | Power Meter                                             | 10/9/2017  | Annual       | 10/9/2018  | 1138001       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/15/2017 | Annual       | 11/15/2018 | 1339007       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/22/2017 | Annual       | 11/22/2018 | 1339008       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/14/2017  | Biennial     | 2/14/2019  | 170112507     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/4/2018   | Annual       | 6/4/2019   | MY53401181    |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | NLP-2950+ | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2209-10 | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Pasternack            | PE5011-1  | Torque Wrench                                           | 7/19/2017  | Biennial     | 7/19/2019  | N/A           |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 5/15/2018  | Annual       | 5/15/2019  | 1070          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 9/18/2017  | Annual       | 9/18/2018  | 3287          |
| SPEAG                 | DAE4      | Data Acquisition Electronics                            | 1/26/2018  | Annual       | 1/26/2019  | 1533          |
| SPEAG                 | ES3DV3    | SAR Probe                                               | 4/12/2018  | Annual       | 4/12/2019  | 3275          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 4/12/2018  | Annual       | 4/12/2019  | 501           |

Measurement Uncertainty =  $\pm 23\%$  (k=2)

|                | Name            | Function                 | Signature                                                                             |
|----------------|-----------------|--------------------------|---------------------------------------------------------------------------------------|
| Calibrated By: | Sangmin Cha     | Team Lead Engineer       |  |
| Approved By:   | Kaitlin O'Keefe | Senior Technical Manager |  |

# DIPOLE CALIBRATION EXTENSION

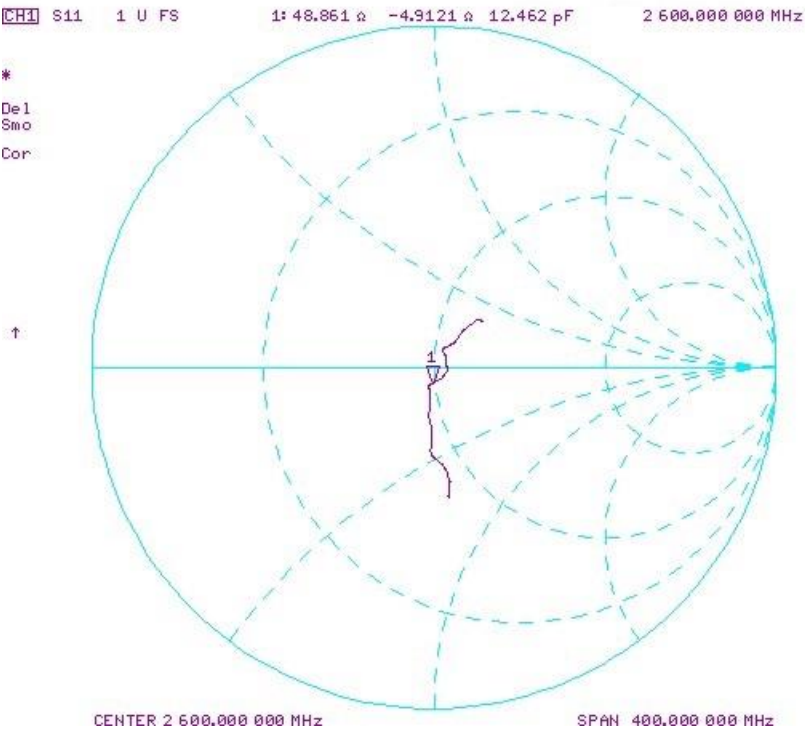
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

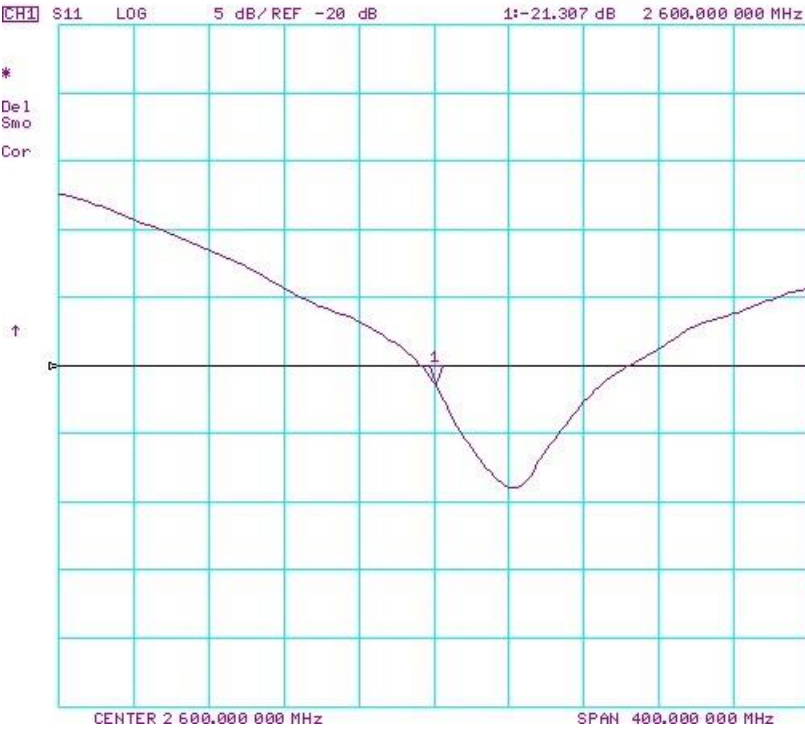
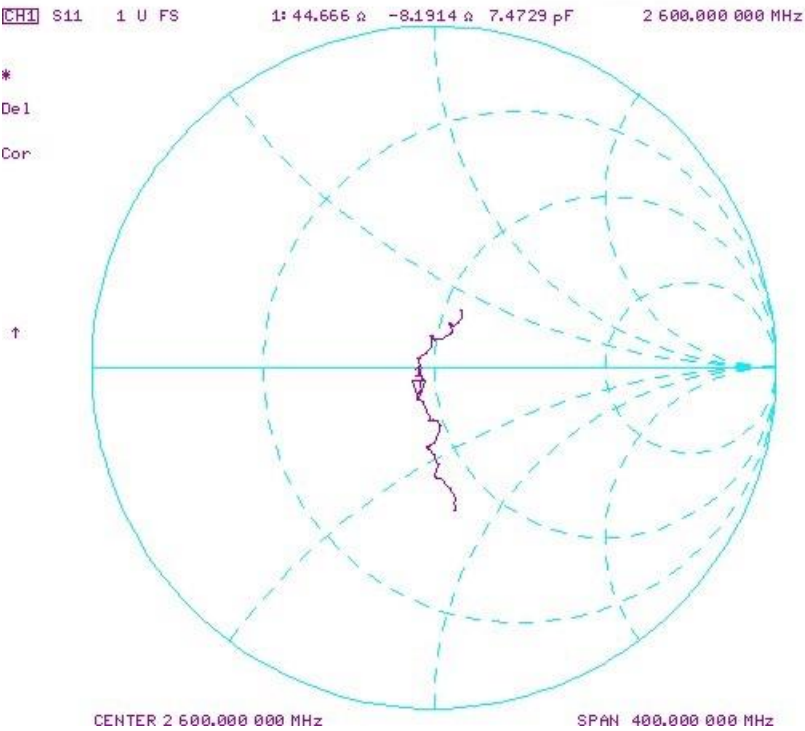
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 9/11/2017        | 9/10/2018      | 1.152                             | 5.69                                             | 5.52                                   | -2.99%           | 2.54                                              | 2.51                                    | -1.18%            | 49.1                                  | 48.9                               | 0.2                   | -6.1                                       | -4.9                                    | 1.2                        | -24.1                             | -25.8                          | -7.10%        | PASS      |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Body (10g) W/kg @ 20.0 dBm | Measured Body SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 9/11/2017        | 9/10/2018      | 1.152                             | 5.53                                             | 5.28                                   | -4.52%           | 2.48                                              | 2.35                                    | -5.24%            | 46.2                                  | 44.7                               | 1.5                   | -4.7                                       | -8.2                                    | 3.5                        | -24.1                             | -21.3                          | 11.60%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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 **PC Test**

Certificate No: **D5GHzV2-1163\_Sep17**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1163**

Calibration procedure(s) **QA CAL-22.v2**  
**Calibration procedure for dipole validation kits between 3-6 GHz**

*SCV*  
*10/03/2017*

Calibration date: **September 13, 2017**

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&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP             | SN: 104778         | 04-Apr-17 (No. 217-02521/02522)   | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103244         | 04-Apr-17 (No. 217-02521)         | Apr-18                 |
| Power sensor NRP-Z91        | SN: 103245         | 04-Apr-17 (No. 217-02522)         | Apr-18                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 07-Apr-17 (No. 217-02528)         | Apr-18                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529)         | Apr-18                 |
| Reference Probe EX3DV4      | SN: 3503           | 31-Dec-16 (No. EX3-3503_Dec16)    | Dec-17                 |
| DAE4                        | SN: 601            | 28-Mar-17 (No. DAE4-601_Mar17)    | Mar-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: 100972         | 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-16) | In house check: Oct-17 |

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

*Signature*

Approved by: **Katja Pokovic** **Technical Manager**

Issued: September 13, 2017

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



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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.

|                                     |                                                                      |                                  |
|-------------------------------------|----------------------------------------------------------------------|----------------------------------|
| <b>DASY Version</b>                 | DASY5                                                                | V52.10.0                         |
| <b>Extrapolation</b>                | Advanced Extrapolation                                               |                                  |
| <b>Phantom</b>                      | Modular Flat Phantom V5.0                                            |                                  |
| <b>Distance Dipole Center - TSL</b> | 10 mm                                                                | with Spacer                      |
| <b>Zoom Scan Resolution</b>         | dx, dy = 4.0 mm, dz = 1.4 mm                                         | Graded Ratio = 1.4 (Z direction) |
| <b>Frequency</b>                    | 5250 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5750 MHz $\pm$ 1 MHz |                                  |

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                                | Temperature         | Permittivity   | Conductivity         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 35.9           | 4.71 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 36.7 $\pm$ 6 % | 4.59 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL at 5250 MHz

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                                |
|-------------------------------------------------------------|--------------------|------------------------------------------------|
| SAR measured                                                | 100 mW input power | 7.84 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>78.7 W/kg <math>\pm</math> 19.9 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                |
|---------------------------------------------------------------|--------------------|------------------------------------------------|
| SAR measured                                                  | 100 mW input power | 2.24 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>22.5 W/kg <math>\pm</math> 19.5 % (k=2)</b> |

### 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 | 36.2 ± 6 %   | 4.95 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5600 MHz

|                                                             |                    |                                   |
|-------------------------------------------------------------|--------------------|-----------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                   |
| SAR measured                                                | 100 mW input power | 8.19 W/kg                         |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>82.1 W / kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.33 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.4 W/kg ± 19.5 % (k=2)</b> |

### Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.4         | 5.22 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 36.0 ± 6 %   | 5.12 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5750 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.80 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>78.2 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.21 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>22.2 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.9         | 5.36 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 47.0 ± 6 %   | 5.49 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5250 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.80 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>77.4 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.17 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.5 W/kg ± 19.5 % (k=2)</b> |

### 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 | 46.4 ± 6 %   | 5.96 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5600 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 8.03 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>79.7 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.24 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>22.2 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.3         | 5.94 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.1 ± 6 %   | 6.17 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5750 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.80 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>77.4 W/kg ± 19.9 % (k=2)</b> |

|                                                               |                    |                                 |
|---------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                 |
| SAR measured                                                  | 100 mW input power | 2.17 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.5 W/kg ± 19.5 % (k=2)</b> |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.6 $\Omega$ - 1.7 j $\Omega$ |
| Return Loss                          | - 30.3 dB                      |

### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.0 $\Omega$ + 4.6 j $\Omega$ |
| Return Loss                          | - 26.8 dB                      |

### Antenna Parameters with Head TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 52.6 $\Omega$ + 5.4 j $\Omega$ |
| Return Loss                          | - 24.7 dB                      |

### Antenna Parameters with Body TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.6 $\Omega$ - 0.1 j $\Omega$ |
| Return Loss                          | - 29.0 dB                      |

### Antenna Parameters with Body TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.3 $\Omega$ + 5.0 j $\Omega$ |
| Return Loss                          | - 25.9 dB                      |

### Antenna Parameters with Body TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.2 $\Omega$ + 5.1 j $\Omega$ |
| Return Loss                          | - 24.7 dB                      |

## General Antenna Parameters and Design

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

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

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

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

## Additional EUT Data

|                 |               |
|-----------------|---------------|
| Manufactured by | SPEAG         |
| Manufactured on | June 06, 2013 |

## DASY5 Validation Report for Head TSL

Date: 13.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1163**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.59$  S/m;  $\epsilon_r = 36.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.95$  S/m;  $\epsilon_r = 36.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5750$  MHz;  $\sigma = 5.12$  S/m;  $\epsilon_r = 36$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.64 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 28.4 W/kg

**SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.24 W/kg**

Maximum value of SAR (measured) = 17.5 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 = 70.03 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.4 W/kg

**SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.33 W/kg**

Maximum value of SAR (measured) = 18.9 W/kg

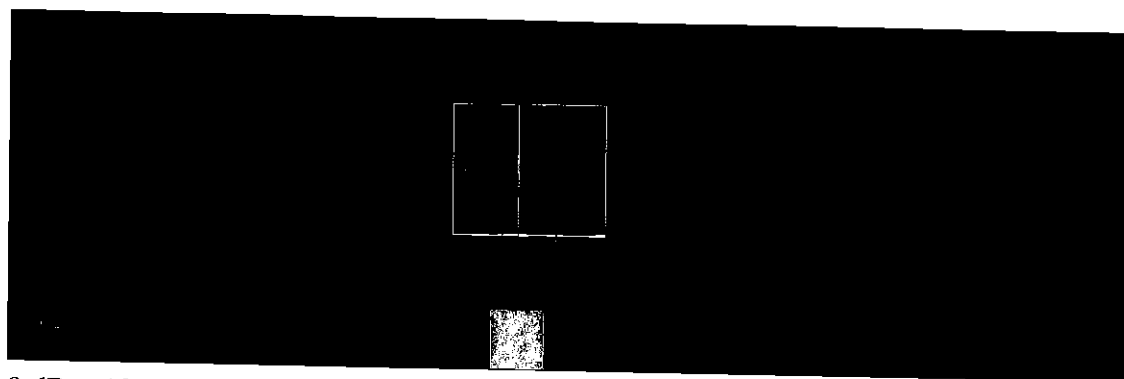
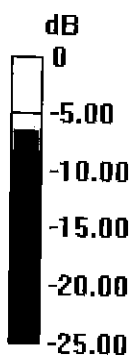
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 68.11 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 30.7 W/kg

**SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.21 W/kg**

Maximum value of SAR (measured) = 18.1 W/kg

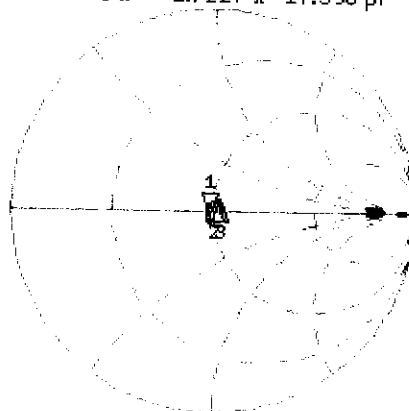


0 dB = 18.1 W/kg = 12.58 dBW/kg

# Impedance Measurement Plot for Head TSL

13 Sep 2017 12:31:45  
 CH1 S11 1 U FS 1: 47.576  $\Omega$  -1.7227  $\Omega$  17.598 pF 5 250.000 000 MHz

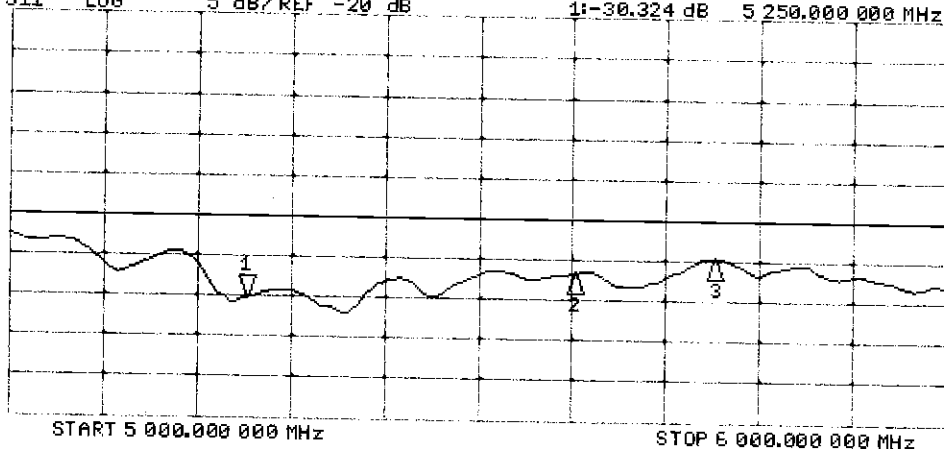
\*  
 Del  
 Cor  
 Avg  
 16  
 H1d



CH1 Markers  
 2: 49.963  $\Omega$   
 4: 5586  $\Omega$   
 5.60000 GHz  
 3: 52.564  $\Omega$   
 5.3887  $\Omega$   
 5.75000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -30.324 dB 5 250.000 000 MHz

Cor  
 Avg  
 16  
 H1d



CH2 Markers  
 2: -26.824 dB  
 5.60000 GHz  
 3: -24.710 dB  
 5.75000 GHz

## DASY5 Validation Report for Body TSL

Date: 06.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1163

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 5.49$  S/m;  $\epsilon_r = 47$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.96$  S/m;  $\epsilon_r = 46.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5750$  MHz;  $\sigma = 6.17$  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); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.51, 4.51, 4.51); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- 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=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.77 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 30.6 W/kg

**SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.17 W/kg**

Maximum value of SAR (measured) = 18.5 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 = 64.00 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 33.7 W/kg

**SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.24 W/kg**

Maximum value of SAR (measured) = 19.6 W/kg

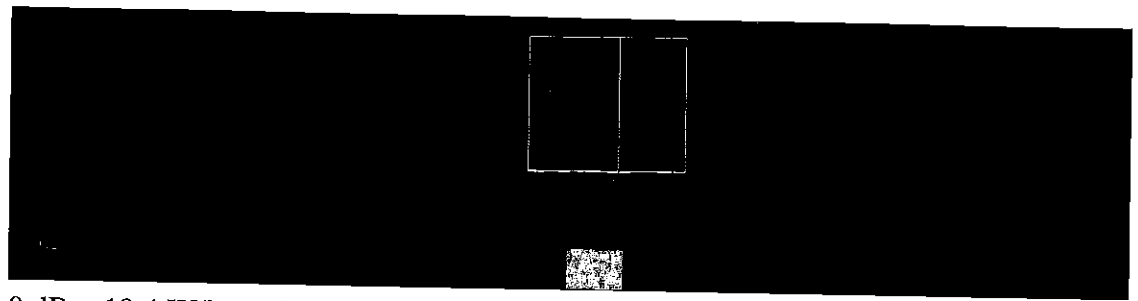
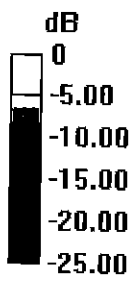
### Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.82 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 34.3 W/kg

**SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.17 W/kg**

Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg

# Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS

6 Sep 2017 15:32:03  
1: 46.590  $\Omega$  -128.91 m $\Omega$  235.17 pF 5 250.000 000 MHz

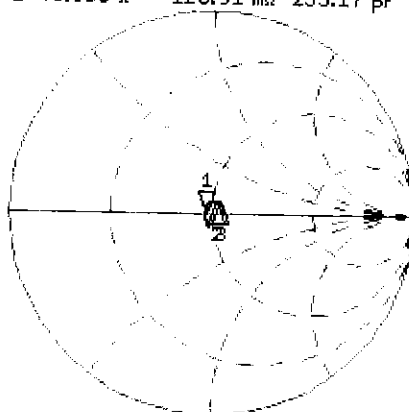
\*

De1

Cor

Avg  
16

H1d



CH1 Markers

2: 51.301  $\Omega$   
4.9570  $\Omega$   
5.60000 GHz  
3: 53.199  $\Omega$   
5.0781  $\Omega$   
5.75000 GHz

CH2 S11 LOG

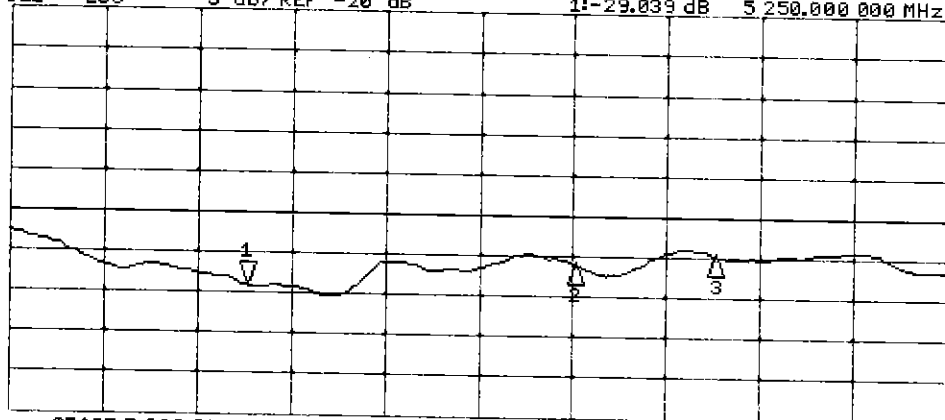
5 dB/REF -20 dB

1: -29.039 dB 5 250.000 000 MHz

Cor

Avg  
16

H1d



CH2 Markers

2: -25.929 dB  
5.60000 GHz  
3: -24.720 dB  
5.75000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz



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

Client **PC Test**

Certificate No: **ES3-3022\_Jun18**

## CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6  
Calibration procedure for dosimetric E-field probes**

Calibration date: **June 22, 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 ( $22 \pm 3$ )°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: S5277 (20x)  | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Reference Probe ES3DV2     | SN: 3013         | 30-Dec-17 (No. ES3-3013_Dec17)    | Dec-18                 |
| DAE4                       | SN: 660          | 21-Dec-17 (No. DAE4-660_Dec17)    | Dec-18                 |
| Secondary Standards        | ID               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B         | SN: GB41293874   | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: MY41498087   | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: 000110210    | 06-Apr-16 (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 HP 8753E  | SN: US37390585   | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |

|                                                                                                                 | Name          | Function              | Signature |
|-----------------------------------------------------------------------------------------------------------------|---------------|-----------------------|-----------|
| Calibrated by:                                                                                                  | Leif Klysner  | Laboratory Technician |           |
| Approved by:                                                                                                    | Katja Pokovic | Technical Manager     |           |
| Issued: June 23, 2018                                                                                           |               |                       |           |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. |               |                       |           |



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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 $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\vartheta = 0$ 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  $\vartheta = 0$  ( $f \leq 900$  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  $E^2$ -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 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<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 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).

# Probe ES3DV2

## SN:3022

Manufactured: April 15, 2003  
Calibrated: June 22, 2018

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

## DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

### Basic Calibration Parameters

|                                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|-----------------------------------------------------------|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 0.97     | 1.01     | 0.96     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                                     | 99.7     | 96.5     | 102.3    |               |

### 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    | 180.7    | $\pm 3.3 \%$              |
|     |                           | Y | 0.0     | 0.0                          | 1.0 |         | 185.0    |                           |
|     |                           | Z | 0.0     | 0.0                          | 1.0 |         | 180.9    |                           |

Note: For details on UID parameters see Appendix.

### Sensor Model Parameters

|   | C1<br>fF | C2<br>fF | $\alpha$<br>$\text{V}^{-1}$ | T1<br>$\text{ms} \cdot \text{V}^{-2}$ | T2<br>$\text{ms} \cdot \text{V}^{-1}$ | T3<br>ms | T4<br>$\text{V}^{-2}$ | T5<br>$\text{V}^{-1}$ | T6    |
|---|----------|----------|-----------------------------|---------------------------------------|---------------------------------------|----------|-----------------------|-----------------------|-------|
| X | 56.30    | 408.5    | 36.17                       | 29.39                                 | 2.977                                 | 5.10     | 0.000                 | 0.584                 | 1.011 |
| Y | 51.61    | 379.9    | 36.94                       | 28.97                                 | 2.404                                 | 5.10     | 0.000                 | 0.498                 | 1.013 |
| Z | 49.66    | 357.5    | 35.61                       | 28.42                                 | 2.517                                 | 5.10     | 0.193                 | 0.469                 | 1.009 |

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  $E^2$ -field uncertainty inside TSL (see Pages 5 and 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.

## DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

### 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) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-----------|
| 750                  | 41.9                               | 0.89                            | 6.54    | 6.54    | 6.54    | 0.50               | 1.39                    | ± 12.0 %  |
| 835                  | 41.5                               | 0.90                            | 6.16    | 6.16    | 6.16    | 0.40               | 1.50                    | ± 12.0 %  |
| 1750                 | 40.1                               | 1.37                            | 5.32    | 5.32    | 5.32    | 0.32               | 1.94                    | ± 12.0 %  |
| 1900                 | 40.0                               | 1.40                            | 5.07    | 5.07    | 5.07    | 0.53               | 1.39                    | ± 12.0 %  |
| 2300                 | 39.5                               | 1.67                            | 4.76    | 4.76    | 4.76    | 0.54               | 1.44                    | ± 12.0 %  |
| 2450                 | 39.2                               | 1.80                            | 4.52    | 4.52    | 4.52    | 0.58               | 1.39                    | ± 12.0 %  |
| 2600                 | 39.0                               | 1.96                            | 4.24    | 4.24    | 4.24    | 0.52               | 1.59                    | ± 12.0 %  |

<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. 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.

## DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

### 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>G</sup> | Depth <sup>G</sup> (mm) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-----------|
| 750                  | 55.5                               | 0.96                            | 6.12    | 6.12    | 6.12    | 0.48               | 1.36                    | ± 12.0 %  |
| 835                  | 55.2                               | 0.97                            | 5.96    | 5.96    | 5.96    | 0.57               | 1.24                    | ± 12.0 %  |
| 1750                 | 53.4                               | 1.49                            | 4.93    | 4.93    | 4.93    | 0.44               | 1.52                    | ± 12.0 %  |
| 1900                 | 53.3                               | 1.52                            | 4.67    | 4.67    | 4.67    | 0.37               | 1.86                    | ± 12.0 %  |
| 2300                 | 52.9                               | 1.81                            | 4.36    | 4.36    | 4.36    | 0.72               | 1.30                    | ± 12.0 %  |
| 2450                 | 52.7                               | 1.95                            | 4.22    | 4.22    | 4.22    | 0.80               | 1.19                    | ± 12.0 %  |
| 2600                 | 52.5                               | 2.16                            | 4.03    | 4.03    | 4.03    | 0.72               | 1.14                    | ± 12.0 %  |

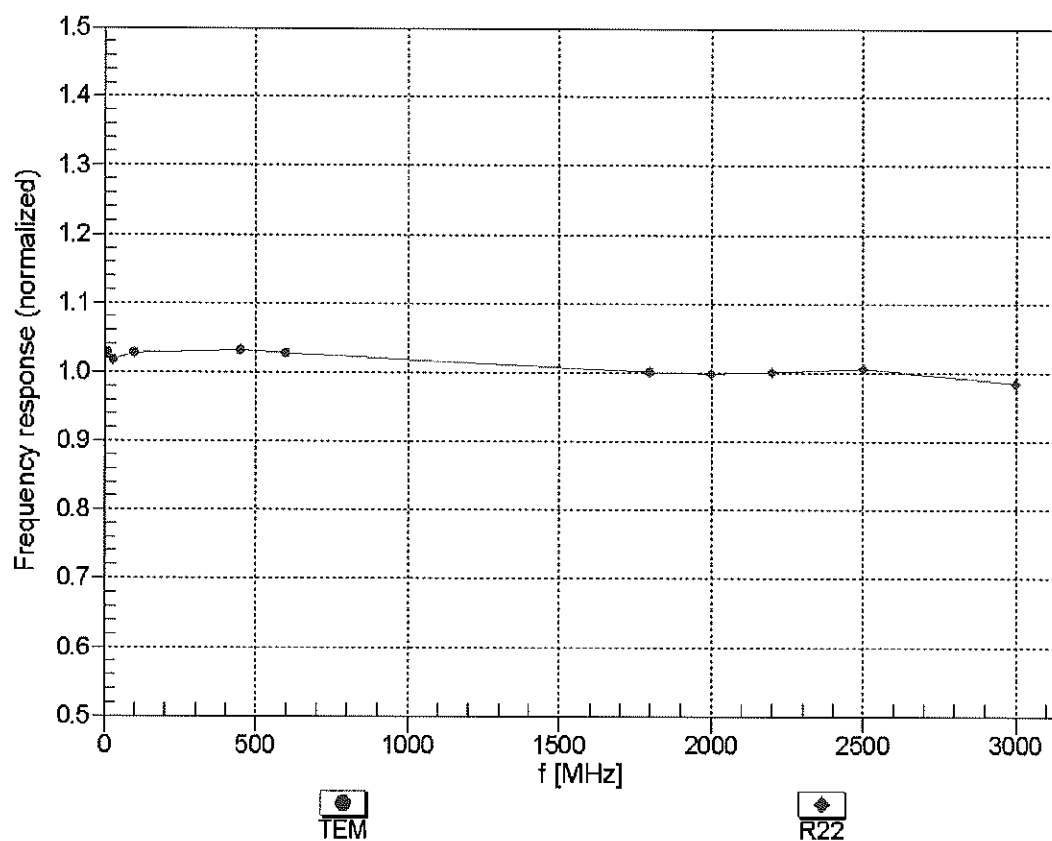
<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below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

## Frequency Response of E-Field

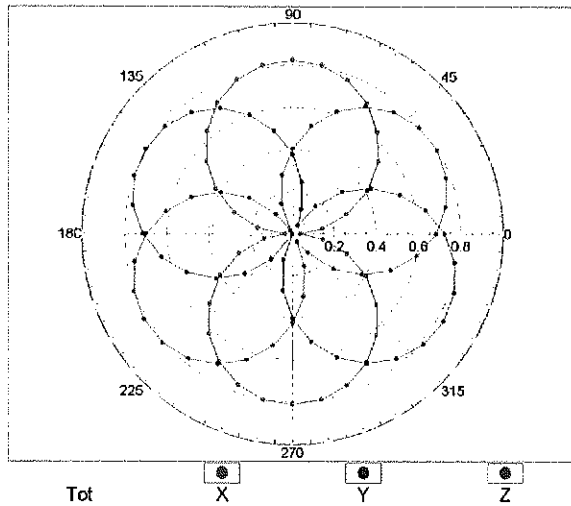
(TEM-Cell:ifi110 EXX, Waveguide: R22)



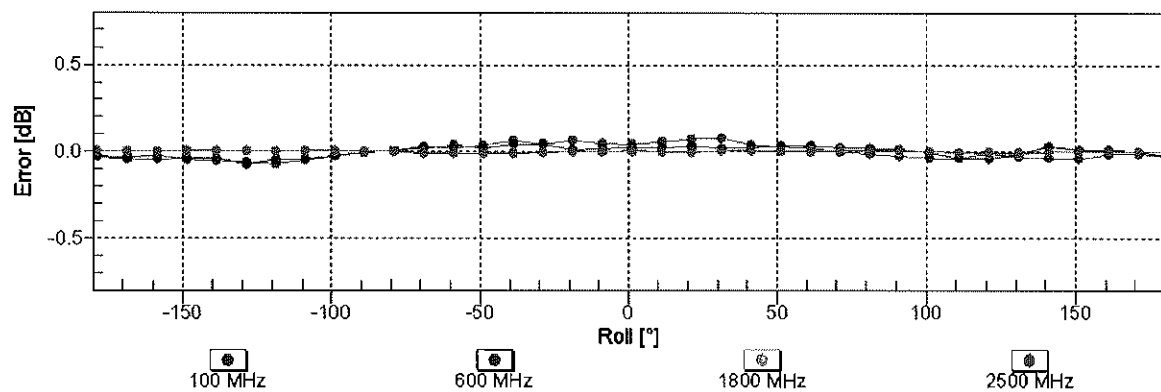
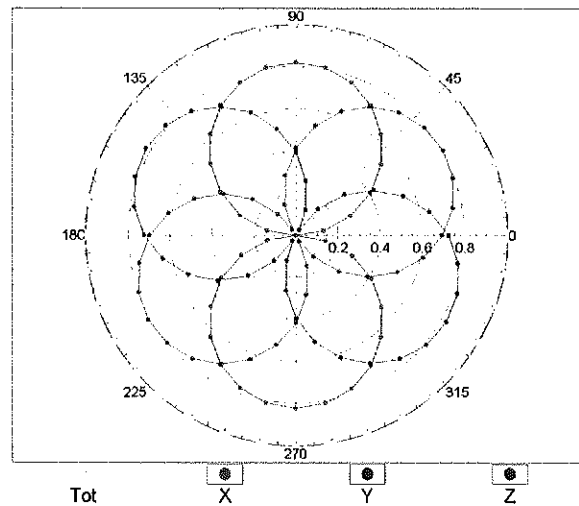
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

## Receiving Pattern ( $\phi$ ), $\vartheta = 0^\circ$

f=600 MHz,TEM

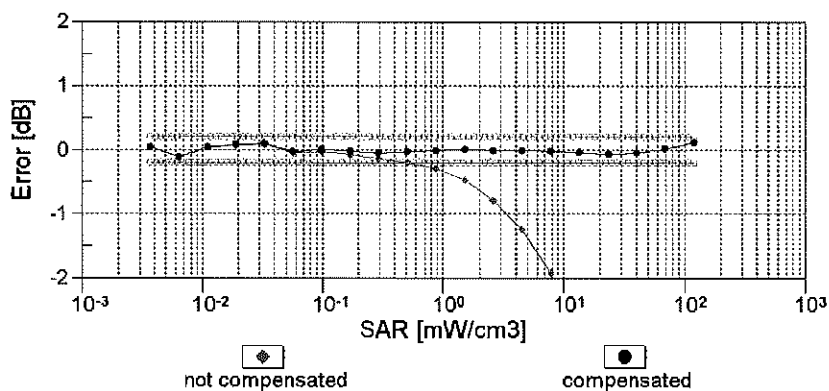
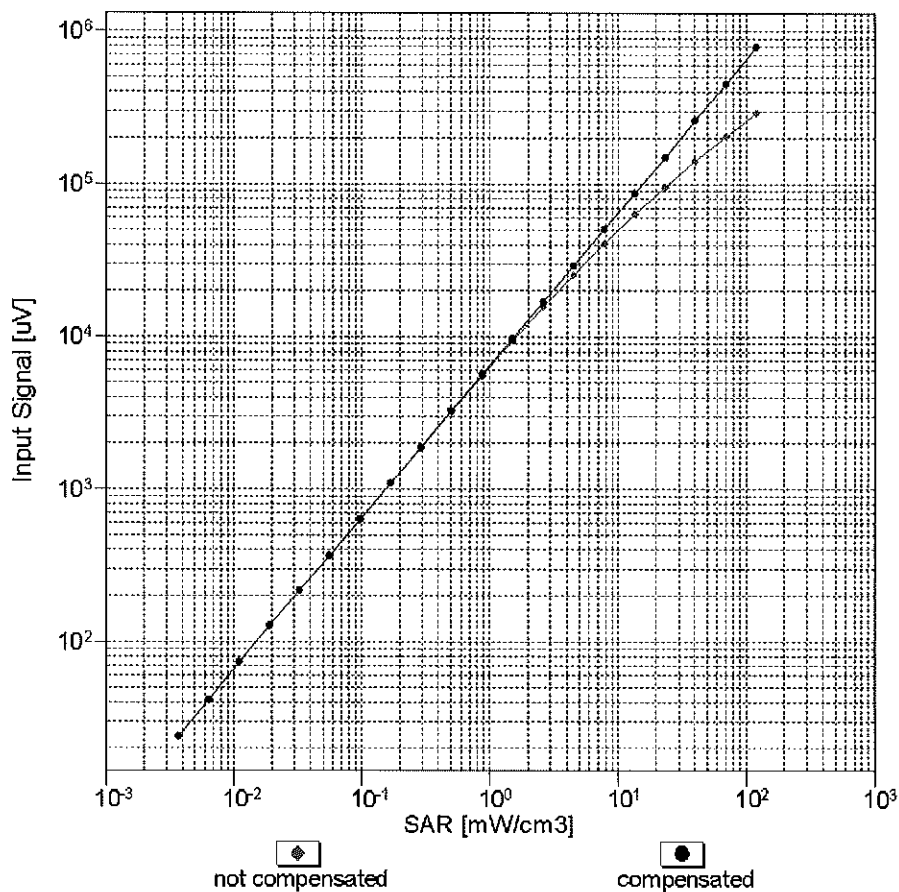


f=1800 MHz,R22



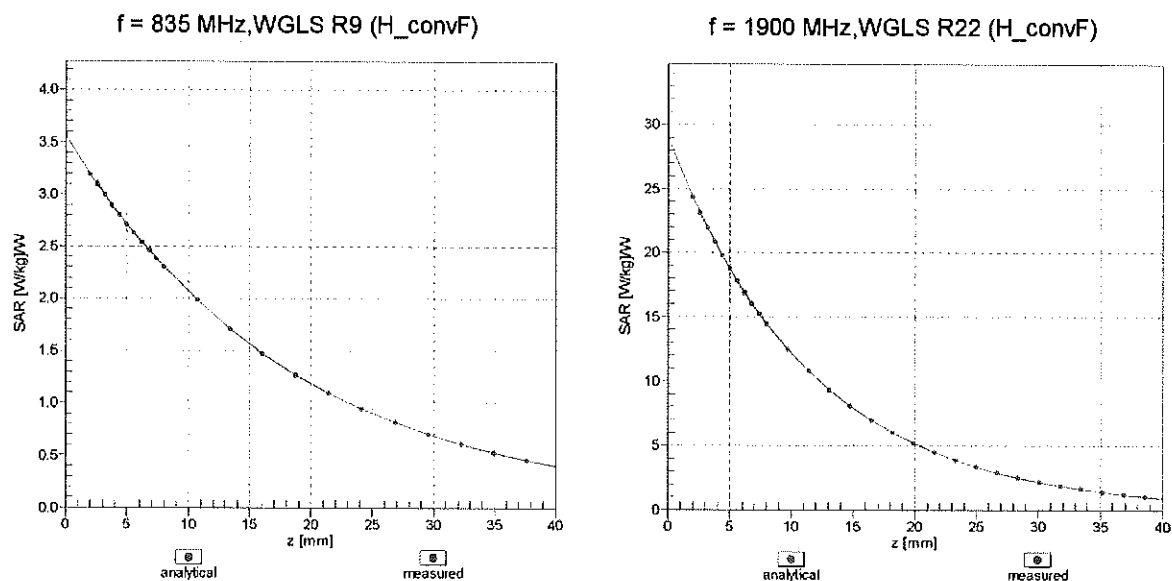
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

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



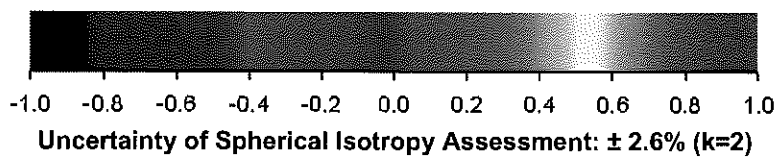
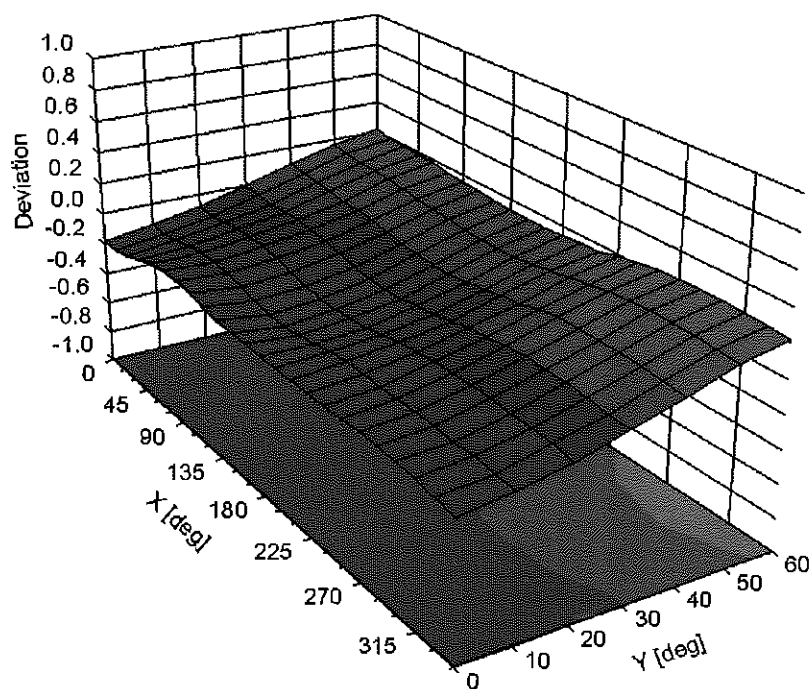
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

## Conversion Factor Assessment



## Deviation from Isotropy in Liquid

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



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )

## DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

### Other Probe Parameters

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 101.3      |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 10 mm      |
| Tip Diameter                                  | 4 mm       |
| Probe Tip to Sensor X Calibration Point       | 2 mm       |
| Probe Tip to Sensor Y Calibration Point       | 2 mm       |
| Probe Tip to Sensor Z Calibration Point       | 2 mm       |
| Recommended Measurement Distance from Surface | 3 mm       |

**Appendix: Modulation Calibration Parameters**

| UID           | Communication System Name                     |   | A<br>dB | B<br>dB $\mu$ V | C     | D<br>dB | VR<br>mV | Max<br>Unc <sup>E</sup><br>(k=2) |
|---------------|-----------------------------------------------|---|---------|-----------------|-------|---------|----------|----------------------------------|
| 0             | CW                                            | X | 0.00    | 0.00            | 1.00  | 0.00    | 180.7    | $\pm 3.3 \%$                     |
|               |                                               | Y | 0.00    | 0.00            | 1.00  |         | 185.0    |                                  |
|               |                                               | Z | 0.00    | 0.00            | 1.00  |         | 180.9    |                                  |
| 10010-<br>CAA | SAR Validation (Square, 100ms, 10ms)          | X | 9.12    | 80.72           | 19.72 | 10.00   | 25.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 7.78    | 78.39           | 18.16 |         | 25.0     |                                  |
|               |                                               | Z | 8.88    | 80.43           | 19.18 |         | 25.0     |                                  |
| 10011-<br>CAB | UMTS-FDD (WCDMA)                              | X | 1.13    | 69.14           | 16.23 | 0.00    | 150.0    | $\pm 9.6 \%$                     |
|               |                                               | Y | 0.94    | 65.93           | 14.05 |         | 150.0    |                                  |
|               |                                               | Z | 1.03    | 67.74           | 15.26 |         | 150.0    |                                  |
| 10012-<br>CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)      | X | 1.32    | 65.59           | 16.25 | 0.41    | 150.0    | $\pm 9.6 \%$                     |
|               |                                               | Y | 1.23    | 64.33           | 15.18 |         | 150.0    |                                  |
|               |                                               | Z | 1.28    | 65.16           | 15.80 |         | 150.0    |                                  |
| 10013-<br>CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps) | X | 5.15    | 67.35           | 17.56 | 1.46    | 150.0    | $\pm 9.6 \%$                     |
|               |                                               | Y | 5.05    | 67.11           | 17.34 |         | 150.0    |                                  |
|               |                                               | Z | 5.06    | 67.35           | 17.45 |         | 150.0    |                                  |
| 10021-<br>DAC | GSM-FDD (TDMA, GMSK)                          | X | 21.12   | 96.30           | 26.79 | 9.39    | 50.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 34.63   | 103.95          | 28.36 |         | 50.0     |                                  |
|               |                                               | Z | 29.26   | 101.54          | 27.92 |         | 50.0     |                                  |
| 10023-<br>DAC | GPRS-FDD (TDMA, GMSK, TN 0)                   | X | 18.75   | 94.15           | 26.16 | 9.57    | 50.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 27.39   | 100.04          | 27.27 |         | 50.0     |                                  |
|               |                                               | Z | 24.24   | 98.32           | 27.00 |         | 50.0     |                                  |
| 10024-<br>DAC | GPRS-FDD (TDMA, GMSK, TN 0-1)                 | X | 100.00  | 119.51          | 31.22 | 6.56    | 60.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 100.00  | 117.40          | 29.84 |         | 60.0     |                                  |
|               |                                               | Z | 100.00  | 118.34          | 30.40 |         | 60.0     |                                  |
| 10025-<br>DAC | EDGE-FDD (TDMA, 8PSK, TN 0)                   | X | 19.29   | 106.16          | 40.42 | 12.57   | 50.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 14.92   | 99.57           | 37.85 |         | 50.0     |                                  |
|               |                                               | Z | 20.66   | 109.51          | 41.75 |         | 50.0     |                                  |
| 10026-<br>DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1)                 | X | 19.66   | 103.12          | 35.65 | 9.56    | 60.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 18.05   | 101.73          | 35.07 |         | 60.0     |                                  |
|               |                                               | Z | 20.79   | 105.41          | 36.46 |         | 60.0     |                                  |
| 10027-<br>DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2)               | X | 100.00  | 118.25          | 29.66 | 4.80    | 80.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 100.00  | 115.76          | 28.17 |         | 80.0     |                                  |
|               |                                               | Z | 100.00  | 117.04          | 28.87 |         | 80.0     |                                  |
| 10028-<br>DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)             | X | 100.00  | 118.29          | 28.82 | 3.55    | 100.0    | $\pm 9.6 \%$                     |
|               |                                               | Y | 100.00  | 115.14          | 27.08 |         | 100.0    |                                  |
|               |                                               | Z | 100.00  | 116.95          | 28.01 |         | 100.0    |                                  |
| 10029-<br>DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2)               | X | 13.53   | 94.90           | 31.74 | 7.80    | 80.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 11.99   | 92.66           | 30.82 |         | 80.0     |                                  |
|               |                                               | Z | 13.36   | 95.33           | 31.90 |         | 80.0     |                                  |
| 10030-<br>CAA | IEEE 802.15.1 Bluetooth (GFSK, DH1)           | X | 100.00  | 117.88          | 29.84 | 5.30    | 70.0     | $\pm 9.6 \%$                     |
|               |                                               | Y | 100.00  | 115.45          | 28.36 |         | 70.0     |                                  |
|               |                                               | Z | 100.00  | 116.58          | 28.99 |         | 70.0     |                                  |
| 10031-<br>CAA | IEEE 802.15.1 Bluetooth (GFSK, DH3)           | X | 100.00  | 118.97          | 27.49 | 1.88    | 100.0    | $\pm 9.6 \%$                     |
|               |                                               | Y | 100.00  | 112.96          | 24.59 |         | 100.0    |                                  |
|               |                                               | Z | 100.00  | 116.57          | 26.27 |         | 100.0    |                                  |

|           |                                                     |   |        |        |       |       |       |         |
|-----------|-----------------------------------------------------|---|--------|--------|-------|-------|-------|---------|
| 10032-CAA | IEEE 802.15.1 Bluetooth (GFSK, DH5)                 | X | 100.00 | 122.85 | 27.97 | 1.17  | 100.0 | ± 9.6 % |
|           |                                                     | Y | 100.00 | 112.87 | 23.49 |       | 100.0 |         |
|           |                                                     | Z | 100.00 | 119.11 | 26.22 |       | 100.0 |         |
| 10033-CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)           | X | 16.94  | 95.81  | 26.51 | 5.30  | 70.0  | ± 9.6 % |
|           |                                                     | Y | 16.15  | 94.60  | 25.59 |       | 70.0  |         |
|           |                                                     | Z | 17.74  | 96.16  | 26.17 |       | 70.0  |         |
| 10034-CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)           | X | 8.87   | 89.65  | 22.97 | 1.88  | 100.0 | ± 9.6 % |
|           |                                                     | Y | 5.53   | 82.01  | 19.73 |       | 100.0 |         |
|           |                                                     | Z | 7.80   | 87.02  | 21.52 |       | 100.0 |         |
| 10035-CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)           | X | 5.00   | 83.13  | 20.55 | 1.17  | 100.0 | ± 9.6 % |
|           |                                                     | Y | 3.13   | 75.87  | 17.18 |       | 100.0 |         |
|           |                                                     | Z | 4.27   | 80.34  | 18.96 |       | 100.0 |         |
| 10036-CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH1)               | X | 20.34  | 99.02  | 27.54 | 5.30  | 70.0  | ± 9.6 % |
|           |                                                     | Y | 20.03  | 98.23  | 26.74 |       | 70.0  |         |
|           |                                                     | Z | 21.83  | 99.68  | 27.27 |       | 70.0  |         |
| 10037-CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH3)               | X | 8.42   | 88.95  | 22.71 | 1.88  | 100.0 | ± 9.6 % |
|           |                                                     | Y | 5.23   | 81.29  | 19.45 |       | 100.0 |         |
|           |                                                     | Z | 7.27   | 86.10  | 21.20 |       | 100.0 |         |
| 10038-CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH5)               | X | 5.22   | 84.01  | 20.94 | 1.17  | 100.0 | ± 9.6 % |
|           |                                                     | Y | 3.22   | 76.47  | 17.50 |       | 100.0 |         |
|           |                                                     | Z | 4.42   | 81.08  | 19.32 |       | 100.0 |         |
| 10039-CAB | CDMA2000 (1xRTT, RC1)                               | X | 2.15   | 74.05  | 16.96 | 0.00  | 150.0 | ± 9.6 % |
|           |                                                     | Y | 1.48   | 68.71  | 13.88 |       | 150.0 |         |
|           |                                                     | Z | 1.75   | 71.47  | 15.26 |       | 150.0 |         |
| 10042-CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) | X | 51.16  | 108.30 | 28.43 | 7.78  | 50.0  | ± 9.6 % |
|           |                                                     | Y | 88.21  | 114.49 | 29.14 |       | 50.0  |         |
|           |                                                     | Z | 92.16  | 115.96 | 29.82 |       | 50.0  |         |
| 10044-CAA | IS-91/EIA/TIA-553 FDD (FDMA, FM)                    | X | 0.00   | 110.75 | 3.44  | 0.00  | 150.0 | ± 9.6 % |
|           |                                                     | Y | 0.01   | 124.18 | 1.76  |       | 150.0 |         |
|           |                                                     | Z | 0.00   | 108.83 | 6.62  |       | 150.0 |         |
| 10048-CAA | DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)           | X | 11.42  | 83.38  | 24.28 | 13.80 | 25.0  | ± 9.6 % |
|           |                                                     | Y | 13.16  | 86.56  | 24.81 |       | 25.0  |         |
|           |                                                     | Z | 12.43  | 85.46  | 24.63 |       | 25.0  |         |
| 10049-CAA | DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)         | X | 13.53  | 87.91  | 24.50 | 10.79 | 40.0  | ± 9.6 % |
|           |                                                     | Y | 16.13  | 90.98  | 24.89 |       | 40.0  |         |
|           |                                                     | Z | 15.33  | 90.21  | 24.85 |       | 40.0  |         |
| 10056-CAA | UMTS-TDD (TD-SCDMA, 1.28 Mcps)                      | X | 12.94  | 87.44  | 24.76 | 9.03  | 50.0  | ± 9.6 % |
|           |                                                     | Y | 13.62  | 88.57  | 24.69 |       | 50.0  |         |
|           |                                                     | Z | 13.86  | 88.86  | 24.90 |       | 50.0  |         |
| 10058-DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)                   | X | 9.99   | 89.04  | 28.92 | 6.55  | 100.0 | ± 9.6 % |
|           |                                                     | Y | 8.79   | 86.66  | 27.91 |       | 100.0 |         |
|           |                                                     | Z | 9.58   | 88.70  | 28.79 |       | 100.0 |         |
| 10059-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)            | X | 1.52   | 67.99  | 17.40 | 0.61  | 110.0 | ± 9.6 % |
|           |                                                     | Y | 1.38   | 66.31  | 16.16 |       | 110.0 |         |
|           |                                                     | Z | 1.46   | 67.39  | 16.89 |       | 110.0 |         |
| 10060-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)          | X | 100.00 | 131.43 | 33.80 | 1.30  | 110.0 | ± 9.6 % |
|           |                                                     | Y | 63.48  | 121.74 | 30.70 |       | 110.0 |         |
|           |                                                     | Z | 100.00 | 130.20 | 33.12 |       | 110.0 |         |

|           |                                                |   |       |        |       |      |       |         |
|-----------|------------------------------------------------|---|-------|--------|-------|------|-------|---------|
| 10061-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)      | X | 12.72 | 100.01 | 28.21 | 2.04 | 110.0 | ± 9.6 % |
|           |                                                | Y | 8.00  | 91.91  | 25.30 |      | 110.0 |         |
|           |                                                | Z | 11.18 | 97.82  | 27.34 |      | 110.0 |         |
| 10062-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)       | X | 4.86  | 67.08  | 16.83 | 0.49 | 100.0 | ± 9.6 % |
|           |                                                | Y | 4.76  | 66.82  | 16.60 |      | 100.0 |         |
|           |                                                | Z | 4.77  | 67.05  | 16.71 |      | 100.0 |         |
| 10063-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)       | X | 4.90  | 67.25  | 16.98 | 0.72 | 100.0 | ± 9.6 % |
|           |                                                | Y | 4.80  | 66.98  | 16.73 |      | 100.0 |         |
|           |                                                | Z | 4.81  | 67.21  | 16.85 |      | 100.0 |         |
| 10064-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)      | X | 5.23  | 67.58  | 17.24 | 0.86 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.11  | 67.30  | 17.01 |      | 100.0 |         |
|           |                                                | Z | 5.11  | 67.52  | 17.11 |      | 100.0 |         |
| 10065-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)      | X | 5.14  | 67.63  | 17.42 | 1.21 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.02  | 67.34  | 17.18 |      | 100.0 |         |
|           |                                                | Z | 5.03  | 67.57  | 17.29 |      | 100.0 |         |
| 10066-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)      | X | 5.20  | 67.78  | 17.66 | 1.46 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.07  | 67.47  | 17.41 |      | 100.0 |         |
|           |                                                | Z | 5.08  | 67.71  | 17.52 |      | 100.0 |         |
| 10067-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)      | X | 5.53  | 67.98  | 18.13 | 2.04 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.40  | 67.73  | 17.91 |      | 100.0 |         |
|           |                                                | Z | 5.42  | 67.97  | 18.03 |      | 100.0 |         |
| 10068-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)      | X | 5.67  | 68.34  | 18.51 | 2.55 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.53  | 68.01  | 18.26 |      | 100.0 |         |
|           |                                                | Z | 5.54  | 68.25  | 18.37 |      | 100.0 |         |
| 10069-CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)      | X | 5.75  | 68.32  | 18.71 | 2.67 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.61  | 68.01  | 18.46 |      | 100.0 |         |
|           |                                                | Z | 5.63  | 68.27  | 18.59 |      | 100.0 |         |
| 10071-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)  | X | 5.30  | 67.61  | 17.96 | 1.99 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.20  | 67.35  | 17.74 |      | 100.0 |         |
|           |                                                | Z | 5.21  | 67.60  | 17.85 |      | 100.0 |         |
| 10072-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps) | X | 5.37  | 68.19  | 18.29 | 2.30 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.25  | 67.88  | 18.05 |      | 100.0 |         |
|           |                                                | Z | 5.27  | 68.14  | 18.18 |      | 100.0 |         |
| 10073-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps) | X | 5.52  | 68.58  | 18.74 | 2.83 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.38  | 68.25  | 18.48 |      | 100.0 |         |
|           |                                                | Z | 5.41  | 68.54  | 18.62 |      | 100.0 |         |
| 10074-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps) | X | 5.57  | 68.68  | 19.00 | 3.30 | 100.0 | ± 9.6 % |
|           |                                                | Y | 5.43  | 68.33  | 18.73 |      | 100.0 |         |
|           |                                                | Z | 5.47  | 68.64  | 18.88 |      | 100.0 |         |
| 10075-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps) | X | 5.73  | 69.19  | 19.51 | 3.82 | 90.0  | ± 9.6 % |
|           |                                                | Y | 5.57  | 68.75  | 19.20 |      | 90.0  |         |
|           |                                                | Z | 5.61  | 69.08  | 19.36 |      | 90.0  |         |
| 10076-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps) | X | 5.76  | 69.02  | 19.65 | 4.15 | 90.0  | ± 9.6 % |
|           |                                                | Y | 5.60  | 68.61  | 19.35 |      | 90.0  |         |
|           |                                                | Z | 5.65  | 68.96  | 19.53 |      | 90.0  |         |
| 10077-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps) | X | 5.80  | 69.13  | 19.76 | 4.30 | 90.0  | ± 9.6 % |
|           |                                                | Y | 5.64  | 68.71  | 19.46 |      | 90.0  |         |
|           |                                                | Z | 5.70  | 69.08  | 19.65 |      | 90.0  |         |

|           |                                                     |   |        |        |       |      |       |         |
|-----------|-----------------------------------------------------|---|--------|--------|-------|------|-------|---------|
| 10081-CAB | CDMA2000 (1xRTT, RC3)                               | X | 0.97   | 67.77  | 13.80 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 0.73   | 64.07  | 11.07 |      | 150.0 |         |
|           |                                                     | Z | 0.81   | 65.70  | 12.14 |      | 150.0 |         |
| 10082-CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) | X | 2.25   | 64.31  | 9.20  | 4.77 | 80.0  | ± 9.6 % |
|           |                                                     | Y | 1.88   | 62.88  | 7.97  |      | 80.0  |         |
|           |                                                     | Z | 2.02   | 63.56  | 8.52  |      | 80.0  |         |
| 10090-DAC | GPRS-FDD (TDMA, GMSK, TN 0-4)                       | X | 100.00 | 119.60 | 31.28 | 6.56 | 60.0  | ± 9.6 % |
|           |                                                     | Y | 100.00 | 117.50 | 29.91 |      | 60.0  |         |
|           |                                                     | Z | 100.00 | 118.43 | 30.47 |      | 60.0  |         |
| 10097-CAB | UMTS-FDD (HSDPA)                                    | X | 1.89   | 68.21  | 16.12 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 1.73   | 66.65  | 14.94 |      | 150.0 |         |
|           |                                                     | Z | 1.81   | 67.75  | 15.61 |      | 150.0 |         |
| 10098-CAB | UMTS-FDD (HSUPA, Subtest 2)                         | X | 1.85   | 68.19  | 16.10 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 1.69   | 66.60  | 14.90 |      | 150.0 |         |
|           |                                                     | Z | 1.78   | 67.71  | 15.59 |      | 150.0 |         |
| 10099-DAC | EDGE-FDD (TDMA, 8PSK, TN 0-4)                       | X | 19.56  | 102.95 | 35.59 | 9.56 | 60.0  | ± 9.6 % |
|           |                                                     | Y | 18.00  | 101.62 | 35.03 |      | 60.0  |         |
|           |                                                     | Z | 20.69  | 105.25 | 36.41 |      | 60.0  |         |
| 10100-CAD | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)            | X | 3.30   | 71.09  | 17.05 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 3.01   | 69.46  | 16.11 |      | 150.0 |         |
|           |                                                     | Z | 3.13   | 70.42  | 16.66 |      | 150.0 |         |
| 10101-CAD | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)          | X | 3.35   | 67.99  | 16.21 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 3.20   | 67.18  | 15.65 |      | 150.0 |         |
|           |                                                     | Z | 3.25   | 67.66  | 15.95 |      | 150.0 |         |
| 10102-CAD | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)          | X | 3.45   | 67.89  | 16.28 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 3.31   | 67.16  | 15.76 |      | 150.0 |         |
|           |                                                     | Z | 3.35   | 67.61  | 16.03 |      | 150.0 |         |
| 10103-CAD | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)            | X | 8.68   | 78.34  | 21.41 | 3.98 | 65.0  | ± 9.6 % |
|           |                                                     | Y | 8.39   | 78.12  | 21.24 |      | 65.0  |         |
|           |                                                     | Z | 8.61   | 78.63  | 21.46 |      | 65.0  |         |
| 10104-CAD | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)          | X | 8.59   | 76.98  | 21.71 | 3.98 | 65.0  | ± 9.6 % |
|           |                                                     | Y | 8.24   | 76.55  | 21.45 |      | 65.0  |         |
|           |                                                     | Z | 8.42   | 77.02  | 21.66 |      | 65.0  |         |
| 10105-CAD | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)          | X | 8.27   | 76.21  | 21.68 | 3.98 | 65.0  | ± 9.6 % |
|           |                                                     | Y | 7.96   | 75.85  | 21.44 |      | 65.0  |         |
|           |                                                     | Z | 8.08   | 76.18  | 21.59 |      | 65.0  |         |
| 10108-CAE | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)            | X | 2.90   | 70.34  | 16.91 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 2.64   | 68.76  | 15.95 |      | 150.0 |         |
|           |                                                     | Z | 2.74   | 69.70  | 16.50 |      | 150.0 |         |
| 10109-CAE | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)          | X | 3.01   | 67.84  | 16.14 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 2.85   | 66.97  | 15.51 |      | 150.0 |         |
|           |                                                     | Z | 2.90   | 67.50  | 15.84 |      | 150.0 |         |
| 10110-CAE | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)             | X | 2.38   | 69.52  | 16.61 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 2.14   | 67.85  | 15.51 |      | 150.0 |         |
|           |                                                     | Z | 2.23   | 68.86  | 16.13 |      | 150.0 |         |
| 10111-CAE | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)           | X | 2.71   | 68.52  | 16.43 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                     | Y | 2.53   | 67.49  | 15.63 |      | 150.0 |         |
|           |                                                     | Z | 2.60   | 68.20  | 16.05 |      | 150.0 |         |

|           |                                                |   |      |       |       |      |       |         |
|-----------|------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10112-CAE | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)     | X | 3.13 | 67.76 | 16.17 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 2.98 | 66.98 | 15.59 |      | 150.0 |         |
|           |                                                | Z | 3.02 | 67.48 | 15.89 |      | 150.0 |         |
| 10113-CAE | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)      | X | 2.86 | 68.59 | 16.53 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 2.69 | 67.66 | 15.79 |      | 150.0 |         |
|           |                                                | Z | 2.75 | 68.32 | 16.17 |      | 150.0 |         |
| 10114-CAC | IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)  | X | 5.22 | 67.41 | 16.60 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 5.16 | 67.20 | 16.42 |      | 150.0 |         |
|           |                                                | Z | 5.15 | 67.40 | 16.52 |      | 150.0 |         |
| 10115-CAC | IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)  | X | 5.59 | 67.76 | 16.79 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 5.47 | 67.41 | 16.54 |      | 150.0 |         |
|           |                                                | Z | 5.46 | 67.57 | 16.61 |      | 150.0 |         |
| 10116-CAC | IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM) | X | 5.35 | 67.70 | 16.67 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 5.27 | 67.44 | 16.47 |      | 150.0 |         |
|           |                                                | Z | 5.26 | 67.61 | 16.55 |      | 150.0 |         |
| 10117-CAC | IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)       | X | 5.21 | 67.36 | 16.59 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 5.12 | 67.05 | 16.36 |      | 150.0 |         |
|           |                                                | Z | 5.11 | 67.24 | 16.46 |      | 150.0 |         |
| 10118-CAC | IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)       | X | 5.68 | 67.99 | 16.91 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 5.59 | 67.74 | 16.72 |      | 150.0 |         |
|           |                                                | Z | 5.55 | 67.82 | 16.75 |      | 150.0 |         |
| 10119-CAC | IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)      | X | 5.33 | 67.64 | 16.65 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 5.25 | 67.40 | 16.46 |      | 150.0 |         |
|           |                                                | Z | 5.23 | 67.56 | 16.54 |      | 150.0 |         |
| 10140-CAD | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)     | X | 3.49 | 67.90 | 16.20 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 3.35 | 67.17 | 15.68 |      | 150.0 |         |
|           |                                                | Z | 3.38 | 67.62 | 15.95 |      | 150.0 |         |
| 10141-CAD | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)     | X | 3.61 | 67.94 | 16.34 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 3.47 | 67.27 | 15.86 |      | 150.0 |         |
|           |                                                | Z | 3.51 | 67.70 | 16.12 |      | 150.0 |         |
| 10142-CAD | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)        | X | 2.16 | 69.56 | 16.39 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 1.89 | 67.62 | 15.05 |      | 150.0 |         |
|           |                                                | Z | 1.99 | 68.80 | 15.75 |      | 150.0 |         |
| 10143-CAD | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)      | X | 2.59 | 69.29 | 16.26 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 2.35 | 67.87 | 15.16 |      | 150.0 |         |
|           |                                                | Z | 2.44 | 68.82 | 15.68 |      | 150.0 |         |
| 10144-CAD | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)      | X | 2.39 | 67.25 | 14.80 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 2.18 | 65.99 | 13.75 |      | 150.0 |         |
|           |                                                | Z | 2.24 | 66.71 | 14.17 |      | 150.0 |         |
| 10145-CAE | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)      | X | 1.43 | 66.95 | 13.27 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 1.14 | 64.01 | 11.00 |      | 150.0 |         |
|           |                                                | Z | 1.19 | 64.93 | 11.55 |      | 150.0 |         |
| 10146-CAE | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)    | X | 2.88 | 71.44 | 15.09 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 2.19 | 68.05 | 12.99 |      | 150.0 |         |
|           |                                                | Z | 2.00 | 66.89 | 12.10 |      | 150.0 |         |
| 10147-CAE | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)    | X | 3.73 | 75.07 | 16.77 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                | Y | 2.71 | 70.86 | 14.41 |      | 150.0 |         |
|           |                                                | Z | 2.36 | 69.01 | 13.24 |      | 150.0 |         |

|           |                                            |   |      |       |       |      |       |         |
|-----------|--------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10149-CAD | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)  | X | 3.02 | 67.89 | 16.19 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.86 | 67.02 | 15.55 |      | 150.0 |         |
|           |                                            | Z | 2.91 | 67.56 | 15.88 |      | 150.0 |         |
| 10150-CAD | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)  | X | 3.14 | 67.81 | 16.21 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.99 | 67.03 | 15.62 |      | 150.0 |         |
|           |                                            | Z | 3.03 | 67.53 | 15.93 |      | 150.0 |         |
| 10151-CAD | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)    | X | 9.24 | 80.70 | 22.42 | 3.98 | 65.0  | ± 9.6 % |
|           |                                            | Y | 8.94 | 80.53 | 22.24 |      | 65.0  |         |
|           |                                            | Z | 9.27 | 81.24 | 22.54 |      | 65.0  |         |
| 10152-CAD | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)  | X | 8.24 | 77.24 | 21.58 | 3.98 | 65.0  | ± 9.6 % |
|           |                                            | Y | 7.84 | 76.70 | 21.22 |      | 65.0  |         |
|           |                                            | Z | 8.05 | 77.25 | 21.46 |      | 65.0  |         |
| 10153-CAD | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)  | X | 8.60 | 77.96 | 22.20 | 3.98 | 65.0  | ± 9.6 % |
|           |                                            | Y | 8.27 | 77.61 | 21.94 |      | 65.0  |         |
|           |                                            | Z | 8.46 | 78.10 | 22.14 |      | 65.0  |         |
| 10154-CAE | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)    | X | 2.43 | 69.95 | 16.88 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.18 | 68.21 | 15.75 |      | 150.0 |         |
|           |                                            | Z | 2.27 | 69.24 | 16.37 |      | 150.0 |         |
| 10155-CAE | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)  | X | 2.71 | 68.53 | 16.44 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.53 | 67.50 | 15.65 |      | 150.0 |         |
|           |                                            | Z | 2.60 | 68.21 | 16.06 |      | 150.0 |         |
| 10156-CAE | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)     | X | 2.02 | 69.83 | 16.32 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 1.73 | 67.53 | 14.74 |      | 150.0 |         |
|           |                                            | Z | 1.84 | 68.84 | 15.51 |      | 150.0 |         |
| 10157-CAE | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)   | X | 2.24 | 67.95 | 14.94 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 1.99 | 66.32 | 13.65 |      | 150.0 |         |
|           |                                            | Z | 2.07 | 67.20 | 14.15 |      | 150.0 |         |
| 10158-CAE | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)  | X | 2.87 | 68.64 | 16.57 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.69 | 67.71 | 15.83 |      | 150.0 |         |
|           |                                            | Z | 2.75 | 68.38 | 16.22 |      | 150.0 |         |
| 10159-CAE | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)   | X | 2.35 | 68.36 | 15.21 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.09 | 66.69 | 13.90 |      | 150.0 |         |
|           |                                            | Z | 2.17 | 67.60 | 14.40 |      | 150.0 |         |
| 10160-CAD | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)    | X | 2.90 | 69.35 | 16.70 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.71 | 68.24 | 15.94 |      | 150.0 |         |
|           |                                            | Z | 2.77 | 68.92 | 16.36 |      | 150.0 |         |
| 10161-CAD | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)  | X | 3.03 | 67.73 | 16.15 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.88 | 66.94 | 15.54 |      | 150.0 |         |
|           |                                            | Z | 2.92 | 67.46 | 15.85 |      | 150.0 |         |
| 10162-CAD | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)  | X | 3.14 | 67.82 | 16.23 | 0.00 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.99 | 67.08 | 15.65 |      | 150.0 |         |
|           |                                            | Z | 3.03 | 67.60 | 15.96 |      | 150.0 |         |
| 10166-CAE | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)   | X | 3.79 | 70.15 | 19.63 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.61 | 69.64 | 19.37 |      | 150.0 |         |
|           |                                            | Z | 3.59 | 69.77 | 19.29 |      | 150.0 |         |
| 10167-CAE | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM) | X | 4.70 | 73.05 | 20.10 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 4.36 | 72.33 | 19.76 |      | 150.0 |         |
|           |                                            | Z | 4.38 | 72.59 | 19.72 |      | 150.0 |         |

|           |                                            |   |       |        |       |      |       |         |
|-----------|--------------------------------------------|---|-------|--------|-------|------|-------|---------|
| 10168-CAE | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM) | X | 5.13  | 74.98  | 21.26 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 4.81  | 74.54  | 21.08 |      | 150.0 |         |
|           |                                            | Z | 4.81  | 74.66  | 20.96 |      | 150.0 |         |
| 10169-CAD | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)      | X | 3.24  | 70.32  | 19.77 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.95  | 68.97  | 19.14 |      | 150.0 |         |
|           |                                            | Z | 2.96  | 69.16  | 19.07 |      | 150.0 |         |
| 10170-CAD | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)    | X | 4.47  | 76.14  | 21.98 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.92  | 74.50  | 21.37 |      | 150.0 |         |
|           |                                            | Z | 3.95  | 74.66  | 21.22 |      | 150.0 |         |
| 10171-AAD | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)    | X | 3.75  | 72.35  | 19.45 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.27  | 70.62  | 18.68 |      | 150.0 |         |
|           |                                            | Z | 3.32  | 71.00  | 18.68 |      | 150.0 |         |
| 10172-CAD | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)      | X | 25.61 | 107.79 | 33.43 | 6.02 | 65.0  | ± 9.6 % |
|           |                                            | Y | 22.14 | 106.45 | 33.18 |      | 65.0  |         |
|           |                                            | Z | 23.36 | 107.08 | 33.16 |      | 65.0  |         |
| 10173-CAD | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)    | X | 28.53 | 105.12 | 30.95 | 6.02 | 65.0  | ± 9.6 % |
|           |                                            | Y | 32.15 | 108.79 | 32.08 |      | 65.0  |         |
|           |                                            | Z | 30.18 | 106.96 | 31.30 |      | 65.0  |         |
| 10174-CAD | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)    | X | 22.70 | 99.68  | 28.85 | 6.02 | 65.0  | ± 9.6 % |
|           |                                            | Y | 24.46 | 102.42 | 29.70 |      | 65.0  |         |
|           |                                            | Z | 22.92 | 100.73 | 28.97 |      | 65.0  |         |
| 10175-CAE | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)      | X | 3.21  | 70.03  | 19.54 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.92  | 68.68  | 18.89 |      | 150.0 |         |
|           |                                            | Z | 2.93  | 68.89  | 18.85 |      | 150.0 |         |
| 10176-CAE | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)    | X | 4.48  | 76.16  | 21.99 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.92  | 74.53  | 21.39 |      | 150.0 |         |
|           |                                            | Z | 3.95  | 74.68  | 21.24 |      | 150.0 |         |
| 10177-CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)       | X | 3.23  | 70.18  | 19.63 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.94  | 68.82  | 18.99 |      | 150.0 |         |
|           |                                            | Z | 2.95  | 69.02  | 18.93 |      | 150.0 |         |
| 10178-CAE | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)     | X | 4.43  | 75.93  | 21.86 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.88  | 74.30  | 21.26 |      | 150.0 |         |
|           |                                            | Z | 3.92  | 74.49  | 21.13 |      | 150.0 |         |
| 10179-CAE | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)    | X | 4.09  | 74.17  | 20.60 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.57  | 72.47  | 19.91 |      | 150.0 |         |
|           |                                            | Z | 3.61  | 72.76  | 19.84 |      | 150.0 |         |
| 10180-CAE | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)     | X | 3.74  | 72.28  | 19.40 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.26  | 70.55  | 18.63 |      | 150.0 |         |
|           |                                            | Z | 3.31  | 70.94  | 18.64 |      | 150.0 |         |
| 10181-CAD | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)      | X | 3.23  | 70.16  | 19.62 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 2.94  | 68.81  | 18.98 |      | 150.0 |         |
|           |                                            | Z | 2.94  | 69.01  | 18.92 |      | 150.0 |         |
| 10182-CAD | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)    | X | 4.42  | 75.91  | 21.85 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.87  | 74.28  | 21.25 |      | 150.0 |         |
|           |                                            | Z | 3.91  | 74.47  | 21.12 |      | 150.0 |         |
| 10183-AAC | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)    | X | 3.73  | 72.25  | 19.39 | 3.01 | 150.0 | ± 9.6 % |
|           |                                            | Y | 3.25  | 70.53  | 18.62 |      | 150.0 |         |
|           |                                            | Z | 3.31  | 70.92  | 18.63 |      | 150.0 |         |

|           |                                               |   |      |       |       |      |       |         |
|-----------|-----------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10184-CAD | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)          | X | 3.24 | 70.20 | 19.64 | 3.01 | 150.0 | ± 9.6 % |
|           |                                               | Y | 2.95 | 68.85 | 19.00 |      | 150.0 |         |
|           |                                               | Z | 2.95 | 69.05 | 18.94 |      | 150.0 |         |
| 10185-CAD | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)        | X | 4.44 | 75.97 | 21.89 | 3.01 | 150.0 | ± 9.6 % |
|           |                                               | Y | 3.89 | 74.35 | 21.29 |      | 150.0 |         |
|           |                                               | Z | 3.93 | 74.54 | 21.15 |      | 150.0 |         |
| 10186-AAD | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)        | X | 3.75 | 72.32 | 19.42 | 3.01 | 150.0 | ± 9.6 % |
|           |                                               | Y | 3.27 | 70.59 | 18.65 |      | 150.0 |         |
|           |                                               | Z | 3.32 | 70.99 | 18.66 |      | 150.0 |         |
| 10187-CAE | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)        | X | 3.25 | 70.25 | 19.70 | 3.01 | 150.0 | ± 9.6 % |
|           |                                               | Y | 2.96 | 68.90 | 19.06 |      | 150.0 |         |
|           |                                               | Z | 2.96 | 69.09 | 19.00 |      | 150.0 |         |
| 10188-CAE | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)      | X | 4.58 | 76.60 | 22.24 | 3.01 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.01 | 74.99 | 21.66 |      | 150.0 |         |
|           |                                               | Z | 4.04 | 75.11 | 21.49 |      | 150.0 |         |
| 10189-AAE | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)      | X | 3.83 | 72.73 | 19.68 | 3.01 | 150.0 | ± 9.6 % |
|           |                                               | Y | 3.34 | 71.00 | 18.93 |      | 150.0 |         |
|           |                                               | Z | 3.39 | 71.37 | 18.92 |      | 150.0 |         |
| 10193-CAC | IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)  | X | 4.62 | 66.80 | 16.33 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.53 | 66.52 | 16.07 |      | 150.0 |         |
|           |                                               | Z | 4.53 | 66.76 | 16.19 |      | 150.0 |         |
| 10194-CAC | IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM) | X | 4.81 | 67.15 | 16.45 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.70 | 66.84 | 16.20 |      | 150.0 |         |
|           |                                               | Z | 4.71 | 67.08 | 16.32 |      | 150.0 |         |
| 10195-CAC | IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM) | X | 4.85 | 67.17 | 16.46 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.75 | 66.88 | 16.22 |      | 150.0 |         |
|           |                                               | Z | 4.75 | 67.11 | 16.34 |      | 150.0 |         |
| 10196-CAC | IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)       | X | 4.64 | 66.89 | 16.36 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.53 | 66.59 | 16.09 |      | 150.0 |         |
|           |                                               | Z | 4.54 | 66.82 | 16.21 |      | 150.0 |         |
| 10197-CAC | IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)      | X | 4.83 | 67.17 | 16.47 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.72 | 66.87 | 16.21 |      | 150.0 |         |
|           |                                               | Z | 4.72 | 67.10 | 16.33 |      | 150.0 |         |
| 10198-CAC | IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)      | X | 4.86 | 67.19 | 16.48 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.75 | 66.90 | 16.23 |      | 150.0 |         |
|           |                                               | Z | 4.75 | 67.13 | 16.35 |      | 150.0 |         |
| 10219-CAC | IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)       | X | 4.58 | 66.90 | 16.32 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.48 | 66.59 | 16.05 |      | 150.0 |         |
|           |                                               | Z | 4.49 | 66.83 | 16.17 |      | 150.0 |         |
| 10220-CAC | IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)    | X | 4.82 | 67.15 | 16.46 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.71 | 66.84 | 16.21 |      | 150.0 |         |
|           |                                               | Z | 4.71 | 67.07 | 16.32 |      | 150.0 |         |
| 10221-CAC | IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)    | X | 4.86 | 67.12 | 16.46 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 4.76 | 66.83 | 16.22 |      | 150.0 |         |
|           |                                               | Z | 4.76 | 67.06 | 16.33 |      | 150.0 |         |
| 10222-CAC | IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)        | X | 5.19 | 67.37 | 16.59 | 0.00 | 150.0 | ± 9.6 % |
|           |                                               | Y | 5.09 | 67.05 | 16.35 |      | 150.0 |         |
|           |                                               | Z | 5.09 | 67.25 | 16.45 |      | 150.0 |         |

|           |                                           |   |       |        |       |      |       |         |
|-----------|-------------------------------------------|---|-------|--------|-------|------|-------|---------|
| 10223-CAC | IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)  | X | 5.52  | 67.63  | 16.74 | 0.00 | 150.0 | ± 9.6 % |
|           |                                           | Y | 5.42  | 67.33  | 16.53 |      | 150.0 |         |
|           |                                           | Z | 5.40  | 67.49  | 16.60 |      | 150.0 |         |
| 10224-CAC | IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM) | X | 5.23  | 67.46  | 16.56 | 0.00 | 150.0 | ± 9.6 % |
|           |                                           | Y | 5.14  | 67.16  | 16.34 |      | 150.0 |         |
|           |                                           | Z | 5.13  | 67.36  | 16.43 |      | 150.0 |         |
| 10225-CAB | UMTS-FDD (HSPA+)                          | X | 2.89  | 66.40  | 15.64 | 0.00 | 150.0 | ± 9.6 % |
|           |                                           | Y | 2.77  | 65.79  | 15.06 |      | 150.0 |         |
|           |                                           | Z | 2.80  | 66.23  | 15.32 |      | 150.0 |         |
| 10226-CAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)  | X | 30.12 | 106.23 | 31.36 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 34.82 | 110.42 | 32.62 |      | 65.0  |         |
|           |                                           | Z | 32.27 | 108.32 | 31.77 |      | 65.0  |         |
| 10227-CAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)  | X | 24.97 | 101.48 | 29.46 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 29.42 | 105.79 | 30.75 |      | 65.0  |         |
|           |                                           | Z | 27.01 | 103.63 | 29.87 |      | 65.0  |         |
| 10228-CAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)    | X | 29.67 | 111.13 | 34.49 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 27.16 | 110.89 | 34.56 |      | 65.0  |         |
|           |                                           | Z | 28.51 | 111.32 | 34.46 |      | 65.0  |         |
| 10229-CAB | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)    | X | 28.56 | 105.12 | 30.96 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 32.23 | 108.82 | 32.10 |      | 65.0  |         |
|           |                                           | Z | 30.23 | 106.98 | 31.31 |      | 65.0  |         |
| 10230-CAB | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)    | X | 23.87 | 100.59 | 29.13 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 27.48 | 104.47 | 30.31 |      | 65.0  |         |
|           |                                           | Z | 25.51 | 102.53 | 29.49 |      | 65.0  |         |
| 10231-CAB | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)      | X | 28.15 | 109.97 | 34.08 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 25.42 | 109.44 | 34.06 |      | 65.0  |         |
|           |                                           | Z | 26.84 | 110.01 | 34.01 |      | 65.0  |         |
| 10232-CAD | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)    | X | 28.55 | 105.12 | 30.96 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 32.22 | 108.83 | 32.10 |      | 65.0  |         |
|           |                                           | Z | 30.23 | 106.99 | 31.32 |      | 65.0  |         |
| 10233-CAD | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)    | X | 23.88 | 100.61 | 29.14 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 27.47 | 104.47 | 30.31 |      | 65.0  |         |
|           |                                           | Z | 25.50 | 102.54 | 29.49 |      | 65.0  |         |
| 10234-CAD | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)      | X | 26.72 | 108.74 | 33.63 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 23.94 | 108.04 | 33.55 |      | 65.0  |         |
|           |                                           | Z | 25.35 | 108.68 | 33.52 |      | 65.0  |         |
| 10235-CAD | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)   | X | 28.64 | 105.19 | 30.98 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 32.35 | 108.91 | 32.12 |      | 65.0  |         |
|           |                                           | Z | 30.34 | 107.07 | 31.34 |      | 65.0  |         |
| 10236-CAD | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)   | X | 24.09 | 100.74 | 29.17 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 27.77 | 104.64 | 30.35 |      | 65.0  |         |
|           |                                           | Z | 25.76 | 102.69 | 29.53 |      | 65.0  |         |
| 10237-CAD | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)     | X | 28.42 | 110.18 | 34.15 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 25.64 | 109.64 | 34.12 |      | 65.0  |         |
|           |                                           | Z | 27.09 | 110.23 | 34.07 |      | 65.0  |         |
| 10238-CAD | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)   | X | 28.55 | 105.14 | 30.97 | 6.02 | 65.0  | ± 9.6 % |
|           |                                           | Y | 32.21 | 108.84 | 32.10 |      | 65.0  |         |
|           |                                           | Z | 30.22 | 107.00 | 31.32 |      | 65.0  |         |

|           |                                            |   |       |        |       |      |      |         |
|-----------|--------------------------------------------|---|-------|--------|-------|------|------|---------|
| 10239-CAD | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)    | X | 23.87 | 100.62 | 29.14 | 6.02 | 65.0 | ± 9.6 % |
|           |                                            | Y | 27.45 | 104.48 | 30.31 |      | 65.0 |         |
|           |                                            | Z | 25.49 | 102.55 | 29.50 |      | 65.0 |         |
| 10240-CAD | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)      | X | 28.32 | 110.12 | 34.13 | 6.02 | 65.0 | ± 9.6 % |
|           |                                            | Y | 25.54 | 109.58 | 34.10 |      | 65.0 |         |
|           |                                            | Z | 27.00 | 110.17 | 34.06 |      | 65.0 |         |
| 10241-CAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM) | X | 12.01 | 86.44  | 27.50 | 6.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 11.32 | 86.10  | 27.36 |      | 65.0 |         |
|           |                                            | Z | 11.85 | 87.07  | 27.59 |      | 65.0 |         |
| 10242-CAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM) | X | 11.22 | 84.92  | 26.83 | 6.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 10.54 | 84.52  | 26.66 |      | 65.0 |         |
|           |                                            | Z | 10.96 | 85.36  | 26.86 |      | 65.0 |         |
| 10243-CAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)   | X | 9.36  | 82.71  | 26.86 | 6.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 8.68  | 81.81  | 26.47 |      | 65.0 |         |
|           |                                            | Z | 9.04  | 82.81  | 26.78 |      | 65.0 |         |
| 10244-CAB | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)   | X | 9.20  | 80.16  | 20.97 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 8.90  | 79.99  | 20.57 |      | 65.0 |         |
|           |                                            | Z | 8.43  | 78.77  | 19.85 |      | 65.0 |         |
| 10245-CAB | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)   | X | 9.05  | 79.64  | 20.72 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 8.67  | 79.32  | 20.26 |      | 65.0 |         |
|           |                                            | Z | 8.23  | 78.16  | 19.56 |      | 65.0 |         |
| 10246-CAB | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK)     | X | 9.25  | 82.90  | 21.89 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 8.35  | 81.34  | 20.87 |      | 65.0 |         |
|           |                                            | Z | 8.83  | 82.25  | 21.22 |      | 65.0 |         |
| 10247-CAD | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)   | X | 7.67  | 77.68  | 20.47 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 7.14  | 76.72  | 19.73 |      | 65.0 |         |
|           |                                            | Z | 7.35  | 77.20  | 19.90 |      | 65.0 |         |
| 10248-CAD | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)   | X | 7.65  | 77.19  | 20.27 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 7.09  | 76.18  | 19.49 |      | 65.0 |         |
|           |                                            | Z | 7.28  | 76.65  | 19.67 |      | 65.0 |         |
| 10249-CAD | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)     | X | 10.28 | 84.91  | 23.29 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 9.73  | 84.22  | 22.70 |      | 65.0 |         |
|           |                                            | Z | 10.33 | 85.25  | 23.10 |      | 65.0 |         |
| 10250-CAD | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)  | X | 8.56  | 79.63  | 22.54 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 8.21  | 79.30  | 22.21 |      | 65.0 |         |
|           |                                            | Z | 8.43  | 79.79  | 22.40 |      | 65.0 |         |
| 10251-CAD | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)  | X | 8.13  | 77.62  | 21.46 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 7.72  | 77.06  | 21.01 |      | 65.0 |         |
|           |                                            | Z | 7.94  | 77.62  | 21.25 |      | 65.0 |         |
| 10252-CAD | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)    | X | 10.04 | 83.94  | 23.64 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 9.73  | 83.79  | 23.39 |      | 65.0 |         |
|           |                                            | Z | 10.22 | 84.72  | 23.77 |      | 65.0 |         |
| 10253-CAD | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)  | X | 8.03  | 76.66  | 21.37 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 7.66  | 76.16  | 21.00 |      | 65.0 |         |
|           |                                            | Z | 7.86  | 76.71  | 21.24 |      | 65.0 |         |
| 10254-CAD | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)  | X | 8.40  | 77.39  | 21.95 | 3.98 | 65.0 | ± 9.6 % |
|           |                                            | Y | 8.07  | 77.03  | 21.65 |      | 65.0 |         |
|           |                                            | Z | 8.26  | 77.52  | 21.85 |      | 65.0 |         |

|           |                                             |   |       |       |       |      |      |         |
|-----------|---------------------------------------------|---|-------|-------|-------|------|------|---------|
| 10255-CAD | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)     | X | 8.96  | 80.36 | 22.51 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.65  | 80.17 | 22.31 |      | 65.0 |         |
|           |                                             | Z | 8.98  | 80.90 | 22.62 |      | 65.0 |         |
| 10256-CAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM) | X | 8.08  | 77.70 | 19.21 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 7.41  | 76.61 | 18.34 |      | 65.0 |         |
|           |                                             | Z | 6.97  | 75.37 | 17.59 |      | 65.0 |         |
| 10257-CAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM) | X | 7.88  | 76.96 | 18.83 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 7.14  | 75.71 | 17.88 |      | 65.0 |         |
|           |                                             | Z | 6.75  | 74.57 | 17.17 |      | 65.0 |         |
| 10258-CAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)   | X | 7.78  | 79.64 | 20.06 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 6.62  | 77.19 | 18.57 |      | 65.0 |         |
|           |                                             | Z | 6.94  | 77.88 | 18.85 |      | 65.0 |         |
| 10259-CAB | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)   | X | 8.02  | 78.38 | 21.20 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 7.56  | 77.67 | 20.62 |      | 65.0 |         |
|           |                                             | Z | 7.78  | 78.17 | 20.80 |      | 65.0 |         |
| 10260-CAB | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)   | X | 8.03  | 78.09 | 21.10 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 7.56  | 77.37 | 20.51 |      | 65.0 |         |
|           |                                             | Z | 7.76  | 77.83 | 20.68 |      | 65.0 |         |
| 10261-CAB | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK)     | X | 9.78  | 83.86 | 23.23 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 9.31  | 83.32 | 22.75 |      | 65.0 |         |
|           |                                             | Z | 9.82  | 84.29 | 23.13 |      | 65.0 |         |
| 10262-CAD | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)   | X | 8.55  | 79.59 | 22.50 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.20  | 79.24 | 22.17 |      | 65.0 |         |
|           |                                             | Z | 8.42  | 79.74 | 22.36 |      | 65.0 |         |
| 10263-CAD | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)   | X | 8.12  | 77.61 | 21.45 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 7.71  | 77.05 | 21.01 |      | 65.0 |         |
|           |                                             | Z | 7.93  | 77.61 | 21.24 |      | 65.0 |         |
| 10264-CAD | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)     | X | 9.97  | 83.80 | 23.57 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 9.64  | 83.61 | 23.31 |      | 65.0 |         |
|           |                                             | Z | 10.14 | 84.55 | 23.69 |      | 65.0 |         |
| 10265-CAD | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)  | X | 8.24  | 77.24 | 21.58 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 7.84  | 76.71 | 21.22 |      | 65.0 |         |
|           |                                             | Z | 8.05  | 77.25 | 21.47 |      | 65.0 |         |
| 10266-CAD | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)  | X | 8.60  | 77.95 | 22.20 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.26  | 77.60 | 21.93 |      | 65.0 |         |
|           |                                             | Z | 8.45  | 78.09 | 22.14 |      | 65.0 |         |
| 10267-CAD | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)    | X | 9.23  | 80.67 | 22.41 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.93  | 80.49 | 22.22 |      | 65.0 |         |
|           |                                             | Z | 9.26  | 81.21 | 22.53 |      | 65.0 |         |
| 10268-CAD | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)  | X | 8.68  | 76.70 | 21.72 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.35  | 76.33 | 21.48 |      | 65.0 |         |
|           |                                             | Z | 8.51  | 76.76 | 21.67 |      | 65.0 |         |
| 10269-CAD | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)  | X | 8.61  | 76.29 | 21.63 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.29  | 75.93 | 21.38 |      | 65.0 |         |
|           |                                             | Z | 8.44  | 76.36 | 21.57 |      | 65.0 |         |
| 10270-CAD | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)    | X | 8.72  | 77.95 | 21.49 | 3.98 | 65.0 | ± 9.6 % |
|           |                                             | Y | 8.44  | 77.75 | 21.34 |      | 65.0 |         |
|           |                                             | Z | 8.65  | 78.26 | 21.56 |      | 65.0 |         |

|           |                                                                    |   |       |       |       |      |       |         |
|-----------|--------------------------------------------------------------------|---|-------|-------|-------|------|-------|---------|
| 10274-CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)                          | X | 2.65  | 66.73 | 15.53 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 2.53  | 66.00 | 14.87 |      | 150.0 |         |
|           |                                                                    | Z | 2.58  | 66.59 | 15.22 |      | 150.0 |         |
| 10275-CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)                           | X | 1.72  | 68.93 | 16.16 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 1.51  | 66.78 | 14.69 |      | 150.0 |         |
|           |                                                                    | Z | 1.61  | 68.10 | 15.52 |      | 150.0 |         |
| 10277-CAA | PHS (QPSK)                                                         | X | 5.72  | 69.80 | 14.27 | 9.03 | 50.0  | ± 9.6 % |
|           |                                                                    | Y | 4.91  | 67.88 | 12.66 |      | 50.0  |         |
|           |                                                                    | Z | 5.15  | 68.54 | 13.15 |      | 50.0  |         |
| 10278-CAA | PHS (QPSK, BW 884MHz, Rolloff 0.5)                                 | X | 8.85  | 78.92 | 20.42 | 9.03 | 50.0  | ± 9.6 % |
|           |                                                                    | Y | 7.98  | 77.31 | 19.14 |      | 50.0  |         |
|           |                                                                    | Z | 8.11  | 77.47 | 19.29 |      | 50.0  |         |
| 10279-CAA | PHS (QPSK, BW 884MHz, Rolloff 0.38)                                | X | 8.99  | 79.11 | 20.50 | 9.03 | 50.0  | ± 9.6 % |
|           |                                                                    | Y | 8.10  | 77.48 | 19.23 |      | 50.0  |         |
|           |                                                                    | Z | 8.23  | 77.64 | 19.38 |      | 50.0  |         |
| 10290-AAB | CDMA2000, RC1, SO55, Full Rate                                     | X | 1.69  | 70.53 | 15.18 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 1.25  | 66.50 | 12.56 |      | 150.0 |         |
|           |                                                                    | Z | 1.40  | 68.36 | 13.59 |      | 150.0 |         |
| 10291-AAB | CDMA2000, RC3, SO55, Full Rate                                     | X | 0.95  | 67.48 | 13.64 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 0.72  | 63.92 | 10.97 |      | 150.0 |         |
|           |                                                                    | Z | 0.79  | 65.48 | 12.01 |      | 150.0 |         |
| 10292-AAB | CDMA2000, RC3, SO32, Full Rate                                     | X | 1.29  | 72.80 | 16.48 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 0.83  | 66.41 | 12.61 |      | 150.0 |         |
|           |                                                                    | Z | 1.02  | 69.60 | 14.38 |      | 150.0 |         |
| 10293-AAB | CDMA2000, RC3, SO3, Full Rate                                      | X | 2.10  | 80.21 | 19.93 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 1.10  | 70.20 | 14.87 |      | 150.0 |         |
|           |                                                                    | Z | 1.60  | 75.99 | 17.57 |      | 150.0 |         |
| 10295-AAB | CDMA2000, RC1, SO3, 1/8th Rate 25 fr.                              | X | 11.30 | 84.68 | 24.49 | 9.03 | 50.0  | ± 9.6 % |
|           |                                                                    | Y | 11.80 | 85.70 | 24.41 |      | 50.0  |         |
|           |                                                                    | Z | 11.89 | 85.73 | 24.46 |      | 50.0  |         |
| 10297-AAC | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)                            | X | 2.91  | 70.44 | 16.97 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 2.65  | 68.85 | 16.01 |      | 150.0 |         |
|           |                                                                    | Z | 2.75  | 69.79 | 16.57 |      | 150.0 |         |
| 10298-AAC | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)                             | X | 1.77  | 69.10 | 15.14 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 1.44  | 66.22 | 13.11 |      | 150.0 |         |
|           |                                                                    | Z | 1.53  | 67.54 | 13.87 |      | 150.0 |         |
| 10299-AAC | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)                           | X | 3.44  | 73.52 | 16.85 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 2.88  | 71.29 | 15.45 |      | 150.0 |         |
|           |                                                                    | Z | 2.69  | 70.29 | 14.69 |      | 150.0 |         |
| 10300-AAC | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)                           | X | 2.46  | 67.83 | 13.54 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                    | Y | 2.09  | 66.06 | 12.24 |      | 150.0 |         |
|           |                                                                    | Z | 1.99  | 65.57 | 11.71 |      | 150.0 |         |
| 10301-AAA | IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC)                 | X | 5.88  | 68.88 | 19.16 | 4.17 | 80.0  | ± 9.6 % |
|           |                                                                    | Y | 5.51  | 67.81 | 18.47 |      | 80.0  |         |
|           |                                                                    | Z | 5.71  | 68.72 | 18.91 |      | 80.0  |         |
| 10302-AAA | IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL symbols) | X | 6.37  | 69.56 | 19.96 | 4.96 | 80.0  | ± 9.6 % |
|           |                                                                    | Y | 5.98  | 68.32 | 19.14 |      | 80.0  |         |
|           |                                                                    | Z | 6.20  | 69.38 | 19.70 |      | 80.0  |         |

|           |                                                                     |   |       |       |       |       |       |         |
|-----------|---------------------------------------------------------------------|---|-------|-------|-------|-------|-------|---------|
| 10303-AAA | IEEE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)                 | X | 6.25  | 69.73 | 20.05 | 4.96  | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.81  | 68.31 | 19.13 |       | 80.0  |         |
|           |                                                                     | Z | 6.05  | 69.46 | 19.73 |       | 80.0  |         |
| 10304-AAA | IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)                 | X | 5.83  | 68.83 | 19.14 | 4.17  | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.47  | 67.66 | 18.36 |       | 80.0  |         |
|           |                                                                     | Z | 5.67  | 68.66 | 18.87 |       | 80.0  |         |
| 10305-AAA | IEEE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 symbols)    | X | 11.59 | 87.86 | 28.59 | 6.02  | 50.0  | ± 9.6 % |
|           |                                                                     | Y | 8.30  | 80.20 | 25.07 |       | 50.0  |         |
|           |                                                                     | Z | 10.73 | 86.12 | 27.50 |       | 50.0  |         |
| 10306-AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 symbols)    | X | 6.95  | 73.41 | 22.40 | 6.02  | 50.0  | ± 9.6 % |
|           |                                                                     | Y | 6.70  | 73.81 | 22.62 |       | 50.0  |         |
|           |                                                                     | Z | 6.66  | 72.86 | 21.87 |       | 50.0  |         |
| 10307-AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 symbols)     | X | 7.11  | 74.28 | 22.59 | 6.02  | 50.0  | ± 9.6 % |
|           |                                                                     | Y | 6.93  | 74.97 | 22.97 |       | 50.0  |         |
|           |                                                                     | Z | 6.77  | 73.56 | 22.00 |       | 50.0  |         |
| 10308-AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)                | X | 7.22  | 74.85 | 22.86 | 6.02  | 50.0  | ± 9.6 % |
|           |                                                                     | Y | 7.08  | 75.70 | 23.30 |       | 50.0  |         |
|           |                                                                     | Z | 8.15  | 79.17 | 24.90 |       | 50.0  |         |
| 10309-AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 symbols) | X | 7.08  | 73.79 | 22.60 | 6.02  | 50.0  | ± 9.6 % |
|           |                                                                     | Y | 6.82  | 74.15 | 22.80 |       | 50.0  |         |
|           |                                                                     | Z | 6.77  | 73.19 | 22.06 |       | 50.0  |         |
| 10310-AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 symbols)  | X | 7.00  | 73.73 | 22.45 | 6.02  | 50.0  | ± 9.6 % |
|           |                                                                     | Y | 6.79  | 74.28 | 22.75 |       | 50.0  |         |
|           |                                                                     | Z | 6.70  | 73.15 | 21.91 |       | 50.0  |         |
| 10311-AAC | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)                            | X | 3.27  | 69.63 | 16.57 | 0.00  | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 2.99  | 68.15 | 15.70 |       | 150.0 |         |
|           |                                                                     | Z | 3.10  | 69.03 | 16.20 |       | 150.0 |         |
| 10313-AAA | iDEN 1:3                                                            | X | 7.67  | 78.82 | 19.03 | 6.99  | 70.0  | ± 9.6 % |
|           |                                                                     | Y | 6.82  | 77.24 | 18.08 |       | 70.0  |         |
|           |                                                                     | Z | 7.52  | 78.71 | 18.78 |       | 70.0  |         |
| 10314-AAA | iDEN 1:6                                                            | X | 9.54  | 84.04 | 23.30 | 10.00 | 30.0  | ± 9.6 % |
|           |                                                                     | Y | 9.16  | 83.89 | 22.95 |       | 30.0  |         |
|           |                                                                     | Z | 9.80  | 84.95 | 23.44 |       | 30.0  |         |
| 10315-AAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)           | X | 1.17  | 65.05 | 15.97 | 0.17  | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 1.09  | 63.78 | 14.85 |       | 150.0 |         |
|           |                                                                     | Z | 1.13  | 64.61 | 15.50 |       | 150.0 |         |
| 10316-AAB | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)       | X | 4.73  | 67.02 | 16.56 | 0.17  | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.63  | 66.73 | 16.31 |       | 150.0 |         |
|           |                                                                     | Z | 4.64  | 66.97 | 16.43 |       | 150.0 |         |
| 10317-AAC | IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)             | X | 4.73  | 67.02 | 16.56 | 0.17  | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.63  | 66.73 | 16.31 |       | 150.0 |         |
|           |                                                                     | Z | 4.64  | 66.97 | 16.43 |       | 150.0 |         |
| 10400-AAD | IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)                 | X | 4.82  | 67.23 | 16.46 | 0.00  | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.70  | 66.92 | 16.20 |       | 150.0 |         |
|           |                                                                     | Z | 4.70  | 67.16 | 16.33 |       | 150.0 |         |
| 10401-AAD | IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)                 | X | 5.50  | 67.42 | 16.62 | 0.00  | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 5.45  | 67.29 | 16.49 |       | 150.0 |         |
|           |                                                                     | Z | 5.44  | 67.46 | 16.57 |       | 150.0 |         |

|           |                                                                                 |   |        |        |       |      |       |         |
|-----------|---------------------------------------------------------------------------------|---|--------|--------|-------|------|-------|---------|
| 10402-AAD | IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)                             | X | 5.77   | 67.80  | 16.65 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 5.67   | 67.48  | 16.43 |      | 150.0 |         |
|           |                                                                                 | Z | 5.66   | 67.64  | 16.50 |      | 150.0 |         |
| 10403-AAB | CDMA2000 (1xEV-DO, Rev. 0)                                                      | X | 1.69   | 70.53  | 15.18 | 0.00 | 115.0 | ± 9.6 % |
|           |                                                                                 | Y | 1.25   | 66.50  | 12.56 |      | 115.0 |         |
|           |                                                                                 | Z | 1.40   | 68.36  | 13.59 |      | 115.0 |         |
| 10404-AAB | CDMA2000 (1xEV-DO, Rev. A)                                                      | X | 1.69   | 70.53  | 15.18 | 0.00 | 115.0 | ± 9.6 % |
|           |                                                                                 | Y | 1.25   | 66.50  | 12.56 |      | 115.0 |         |
|           |                                                                                 | Z | 1.40   | 68.36  | 13.59 |      | 115.0 |         |
| 10406-AAB | CDMA2000, RC3, SO32, SCH0, Full Rate                                            | X | 58.29  | 119.52 | 31.57 | 0.00 | 100.0 | ± 9.6 % |
|           |                                                                                 | Y | 82.81  | 124.83 | 32.44 |      | 100.0 |         |
|           |                                                                                 | Z | 53.04  | 115.96 | 29.70 |      | 100.0 |         |
| 10410-AAD | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9, Subframe Conf=4) | X | 100.00 | 122.33 | 31.60 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                                 | Y | 100.00 | 122.90 | 31.55 |      | 80.0  |         |
|           |                                                                                 | Z | 100.00 | 121.45 | 30.83 |      | 80.0  |         |
| 10415-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)                       | X | 1.01   | 63.41  | 15.03 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 0.96   | 62.37  | 13.98 |      | 150.0 |         |
|           |                                                                                 | Z | 0.99   | 63.08  | 14.59 |      | 150.0 |         |
| 10416-AAA | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)                   | X | 4.63   | 66.84  | 16.39 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.53   | 66.56  | 16.14 |      | 150.0 |         |
|           |                                                                                 | Z | 4.54   | 66.80  | 16.26 |      | 150.0 |         |
| 10417-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)                       | X | 4.63   | 66.84  | 16.39 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.53   | 66.56  | 16.14 |      | 150.0 |         |
|           |                                                                                 | Z | 4.54   | 66.80  | 16.26 |      | 150.0 |         |
| 10418-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preamble)   | X | 4.61   | 66.99  | 16.40 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.52   | 66.70  | 16.14 |      | 150.0 |         |
|           |                                                                                 | Z | 4.53   | 66.96  | 16.28 |      | 150.0 |         |
| 10419-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preamble)  | X | 4.64   | 66.94  | 16.40 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.54   | 66.66  | 16.15 |      | 150.0 |         |
|           |                                                                                 | Z | 4.55   | 66.91  | 16.28 |      | 150.0 |         |
| 10422-AAB | IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)                                    | X | 4.76   | 66.95  | 16.42 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.66   | 66.68  | 16.18 |      | 150.0 |         |
|           |                                                                                 | Z | 4.67   | 66.91  | 16.30 |      | 150.0 |         |
| 10423-AAB | IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM)                                 | X | 4.95   | 67.31  | 16.55 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.83   | 67.01  | 16.30 |      | 150.0 |         |
|           |                                                                                 | Z | 4.83   | 67.23  | 16.42 |      | 150.0 |         |
| 10424-AAB | IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM)                                 | X | 4.86   | 67.25  | 16.52 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 4.75   | 66.95  | 16.27 |      | 150.0 |         |
|           |                                                                                 | Z | 4.75   | 67.18  | 16.39 |      | 150.0 |         |
| 10425-AAB | IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)                                     | X | 5.48   | 67.66  | 16.74 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 5.40   | 67.43  | 16.55 |      | 150.0 |         |
|           |                                                                                 | Z | 5.38   | 67.57  | 16.61 |      | 150.0 |         |
| 10426-AAB | IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM)                                   | X | 5.48   | 67.68  | 16.74 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                                 | Y | 5.41   | 67.49  | 16.57 |      | 150.0 |         |
|           |                                                                                 | Z | 5.39   | 67.62  | 16.64 |      | 150.0 |         |

|           |                                                                |   |        |        |       |      |       |         |
|-----------|----------------------------------------------------------------|---|--------|--------|-------|------|-------|---------|
| 10427-AAB | IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)                 | X | 5.49   | 67.63  | 16.71 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 5.41   | 67.41  | 16.53 |      | 150.0 |         |
|           |                                                                | Z | 5.39   | 67.56  | 16.60 |      | 150.0 |         |
| 10430-AAB | LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)                               | X | 4.28   | 70.45  | 18.15 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.15   | 70.21  | 17.82 |      | 150.0 |         |
|           |                                                                | Z | 4.17   | 70.53  | 17.95 |      | 150.0 |         |
| 10431-AAB | LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)                              | X | 4.34   | 67.42  | 16.43 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.21   | 67.05  | 16.09 |      | 150.0 |         |
|           |                                                                | Z | 4.21   | 67.35  | 16.24 |      | 150.0 |         |
| 10432-AAB | LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)                              | X | 4.63   | 67.29  | 16.48 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.51   | 66.97  | 16.19 |      | 150.0 |         |
|           |                                                                | Z | 4.52   | 67.23  | 16.33 |      | 150.0 |         |
| 10433-AAB | LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)                              | X | 4.88   | 67.28  | 16.54 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.77   | 66.98  | 16.29 |      | 150.0 |         |
|           |                                                                | Z | 4.77   | 67.21  | 16.41 |      | 150.0 |         |
| 10434-AAA | W-CDMA (BS Test Model 1, 64 DPCH)                              | X | 4.37   | 71.21  | 18.12 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.21   | 70.88  | 17.70 |      | 150.0 |         |
|           |                                                                | Z | 4.25   | 71.29  | 17.86 |      | 150.0 |         |
| 10435-AAC | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | X | 100.00 | 122.16 | 31.53 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                | Y | 100.00 | 122.71 | 31.47 |      | 80.0  |         |
|           |                                                                | Z | 100.00 | 121.26 | 30.74 |      | 80.0  |         |
| 10447-AAB | LTE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)                 | X | 3.64   | 67.48  | 15.86 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 3.47   | 66.90  | 15.30 |      | 150.0 |         |
|           |                                                                | Z | 3.50   | 67.31  | 15.51 |      | 150.0 |         |
| 10448-AAB | LTE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)                | X | 4.17   | 67.19  | 16.29 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.04   | 66.82  | 15.93 |      | 150.0 |         |
|           |                                                                | Z | 4.05   | 67.12  | 16.10 |      | 150.0 |         |
| 10449-AAB | LTE-FDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)                | X | 4.43   | 67.11  | 16.37 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.32   | 66.77  | 16.08 |      | 150.0 |         |
|           |                                                                | Z | 4.33   | 67.04  | 16.22 |      | 150.0 |         |
| 10450-AAB | LTE-FDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)                | X | 4.62   | 67.04  | 16.39 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 4.52   | 66.72  | 16.12 |      | 150.0 |         |
|           |                                                                | Z | 4.52   | 66.97  | 16.25 |      | 150.0 |         |
| 10451-AAA | W-CDMA (BS Test Model 1, 64 DPCH, Clipping 44%)                | X | 3.56   | 67.73  | 15.55 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 3.35   | 67.01  | 14.87 |      | 150.0 |         |
|           |                                                                | Z | 3.38   | 67.45  | 15.09 |      | 150.0 |         |
| 10456-AAB | IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle)           | X | 6.34   | 68.21  | 16.88 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 6.27   | 67.98  | 16.71 |      | 150.0 |         |
|           |                                                                | Z | 6.25   | 68.10  | 16.76 |      | 150.0 |         |
| 10457-AAA | UMTS-FDD (DC-HSDPA)                                            | X | 3.84   | 65.46  | 16.11 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 3.77   | 65.19  | 15.83 |      | 150.0 |         |
|           |                                                                | Z | 3.79   | 65.43  | 15.97 |      | 150.0 |         |
| 10458-AAA | CDMA2000 (1xEV-DO, Rev. B, 2 carriers)                         | X | 4.00   | 70.46  | 17.58 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 3.84   | 70.06  | 17.04 |      | 150.0 |         |
|           |                                                                | Z | 3.90   | 70.60  | 17.26 |      | 150.0 |         |
| 10459-AAA | CDMA2000 (1xEV-DO, Rev. B, 3 carriers)                         | X | 5.11   | 67.94  | 18.07 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                | Y | 5.02   | 68.02  | 17.94 |      | 150.0 |         |
|           |                                                                | Z | 5.00   | 68.15  | 17.94 |      | 150.0 |         |

|           |                                                                   |   |        |        |       |      |       |         |
|-----------|-------------------------------------------------------------------|---|--------|--------|-------|------|-------|---------|
| 10460-AAA | UMTS-FDD (WCDMA, AMR)                                             | X | 0.99   | 70.19  | 17.21 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                   | Y | 0.79   | 66.24  | 14.56 |      | 150.0 |         |
|           |                                                                   | Z | 0.89   | 68.50  | 16.06 |      | 150.0 |         |
| 10461-AAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)   | X | 100.00 | 125.48 | 33.13 | 3.29 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 126.71 | 33.38 |      | 80.0  |         |
|           |                                                                   | Z | 100.00 | 124.78 | 32.43 |      | 80.0  |         |
| 10462-AAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | X | 100.00 | 111.35 | 26.37 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 110.68 | 25.72 |      | 80.0  |         |
|           |                                                                   | Z | 99.96  | 108.86 | 24.85 |      | 80.0  |         |
| 10463-AAA | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | X | 100.00 | 108.43 | 24.96 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 107.27 | 24.09 |      | 80.0  |         |
|           |                                                                   | Z | 11.86  | 83.93  | 17.98 |      | 80.0  |         |
| 10464-AAA | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 100.00 | 123.68 | 32.14 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 124.66 | 32.27 |      | 80.0  |         |
|           |                                                                   | Z | 100.00 | 122.71 | 31.32 |      | 80.0  |         |
| 10465-AAA | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 100.00 | 110.89 | 26.14 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 110.13 | 25.45 |      | 80.0  |         |
|           |                                                                   | Z | 38.00  | 97.98  | 22.23 |      | 80.0  |         |
| 10466-AAA | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 66.21  | 103.47 | 23.73 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 29.96  | 94.21  | 20.95 |      | 80.0  |         |
|           |                                                                   | Z | 7.74   | 79.35  | 16.55 |      | 80.0  |         |
| 10467-AAC | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 100.00 | 123.89 | 32.23 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 124.90 | 32.38 |      | 80.0  |         |
|           |                                                                   | Z | 100.00 | 122.94 | 31.42 |      | 80.0  |         |
| 10468-AAC | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 100.00 | 111.04 | 26.21 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 110.31 | 25.54 |      | 80.0  |         |
|           |                                                                   | Z | 48.22  | 100.68 | 22.91 |      | 80.0  |         |
| 10469-AAC | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 70.15  | 104.12 | 23.88 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 31.63  | 94.80  | 21.09 |      | 80.0  |         |
|           |                                                                   | Z | 7.88   | 79.54  | 16.61 |      | 80.0  |         |
| 10470-AAC | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | X | 100.00 | 123.92 | 32.24 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 124.94 | 32.38 |      | 80.0  |         |
|           |                                                                   | Z | 100.00 | 122.97 | 31.42 |      | 80.0  |         |
| 10471-AAC | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | X | 100.00 | 111.00 | 26.18 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 110.26 | 25.51 |      | 80.0  |         |
|           |                                                                   | Z | 47.97  | 100.58 | 22.87 |      | 80.0  |         |
| 10472-AAC | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)  | X | 70.92  | 104.20 | 23.88 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 31.52  | 94.72  | 21.06 |      | 80.0  |         |
|           |                                                                   | Z | 7.84   | 79.47  | 16.58 |      | 80.0  |         |
| 10473-AAC | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | X | 100.00 | 123.89 | 32.23 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 124.91 | 32.37 |      | 80.0  |         |
|           |                                                                   | Z | 100.00 | 122.94 | 31.41 |      | 80.0  |         |
| 10474-AAC | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | X | 100.00 | 111.01 | 26.19 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 100.00 | 110.27 | 25.51 |      | 80.0  |         |
|           |                                                                   | Z | 47.00  | 100.37 | 22.82 |      | 80.0  |         |
| 10475-AAC | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)  | X | 68.93  | 103.90 | 23.81 | 3.23 | 80.0  | ± 9.6 % |
|           |                                                                   | Y | 30.64  | 94.44  | 20.99 |      | 80.0  |         |
|           |                                                                   | Z | 7.75   | 79.37  | 16.55 |      | 80.0  |         |

|           |                                                                     |   |        |        |       |      |      |         |
|-----------|---------------------------------------------------------------------|---|--------|--------|-------|------|------|---------|
| 10477-AAC | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)    | X | 100.00 | 110.85 | 26.11 | 3.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 100.00 | 110.08 | 25.42 |      | 80.0 |         |
|           |                                                                     | Z | 39.81  | 98.45  | 22.33 |      | 80.0 |         |
| 10478-AAC | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)    | X | 66.88  | 103.53 | 23.72 | 3.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 29.54  | 94.01  | 20.87 |      | 80.0 |         |
|           |                                                                     | Z | 7.64   | 79.20  | 16.49 |      | 80.0 |         |
| 10479-AAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)   | X | 18.61  | 98.48  | 27.45 | 3.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 25.62  | 103.89 | 28.72 |      | 80.0 |         |
|           |                                                                     | Z | 19.02  | 98.49  | 26.87 |      | 80.0 |         |
| 10480-AAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | X | 17.74  | 92.23  | 23.95 | 3.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 23.09  | 96.00  | 24.65 |      | 80.0 |         |
|           |                                                                     | Z | 15.42  | 89.78  | 22.53 |      | 80.0 |         |
| 10481-AAA | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | X | 14.70  | 88.73  | 22.56 | 3.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 17.07  | 90.84  | 22.79 |      | 80.0 |         |
|           |                                                                     | Z | 11.82  | 85.36  | 20.81 |      | 80.0 |         |
| 10482-AAA | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 6.42   | 80.34  | 20.27 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 4.54   | 75.37  | 17.94 |      | 80.0 |         |
|           |                                                                     | Z | 5.57   | 78.35  | 19.09 |      | 80.0 |         |
| 10483-AAA | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 9.52   | 83.05  | 21.15 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 9.34   | 82.78  | 20.64 |      | 80.0 |         |
|           |                                                                     | Z | 7.40   | 79.15  | 19.09 |      | 80.0 |         |
| 10484-AAA | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 8.60   | 81.38  | 20.58 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 8.20   | 80.76  | 19.96 |      | 80.0 |         |
|           |                                                                     | Z | 6.69   | 77.58  | 18.54 |      | 80.0 |         |
| 10485-AAC | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 6.55   | 80.98  | 21.28 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 5.07   | 77.22  | 19.53 |      | 80.0 |         |
|           |                                                                     | Z | 6.01   | 79.95  | 20.60 |      | 80.0 |         |
| 10486-AAC | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 5.00   | 73.93  | 18.31 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 4.24   | 71.65  | 16.98 |      | 80.0 |         |
|           |                                                                     | Z | 4.64   | 73.10  | 17.58 |      | 80.0 |         |
| 10487-AAC | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 4.92   | 73.36  | 18.08 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 4.20   | 71.18  | 16.78 |      | 80.0 |         |
|           |                                                                     | Z | 4.56   | 72.51  | 17.34 |      | 80.0 |         |
| 10488-AAC | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | X | 6.10   | 78.52  | 20.97 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 5.11   | 75.97  | 19.78 |      | 80.0 |         |
|           |                                                                     | Z | 5.69   | 77.85  | 20.57 |      | 80.0 |         |
| 10489-AAC | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | X | 4.95   | 72.75  | 18.88 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 4.48   | 71.40  | 18.08 |      | 80.0 |         |
|           |                                                                     | Z | 4.72   | 72.41  | 18.54 |      | 80.0 |         |
| 10490-AAC | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)  | X | 5.00   | 72.39  | 18.75 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 4.55   | 71.14  | 18.00 |      | 80.0 |         |
|           |                                                                     | Z | 4.78   | 72.09  | 18.43 |      | 80.0 |         |
| 10491-AAC | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | X | 5.71   | 75.50  | 19.96 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 5.04   | 73.73  | 19.09 |      | 80.0 |         |
|           |                                                                     | Z | 5.40   | 75.03  | 19.67 |      | 80.0 |         |
| 10492-AAC | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | X | 5.12   | 71.43  | 18.61 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                     | Y | 4.74   | 70.41  | 18.01 |      | 80.0 |         |
|           |                                                                     | Z | 4.91   | 71.17  | 18.36 |      | 80.0 |         |

|           |                                                                      |   |      |       |       |      |      |         |
|-----------|----------------------------------------------------------------------|---|------|-------|-------|------|------|---------|
| 10493-AAC | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 5.16 | 71.20 | 18.53 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.79 | 70.23 | 17.95 |      | 80.0 |         |
|           |                                                                      | Z | 4.96 | 70.96 | 18.29 |      | 80.0 |         |
| 10494-AAC | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 6.40 | 77.43 | 20.51 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 5.52 | 75.29 | 19.53 |      | 80.0 |         |
|           |                                                                      | Z | 6.00 | 76.80 | 20.18 |      | 80.0 |         |
| 10495-AAC | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 5.21 | 71.98 | 18.84 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.80 | 70.86 | 18.21 |      | 80.0 |         |
|           |                                                                      | Z | 4.99 | 71.64 | 18.58 |      | 80.0 |         |
| 10496-AAC | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 5.24 | 71.52 | 18.69 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.85 | 70.51 | 18.11 |      | 80.0 |         |
|           |                                                                      | Z | 5.02 | 71.23 | 18.45 |      | 80.0 |         |
| 10497-AAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)   | X | 4.89 | 76.14 | 17.97 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 3.19 | 70.40 | 15.09 |      | 80.0 |         |
|           |                                                                      | Z | 3.85 | 72.91 | 16.12 |      | 80.0 |         |
| 10498-AAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | X | 3.27 | 68.15 | 13.86 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 2.33 | 64.21 | 11.42 |      | 80.0 |         |
|           |                                                                      | Z | 2.49 | 65.10 | 11.84 |      | 80.0 |         |
| 10499-AAA | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | X | 3.14 | 67.39 | 13.40 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 2.26 | 63.62 | 11.00 |      | 80.0 |         |
|           |                                                                      | Z | 2.39 | 64.37 | 11.36 |      | 80.0 |         |
| 10500-AAA | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 6.12 | 79.35 | 20.96 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.97 | 76.32 | 19.51 |      | 80.0 |         |
|           |                                                                      | Z | 5.70 | 78.62 | 20.44 |      | 80.0 |         |
| 10501-AAA | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 4.96 | 73.36 | 18.48 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.36 | 71.58 | 17.41 |      | 80.0 |         |
|           |                                                                      | Z | 4.68 | 72.83 | 17.95 |      | 80.0 |         |
| 10502-AAA | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 4.98 | 73.06 | 18.32 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.39 | 71.34 | 17.27 |      | 80.0 |         |
|           |                                                                      | Z | 4.70 | 72.53 | 17.78 |      | 80.0 |         |
| 10503-AAC | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)     | X | 6.02 | 78.31 | 20.87 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 5.05 | 75.75 | 19.68 |      | 80.0 |         |
|           |                                                                      | Z | 5.61 | 77.63 | 20.47 |      | 80.0 |         |
| 10504-AAC | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)   | X | 4.93 | 72.67 | 18.83 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.45 | 71.30 | 18.03 |      | 80.0 |         |
|           |                                                                      | Z | 4.70 | 72.32 | 18.48 |      | 80.0 |         |
| 10505-AAC | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)   | X | 4.97 | 72.30 | 18.70 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.52 | 71.04 | 17.95 |      | 80.0 |         |
|           |                                                                      | Z | 4.75 | 71.99 | 18.37 |      | 80.0 |         |
| 10506-AAC | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)    | X | 6.35 | 77.28 | 20.44 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 5.48 | 75.14 | 19.46 |      | 80.0 |         |
|           |                                                                      | Z | 5.95 | 76.64 | 20.11 |      | 80.0 |         |
| 10507-AAC | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)  | X | 5.19 | 71.92 | 18.80 | 2.23 | 80.0 | ± 9.6 % |
|           |                                                                      | Y | 4.78 | 70.80 | 18.18 |      | 80.0 |         |
|           |                                                                      | Z | 4.97 | 71.58 | 18.54 |      | 80.0 |         |

|           |                                                                     |   |      |       |       |      |       |         |
|-----------|---------------------------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10508-AAC | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | X | 5.22 | 71.46 | 18.65 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 4.84 | 70.44 | 18.07 |      | 80.0  |         |
|           |                                                                     | Z | 5.01 | 71.16 | 18.41 |      | 80.0  |         |
| 10509-AAC | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)   | X | 6.16 | 74.73 | 19.49 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.55 | 73.22 | 18.76 |      | 80.0  |         |
|           |                                                                     | Z | 5.87 | 74.29 | 19.25 |      | 80.0  |         |
| 10510-AAC | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | X | 5.58 | 71.18 | 18.59 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.22 | 70.26 | 18.08 |      | 80.0  |         |
|           |                                                                     | Z | 5.37 | 70.88 | 18.37 |      | 80.0  |         |
| 10511-AAC | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | X | 5.59 | 70.81 | 18.48 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.25 | 69.96 | 18.01 |      | 80.0  |         |
|           |                                                                     | Z | 5.39 | 70.55 | 18.28 |      | 80.0  |         |
| 10512-AAC | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)   | X | 6.77 | 76.89 | 20.15 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.92 | 74.92 | 19.26 |      | 80.0  |         |
|           |                                                                     | Z | 6.37 | 76.26 | 19.84 |      | 80.0  |         |
| 10513-AAC | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | X | 5.53 | 71.68 | 18.77 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.14 | 70.63 | 18.21 |      | 80.0  |         |
|           |                                                                     | Z | 5.30 | 71.30 | 18.53 |      | 80.0  |         |
| 10514-AAC | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | X | 5.48 | 71.10 | 18.60 | 2.23 | 80.0  | ± 9.6 % |
|           |                                                                     | Y | 5.12 | 70.15 | 18.08 |      | 80.0  |         |
|           |                                                                     | Z | 5.27 | 70.77 | 18.37 |      | 80.0  |         |
| 10515-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)           | X | 0.97 | 63.65 | 15.12 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 0.92 | 62.50 | 14.00 |      | 150.0 |         |
|           |                                                                     | Z | 0.95 | 63.27 | 14.65 |      | 150.0 |         |
| 10516-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 99pc duty cycle)         | X | 0.79 | 75.90 | 19.78 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 0.49 | 67.25 | 14.66 |      | 150.0 |         |
|           |                                                                     | Z | 0.62 | 71.59 | 17.42 |      | 150.0 |         |
| 10517-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 99pc duty cycle)          | X | 0.85 | 66.16 | 16.04 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 0.75 | 63.97 | 14.23 |      | 150.0 |         |
|           |                                                                     | Z | 0.80 | 65.28 | 15.27 |      | 150.0 |         |
| 10518-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)           | X | 4.62 | 66.92 | 16.37 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.52 | 66.63 | 16.11 |      | 150.0 |         |
|           |                                                                     | Z | 4.53 | 66.88 | 16.24 |      | 150.0 |         |
| 10519-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 99pc duty cycle)          | X | 4.83 | 67.19 | 16.50 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.71 | 66.89 | 16.25 |      | 150.0 |         |
|           |                                                                     | Z | 4.71 | 67.12 | 16.36 |      | 150.0 |         |
| 10520-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 99pc duty cycle)          | X | 4.68 | 67.16 | 16.43 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.56 | 66.83 | 16.16 |      | 150.0 |         |
|           |                                                                     | Z | 4.57 | 67.07 | 16.28 |      | 150.0 |         |
| 10521-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 99pc duty cycle)          | X | 4.61 | 67.16 | 16.41 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.49 | 66.82 | 16.13 |      | 150.0 |         |
|           |                                                                     | Z | 4.50 | 67.06 | 16.26 |      | 150.0 |         |
| 10522-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 99pc duty cycle)          | X | 4.66 | 67.20 | 16.48 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                     | Y | 4.55 | 66.91 | 16.22 |      | 150.0 |         |
|           |                                                                     | Z | 4.56 | 67.16 | 16.35 |      | 150.0 |         |

|           |                                                            |   |      |       |       |      |       |         |
|-----------|------------------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10523-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 99pc duty cycle) | X | 4.53 | 67.06 | 16.32 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.43 | 66.75 | 16.05 |      | 150.0 |         |
|           |                                                            | Z | 4.44 | 67.02 | 16.19 |      | 150.0 |         |
| 10524-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 99pc duty cycle) | X | 4.61 | 67.14 | 16.45 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.50 | 66.83 | 16.19 |      | 150.0 |         |
|           |                                                            | Z | 4.50 | 67.08 | 16.32 |      | 150.0 |         |
| 10525-AAB | IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)          | X | 4.58 | 66.16 | 16.03 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.48 | 65.85 | 15.77 |      | 150.0 |         |
|           |                                                            | Z | 4.49 | 66.11 | 15.90 |      | 150.0 |         |
| 10526-AAB | IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)          | X | 4.77 | 66.55 | 16.18 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.65 | 66.23 | 15.92 |      | 150.0 |         |
|           |                                                            | Z | 4.66 | 66.48 | 16.05 |      | 150.0 |         |
| 10527-AAB | IEEE 802.11ac WiFi (20MHz, MCS2, 99pc duty cycle)          | X | 4.69 | 66.52 | 16.13 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.57 | 66.18 | 15.85 |      | 150.0 |         |
|           |                                                            | Z | 4.58 | 66.44 | 15.99 |      | 150.0 |         |
| 10528-AAB | IEEE 802.11ac WiFi (20MHz, MCS3, 99pc duty cycle)          | X | 4.70 | 66.54 | 16.16 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.59 | 66.20 | 15.89 |      | 150.0 |         |
|           |                                                            | Z | 4.59 | 66.46 | 16.02 |      | 150.0 |         |
| 10529-AAB | IEEE 802.11ac WiFi (20MHz, MCS4, 99pc duty cycle)          | X | 4.70 | 66.54 | 16.16 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.59 | 66.20 | 15.89 |      | 150.0 |         |
|           |                                                            | Z | 4.59 | 66.46 | 16.02 |      | 150.0 |         |
| 10531-AAB | IEEE 802.11ac WiFi (20MHz, MCS6, 99pc duty cycle)          | X | 4.71 | 66.67 | 16.19 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.58 | 66.30 | 15.90 |      | 150.0 |         |
|           |                                                            | Z | 4.59 | 66.56 | 16.03 |      | 150.0 |         |
| 10532-AAB | IEEE 802.11ac WiFi (20MHz, MCS7, 99pc duty cycle)          | X | 4.56 | 66.53 | 16.12 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.44 | 66.14 | 15.82 |      | 150.0 |         |
|           |                                                            | Z | 4.45 | 66.41 | 15.96 |      | 150.0 |         |
| 10533-AAB | IEEE 802.11ac WiFi (20MHz, MCS8, 99pc duty cycle)          | X | 4.71 | 66.57 | 16.14 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 4.60 | 66.24 | 15.87 |      | 150.0 |         |
|           |                                                            | Z | 4.60 | 66.51 | 16.01 |      | 150.0 |         |
| 10534-AAB | IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)          | X | 5.23 | 66.67 | 16.22 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 5.14 | 66.38 | 16.00 |      | 150.0 |         |
|           |                                                            | Z | 5.14 | 66.58 | 16.10 |      | 150.0 |         |
| 10535-AAB | IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)          | X | 5.31 | 66.84 | 16.29 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 5.22 | 66.58 | 16.09 |      | 150.0 |         |
|           |                                                            | Z | 5.21 | 66.78 | 16.19 |      | 150.0 |         |
| 10536-AAB | IEEE 802.11ac WiFi (40MHz, MCS2, 99pc duty cycle)          | X | 5.17 | 66.80 | 16.25 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 5.07 | 66.49 | 16.02 |      | 150.0 |         |
|           |                                                            | Z | 5.07 | 66.71 | 16.13 |      | 150.0 |         |
| 10537-AAB | IEEE 802.11ac WiFi (40MHz, MCS3, 99pc duty cycle)          | X | 5.24 | 66.78 | 16.25 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 5.13 | 66.47 | 16.02 |      | 150.0 |         |
|           |                                                            | Z | 5.13 | 66.67 | 16.12 |      | 150.0 |         |
| 10538-AAB | IEEE 802.11ac WiFi (40MHz, MCS4, 99pc duty cycle)          | X | 5.34 | 66.83 | 16.31 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 5.23 | 66.51 | 16.08 |      | 150.0 |         |
|           |                                                            | Z | 5.22 | 66.70 | 16.17 |      | 150.0 |         |
| 10540-AAB | IEEE 802.11ac WiFi (40MHz, MCS6, 99pc duty cycle)          | X | 5.25 | 66.81 | 16.32 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                            | Y | 5.16 | 66.53 | 16.10 |      | 150.0 |         |
|           |                                                            | Z | 5.16 | 66.73 | 16.20 |      | 150.0 |         |

|           |                                                    |   |      |       |       |      |       |         |
|-----------|----------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10541-AAB | IEEE 802.11ac WiFi (40MHz, MCS7, 99pc duty cycle)  | X | 5.22 | 66.67 | 16.24 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.13 | 66.37 | 16.02 |      | 150.0 |         |
|           |                                                    | Z | 5.13 | 66.58 | 16.12 |      | 150.0 |         |
| 10542-AAB | IEEE 802.11ac WiFi (40MHz, MCS8, 99pc duty cycle)  | X | 5.38 | 66.75 | 16.30 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.29 | 66.46 | 16.08 |      | 150.0 |         |
|           |                                                    | Z | 5.28 | 66.65 | 16.17 |      | 150.0 |         |
| 10543-AAB | IEEE 802.11ac WiFi (40MHz, MCS9, 99pc duty cycle)  | X | 5.47 | 66.79 | 16.33 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.38 | 66.54 | 16.14 |      | 150.0 |         |
|           |                                                    | Z | 5.36 | 66.70 | 16.22 |      | 150.0 |         |
| 10544-AAB | IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)  | X | 5.53 | 66.76 | 16.20 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.45 | 66.49 | 16.00 |      | 150.0 |         |
|           |                                                    | Z | 5.45 | 66.68 | 16.09 |      | 150.0 |         |
| 10545-AAB | IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)  | X | 5.75 | 67.24 | 16.38 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.67 | 66.99 | 16.20 |      | 150.0 |         |
|           |                                                    | Z | 5.66 | 67.15 | 16.27 |      | 150.0 |         |
| 10546-AAB | IEEE 802.11ac WiFi (80MHz, MCS2, 99pc duty cycle)  | X | 5.62 | 67.04 | 16.30 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.52 | 66.72 | 16.08 |      | 150.0 |         |
|           |                                                    | Z | 5.52 | 66.90 | 16.16 |      | 150.0 |         |
| 10547-AAB | IEEE 802.11ac WiFi (80MHz, MCS3, 99pc duty cycle)  | X | 5.71 | 67.13 | 16.33 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.60 | 66.78 | 16.10 |      | 150.0 |         |
|           |                                                    | Z | 5.59 | 66.94 | 16.17 |      | 150.0 |         |
| 10548-AAB | IEEE 802.11ac WiFi (80MHz, MCS4, 99pc duty cycle)  | X | 6.09 | 68.45 | 16.97 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.98 | 68.09 | 16.72 |      | 150.0 |         |
|           |                                                    | Z | 5.90 | 68.06 | 16.71 |      | 150.0 |         |
| 10550-AAB | IEEE 802.11ac WiFi (80MHz, MCS6, 99pc duty cycle)  | X | 5.64 | 67.01 | 16.29 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.56 | 66.76 | 16.11 |      | 150.0 |         |
|           |                                                    | Z | 5.55 | 66.94 | 16.19 |      | 150.0 |         |
| 10551-AAB | IEEE 802.11ac WiFi (80MHz, MCS7, 99pc duty cycle)  | X | 5.64 | 67.06 | 16.28 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.55 | 66.75 | 16.06 |      | 150.0 |         |
|           |                                                    | Z | 5.55 | 66.95 | 16.16 |      | 150.0 |         |
| 10552-AAB | IEEE 802.11ac WiFi (80MHz, MCS8, 99pc duty cycle)  | X | 5.55 | 66.82 | 16.17 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.46 | 66.53 | 15.96 |      | 150.0 |         |
|           |                                                    | Z | 5.46 | 66.74 | 16.06 |      | 150.0 |         |
| 10553-AAB | IEEE 802.11ac WiFi (80MHz, MCS9, 99pc duty cycle)  | X | 5.64 | 66.88 | 16.23 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.54 | 66.58 | 16.02 |      | 150.0 |         |
|           |                                                    | Z | 5.54 | 66.77 | 16.11 |      | 150.0 |         |
| 10554-AAC | IEEE 802.11ac WiFi (160MHz, MCS0, 99pc duty cycle) | X | 5.94 | 67.15 | 16.30 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.87 | 66.87 | 16.10 |      | 150.0 |         |
|           |                                                    | Z | 5.86 | 67.05 | 16.18 |      | 150.0 |         |
| 10555-AAC | IEEE 802.11ac WiFi (160MHz, MCS1, 99pc duty cycle) | X | 6.09 | 67.49 | 16.44 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 6.01 | 67.23 | 16.26 |      | 150.0 |         |
|           |                                                    | Z | 6.00 | 67.38 | 16.32 |      | 150.0 |         |
| 10556-AAC | IEEE 802.11ac WiFi (160MHz, MCS2, 99pc duty cycle) | X | 6.10 | 67.52 | 16.45 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 6.02 | 67.25 | 16.26 |      | 150.0 |         |
|           |                                                    | Z | 6.02 | 67.42 | 16.34 |      | 150.0 |         |
| 10557-AAC | IEEE 802.11ac WiFi (160MHz, MCS3, 99pc duty cycle) | X | 6.08 | 67.44 | 16.43 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                    | Y | 5.99 | 67.15 | 16.23 |      | 150.0 |         |
|           |                                                    | Z | 5.98 | 67.31 | 16.30 |      | 150.0 |         |

|           |                                                                 |   |       |        |       |      |       |         |
|-----------|-----------------------------------------------------------------|---|-------|--------|-------|------|-------|---------|
| 10558-AAC | IEEE 802.11ac WiFi (160MHz, MCS4, 99pc duty cycle)              | X | 6.14  | 67.64  | 16.55 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 6.04  | 67.32  | 16.33 |      | 150.0 |         |
|           |                                                                 | Z | 6.03  | 67.48  | 16.40 |      | 150.0 |         |
| 10560-AAC | IEEE 802.11ac WiFi (160MHz, MCS6, 99pc duty cycle)              | X | 6.12  | 67.44  | 16.49 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 6.03  | 67.14  | 16.28 |      | 150.0 |         |
|           |                                                                 | Z | 6.02  | 67.31  | 16.36 |      | 150.0 |         |
| 10561-AAC | IEEE 802.11ac WiFi (160MHz, MCS7, 99pc duty cycle)              | X | 6.04  | 67.43  | 16.52 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 5.96  | 67.14  | 16.32 |      | 150.0 |         |
|           |                                                                 | Z | 5.95  | 67.31  | 16.39 |      | 150.0 |         |
| 10562-AAC | IEEE 802.11ac WiFi (160MHz, MCS8, 99pc duty cycle)              | X | 6.21  | 67.94  | 16.77 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 6.10  | 67.58  | 16.54 |      | 150.0 |         |
|           |                                                                 | Z | 6.08  | 67.71  | 16.59 |      | 150.0 |         |
| 10563-AAC | IEEE 802.11ac WiFi (160MHz, MCS9, 99pc duty cycle)              | X | 6.62  | 68.71  | 17.11 | 0.00 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 6.41  | 68.12  | 16.77 |      | 150.0 |         |
|           |                                                                 | Z | 6.30  | 68.01  | 16.70 |      | 150.0 |         |
| 10564-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)  | X | 4.97  | 67.05  | 16.56 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 4.87  | 66.78  | 16.32 |      | 150.0 |         |
|           |                                                                 | Z | 4.87  | 67.01  | 16.43 |      | 150.0 |         |
| 10565-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 99pc duty cycle) | X | 5.21  | 67.51  | 16.88 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 5.10  | 67.22  | 16.64 |      | 150.0 |         |
|           |                                                                 | Z | 5.10  | 67.43  | 16.74 |      | 150.0 |         |
| 10566-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 99pc duty cycle) | X | 5.05  | 67.38  | 16.71 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 4.93  | 67.07  | 16.45 |      | 150.0 |         |
|           |                                                                 | Z | 4.93  | 67.29  | 16.57 |      | 150.0 |         |
| 10567-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 99pc duty cycle) | X | 5.07  | 67.74  | 17.03 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 4.96  | 67.43  | 16.79 |      | 150.0 |         |
|           |                                                                 | Z | 4.96  | 67.65  | 16.90 |      | 150.0 |         |
| 10568-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 99pc duty cycle) | X | 4.97  | 67.18  | 16.50 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 4.86  | 66.88  | 16.25 |      | 150.0 |         |
|           |                                                                 | Z | 4.86  | 67.13  | 16.38 |      | 150.0 |         |
| 10569-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 99pc duty cycle) | X | 5.02  | 67.78  | 17.06 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 4.91  | 67.51  | 16.84 |      | 150.0 |         |
|           |                                                                 | Z | 4.92  | 67.74  | 16.95 |      | 150.0 |         |
| 10570-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 99pc duty cycle) | X | 5.06  | 67.64  | 17.01 | 0.46 | 150.0 | ± 9.6 % |
|           |                                                                 | Y | 4.95  | 67.38  | 16.79 |      | 150.0 |         |
|           |                                                                 | Z | 4.95  | 67.60  | 16.90 |      | 150.0 |         |
| 10571-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)       | X | 1.37  | 66.59  | 16.71 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 1.26  | 65.12  | 15.54 |      | 130.0 |         |
|           |                                                                 | Z | 1.32  | 66.08  | 16.22 |      | 130.0 |         |
| 10572-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)       | X | 1.39  | 67.31  | 17.11 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 1.28  | 65.71  | 15.88 |      | 130.0 |         |
|           |                                                                 | Z | 1.34  | 66.74  | 16.60 |      | 130.0 |         |
| 10573-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 90pc duty cycle)     | X | 17.13 | 116.23 | 31.59 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 2.44  | 84.17  | 21.35 |      | 130.0 |         |
|           |                                                                 | Z | 6.44  | 100.05 | 26.86 |      | 130.0 |         |
| 10574-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc duty cycle)      | X | 1.76  | 75.21  | 20.71 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 1.45  | 71.43  | 18.52 |      | 130.0 |         |
|           |                                                                 | Z | 1.62  | 73.67  | 19.79 |      | 130.0 |         |

|           |                                                                 |   |      |       |       |      |       |         |
|-----------|-----------------------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10575-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)  | X | 4.79 | 66.95 | 16.68 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.69 | 66.67 | 16.43 |      | 130.0 |         |
|           |                                                                 | Z | 4.69 | 66.91 | 16.55 |      | 130.0 |         |
| 10576-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)  | X | 4.81 | 67.10 | 16.73 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.71 | 66.83 | 16.49 |      | 130.0 |         |
|           |                                                                 | Z | 4.72 | 67.06 | 16.60 |      | 130.0 |         |
| 10577-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc duty cycle) | X | 5.03 | 67.41 | 16.91 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.92 | 67.12 | 16.66 |      | 130.0 |         |
|           |                                                                 | Z | 4.92 | 67.34 | 16.77 |      | 130.0 |         |
| 10578-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc duty cycle) | X | 4.93 | 67.56 | 17.00 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.81 | 67.27 | 16.75 |      | 130.0 |         |
|           |                                                                 | Z | 4.82 | 67.49 | 16.86 |      | 130.0 |         |
| 10579-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle) | X | 4.71 | 66.96 | 16.38 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.59 | 66.61 | 16.09 |      | 130.0 |         |
|           |                                                                 | Z | 4.60 | 66.86 | 16.22 |      | 130.0 |         |
| 10580-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle) | X | 4.76 | 66.97 | 16.40 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.64 | 66.65 | 16.11 |      | 130.0 |         |
|           |                                                                 | Z | 4.64 | 66.90 | 16.25 |      | 130.0 |         |
| 10581-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle) | X | 4.83 | 67.64 | 16.95 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.71 | 67.32 | 16.69 |      | 130.0 |         |
|           |                                                                 | Z | 4.72 | 67.56 | 16.81 |      | 130.0 |         |
| 10582-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle) | X | 4.66 | 66.74 | 16.19 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.54 | 66.39 | 15.89 |      | 130.0 |         |
|           |                                                                 | Z | 4.54 | 66.64 | 16.03 |      | 130.0 |         |
| 10583-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)       | X | 4.79 | 66.95 | 16.68 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.69 | 66.67 | 16.43 |      | 130.0 |         |
|           |                                                                 | Z | 4.69 | 66.91 | 16.55 |      | 130.0 |         |
| 10584-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)       | X | 4.81 | 67.10 | 16.73 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.71 | 66.83 | 16.49 |      | 130.0 |         |
|           |                                                                 | Z | 4.72 | 67.06 | 16.60 |      | 130.0 |         |
| 10585-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 90pc duty cycle)      | X | 5.03 | 67.41 | 16.91 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.92 | 67.12 | 16.66 |      | 130.0 |         |
|           |                                                                 | Z | 4.92 | 67.34 | 16.77 |      | 130.0 |         |
| 10586-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 90pc duty cycle)      | X | 4.93 | 67.56 | 17.00 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.81 | 67.27 | 16.75 |      | 130.0 |         |
|           |                                                                 | Z | 4.82 | 67.49 | 16.86 |      | 130.0 |         |
| 10587-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 90pc duty cycle)      | X | 4.71 | 66.96 | 16.38 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.59 | 66.61 | 16.09 |      | 130.0 |         |
|           |                                                                 | Z | 4.60 | 66.86 | 16.22 |      | 130.0 |         |
| 10588-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 90pc duty cycle)      | X | 4.76 | 66.97 | 16.40 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.64 | 66.65 | 16.11 |      | 130.0 |         |
|           |                                                                 | Z | 4.64 | 66.90 | 16.25 |      | 130.0 |         |
| 10589-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 90pc duty cycle)      | X | 4.83 | 67.64 | 16.95 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.71 | 67.32 | 16.69 |      | 130.0 |         |
|           |                                                                 | Z | 4.72 | 67.56 | 16.81 |      | 130.0 |         |
| 10590-AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 90pc duty cycle)      | X | 4.66 | 66.74 | 16.19 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                                 | Y | 4.54 | 66.39 | 15.89 |      | 130.0 |         |
|           |                                                                 | Z | 4.54 | 66.64 | 16.03 |      | 130.0 |         |

|           |                                                       |   |      |       |       |      |       |         |
|-----------|-------------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10591-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle) | X | 4.93 | 66.98 | 16.76 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.84 | 66.73 | 16.53 |      | 130.0 |         |
|           |                                                       | Z | 4.84 | 66.95 | 16.64 |      | 130.0 |         |
| 10592-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle) | X | 5.10 | 67.33 | 16.89 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.99 | 67.06 | 16.66 |      | 130.0 |         |
|           |                                                       | Z | 4.99 | 67.28 | 16.77 |      | 130.0 |         |
| 10593-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS2, 90pc duty cycle) | X | 5.03 | 67.27 | 16.79 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.92 | 66.98 | 16.54 |      | 130.0 |         |
|           |                                                       | Z | 4.92 | 67.20 | 16.65 |      | 130.0 |         |
| 10594-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS3, 90pc duty cycle) | X | 5.08 | 67.42 | 16.93 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.97 | 67.14 | 16.70 |      | 130.0 |         |
|           |                                                       | Z | 4.97 | 67.36 | 16.80 |      | 130.0 |         |
| 10595-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS4, 90pc duty cycle) | X | 5.05 | 67.38 | 16.83 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.94 | 67.10 | 16.59 |      | 130.0 |         |
|           |                                                       | Z | 4.94 | 67.32 | 16.70 |      | 130.0 |         |
| 10596-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS5, 90pc duty cycle) | X | 4.99 | 67.40 | 16.85 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.88 | 67.10 | 16.60 |      | 130.0 |         |
|           |                                                       | Z | 4.88 | 67.34 | 16.72 |      | 130.0 |         |
| 10597-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS6, 90pc duty cycle) | X | 4.94 | 67.32 | 16.74 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.83 | 67.01 | 16.48 |      | 130.0 |         |
|           |                                                       | Z | 4.83 | 67.24 | 16.60 |      | 130.0 |         |
| 10598-AAB | IEEE 802.11n (HT Mixed, 20MHz, MCS7, 90pc duty cycle) | X | 4.92 | 67.54 | 16.99 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 4.81 | 67.23 | 16.73 |      | 130.0 |         |
|           |                                                       | Z | 4.81 | 67.45 | 16.84 |      | 130.0 |         |
| 10599-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle) | X | 5.61 | 67.56 | 16.97 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.52 | 67.33 | 16.78 |      | 130.0 |         |
|           |                                                       | Z | 5.52 | 67.51 | 16.86 |      | 130.0 |         |
| 10600-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle) | X | 5.83 | 68.25 | 17.29 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.73 | 67.98 | 17.09 |      | 130.0 |         |
|           |                                                       | Z | 5.68 | 68.03 | 17.10 |      | 130.0 |         |
| 10601-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS2, 90pc duty cycle) | X | 5.67 | 67.85 | 17.10 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.58 | 67.60 | 16.91 |      | 130.0 |         |
|           |                                                       | Z | 5.55 | 67.72 | 16.96 |      | 130.0 |         |
| 10602-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS3, 90pc duty cycle) | X | 5.75 | 67.84 | 17.02 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.68 | 67.65 | 16.85 |      | 130.0 |         |
|           |                                                       | Z | 5.66 | 67.78 | 16.92 |      | 130.0 |         |
| 10603-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS4, 90pc duty cycle) | X | 5.83 | 68.10 | 17.27 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.74 | 67.87 | 17.09 |      | 130.0 |         |
|           |                                                       | Z | 5.72 | 68.02 | 17.16 |      | 130.0 |         |
| 10604-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS5, 90pc duty cycle) | X | 5.61 | 67.53 | 16.97 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.53 | 67.28 | 16.78 |      | 130.0 |         |
|           |                                                       | Z | 5.52 | 67.47 | 16.87 |      | 130.0 |         |
| 10605-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS6, 90pc duty cycle) | X | 5.75 | 67.94 | 17.19 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.68 | 67.77 | 17.03 |      | 130.0 |         |
|           |                                                       | Z | 5.66 | 67.89 | 17.09 |      | 130.0 |         |
| 10606-AAB | IEEE 802.11n (HT Mixed, 40MHz, MCS7, 90pc duty cycle) | X | 5.49 | 67.29 | 16.73 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                       | Y | 5.41 | 67.06 | 16.53 |      | 130.0 |         |
|           |                                                       | Z | 5.38 | 67.16 | 16.58 |      | 130.0 |         |

|           |                                                   |   |      |       |       |      |       |         |
|-----------|---------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10607-AAB | IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle) | X | 4.77 | 66.28 | 16.37 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.67 | 66.00 | 16.12 |      | 130.0 |         |
|           |                                                   | Z | 4.67 | 66.24 | 16.25 |      | 130.0 |         |
| 10608-AAB | IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle) | X | 4.97 | 66.70 | 16.53 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.85 | 66.40 | 16.29 |      | 130.0 |         |
|           |                                                   | Z | 4.86 | 66.65 | 16.41 |      | 130.0 |         |
| 10609-AAB | IEEE 802.11ac WiFi (20MHz, MCS2, 90pc duty cycle) | X | 4.86 | 66.58 | 16.39 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.74 | 66.26 | 16.13 |      | 130.0 |         |
|           |                                                   | Z | 4.75 | 66.51 | 16.26 |      | 130.0 |         |
| 10610-AAB | IEEE 802.11ac WiFi (20MHz, MCS3, 90pc duty cycle) | X | 4.91 | 66.72 | 16.54 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.79 | 66.41 | 16.29 |      | 130.0 |         |
|           |                                                   | Z | 4.80 | 66.66 | 16.41 |      | 130.0 |         |
| 10611-AAB | IEEE 802.11ac WiFi (20MHz, MCS4, 90pc duty cycle) | X | 4.83 | 66.55 | 16.41 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.71 | 66.23 | 16.14 |      | 130.0 |         |
|           |                                                   | Z | 4.72 | 66.48 | 16.27 |      | 130.0 |         |
| 10612-AAB | IEEE 802.11ac WiFi (20MHz, MCS5, 90pc duty cycle) | X | 4.85 | 66.73 | 16.46 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.72 | 66.39 | 16.19 |      | 130.0 |         |
|           |                                                   | Z | 4.73 | 66.65 | 16.32 |      | 130.0 |         |
| 10613-AAB | IEEE 802.11ac WiFi (20MHz, MCS6, 90pc duty cycle) | X | 4.86 | 66.64 | 16.36 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.73 | 66.28 | 16.08 |      | 130.0 |         |
|           |                                                   | Z | 4.74 | 66.53 | 16.21 |      | 130.0 |         |
| 10614-AAB | IEEE 802.11ac WiFi (20MHz, MCS7, 90pc duty cycle) | X | 4.79 | 66.79 | 16.56 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.67 | 66.44 | 16.29 |      | 130.0 |         |
|           |                                                   | Z | 4.67 | 66.69 | 16.42 |      | 130.0 |         |
| 10615-AAB | IEEE 802.11ac WiFi (20MHz, MCS8, 90pc duty cycle) | X | 4.84 | 66.40 | 16.20 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 4.72 | 66.07 | 15.93 |      | 130.0 |         |
|           |                                                   | Z | 4.72 | 66.33 | 16.07 |      | 130.0 |         |
| 10616-AAB | IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle) | X | 5.42 | 66.80 | 16.56 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.33 | 66.52 | 16.36 |      | 130.0 |         |
|           |                                                   | Z | 5.32 | 66.71 | 16.44 |      | 130.0 |         |
| 10617-AAB | IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle) | X | 5.49 | 66.95 | 16.61 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.41 | 66.76 | 16.45 |      | 130.0 |         |
|           |                                                   | Z | 5.40 | 66.93 | 16.53 |      | 130.0 |         |
| 10618-AAB | IEEE 802.11ac WiFi (40MHz, MCS2, 90pc duty cycle) | X | 5.38 | 66.99 | 16.64 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.28 | 66.71 | 16.44 |      | 130.0 |         |
|           |                                                   | Z | 5.28 | 66.90 | 16.53 |      | 130.0 |         |
| 10619-AAB | IEEE 802.11ac WiFi (40MHz, MCS3, 90pc duty cycle) | X | 5.41 | 66.83 | 16.51 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.32 | 66.57 | 16.30 |      | 130.0 |         |
|           |                                                   | Z | 5.31 | 66.75 | 16.39 |      | 130.0 |         |
| 10620-AAB | IEEE 802.11ac WiFi (40MHz, MCS4, 90pc duty cycle) | X | 5.51 | 66.90 | 16.59 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.40 | 66.60 | 16.37 |      | 130.0 |         |
|           |                                                   | Z | 5.39 | 66.77 | 16.45 |      | 130.0 |         |
| 10621-AAB | IEEE 802.11ac WiFi (40MHz, MCS5, 90pc duty cycle) | X | 5.48 | 66.93 | 16.71 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.39 | 66.68 | 16.52 |      | 130.0 |         |
|           |                                                   | Z | 5.38 | 66.86 | 16.61 |      | 130.0 |         |
| 10622-AAB | IEEE 802.11ac WiFi (40MHz, MCS6, 90pc duty cycle) | X | 5.50 | 67.12 | 16.80 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                   | Y | 5.42 | 66.91 | 16.63 |      | 130.0 |         |
|           |                                                   | Z | 5.40 | 67.05 | 16.70 |      | 130.0 |         |

|           |                                                    |   |      |       |       |      |       |         |
|-----------|----------------------------------------------------|---|------|-------|-------|------|-------|---------|
| 10623-AAB | IEEE 802.11ac WiFi (40MHz, MCS7, 90pc duty cycle)  | X | 5.37 | 66.65 | 16.45 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.28 | 66.39 | 16.25 |      | 130.0 |         |
|           |                                                    | Z | 5.28 | 66.58 | 16.34 |      | 130.0 |         |
| 10624-AAB | IEEE 802.11ac WiFi (40MHz, MCS8, 90pc duty cycle)  | X | 5.57 | 66.87 | 16.62 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.48 | 66.61 | 16.42 |      | 130.0 |         |
|           |                                                    | Z | 5.47 | 66.77 | 16.50 |      | 130.0 |         |
| 10625-AAB | IEEE 802.11ac WiFi (40MHz, MCS9, 90pc duty cycle)  | X | 6.04 | 68.14 | 17.31 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.92 | 67.83 | 17.08 |      | 130.0 |         |
|           |                                                    | Z | 5.86 | 67.85 | 17.09 |      | 130.0 |         |
| 10626-AAB | IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)  | X | 5.69 | 66.81 | 16.49 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.62 | 66.57 | 16.31 |      | 130.0 |         |
|           |                                                    | Z | 5.62 | 66.75 | 16.39 |      | 130.0 |         |
| 10627-AAB | IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)  | X | 5.97 | 67.48 | 16.78 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.90 | 67.27 | 16.62 |      | 130.0 |         |
|           |                                                    | Z | 5.88 | 67.40 | 16.68 |      | 130.0 |         |
| 10628-AAB | IEEE 802.11ac WiFi (80MHz, MCS2, 90pc duty cycle)  | X | 5.76 | 67.00 | 16.48 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.67 | 66.72 | 16.28 |      | 130.0 |         |
|           |                                                    | Z | 5.66 | 66.88 | 16.36 |      | 130.0 |         |
| 10629-AAB | IEEE 802.11ac WiFi (80MHz, MCS3, 90pc duty cycle)  | X | 5.84 | 67.06 | 16.50 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.77 | 66.85 | 16.34 |      | 130.0 |         |
|           |                                                    | Z | 5.74 | 66.97 | 16.39 |      | 130.0 |         |
| 10630-AAB | IEEE 802.11ac WiFi (80MHz, MCS4, 90pc duty cycle)  | X | 6.51 | 69.24 | 17.59 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 6.40 | 68.89 | 17.35 |      | 130.0 |         |
|           |                                                    | Z | 6.28 | 68.76 | 17.29 |      | 130.0 |         |
| 10631-AAB | IEEE 802.11ac WiFi (80MHz, MCS5, 90pc duty cycle)  | X | 6.25 | 68.57 | 17.44 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 6.12 | 68.19 | 17.19 |      | 130.0 |         |
|           |                                                    | Z | 6.08 | 68.24 | 17.21 |      | 130.0 |         |
| 10632-AAB | IEEE 802.11ac WiFi (80MHz, MCS6, 90pc duty cycle)  | X | 5.92 | 67.46 | 16.90 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.86 | 67.28 | 16.76 |      | 130.0 |         |
|           |                                                    | Z | 5.84 | 67.41 | 16.81 |      | 130.0 |         |
| 10633-AAB | IEEE 802.11ac WiFi (80MHz, MCS7, 90pc duty cycle)  | X | 5.82 | 67.14 | 16.58 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.71 | 66.81 | 16.36 |      | 130.0 |         |
|           |                                                    | Z | 5.71 | 66.98 | 16.44 |      | 130.0 |         |
| 10634-AAB | IEEE 802.11ac WiFi (80MHz, MCS8, 90pc duty cycle)  | X | 5.79 | 67.13 | 16.63 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.70 | 66.83 | 16.42 |      | 130.0 |         |
|           |                                                    | Z | 5.69 | 67.01 | 16.50 |      | 130.0 |         |
| 10635-AAB | IEEE 802.11ac WiFi (80MHz, MCS9, 90pc duty cycle)  | X | 5.70 | 66.55 | 16.10 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 5.59 | 66.22 | 15.86 |      | 130.0 |         |
|           |                                                    | Z | 5.59 | 66.41 | 15.96 |      | 130.0 |         |
| 10636-AAC | IEEE 802.11ac WiFi (160MHz, MCS0, 90pc duty cycle) | X | 6.11 | 67.22 | 16.60 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 6.05 | 66.97 | 16.42 |      | 130.0 |         |
|           |                                                    | Z | 6.04 | 67.12 | 16.48 |      | 130.0 |         |
| 10637-AAC | IEEE 802.11ac WiFi (160MHz, MCS1, 90pc duty cycle) | X | 6.29 | 67.65 | 16.79 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 6.23 | 67.43 | 16.63 |      | 130.0 |         |
|           |                                                    | Z | 6.20 | 67.55 | 16.68 |      | 130.0 |         |
| 10638-AAC | IEEE 802.11ac WiFi (160MHz, MCS2, 90pc duty cycle) | X | 6.29 | 67.62 | 16.76 | 0.46 | 130.0 | ± 9.6 % |
|           |                                                    | Y | 6.23 | 67.40 | 16.60 |      | 130.0 |         |
|           |                                                    | Z | 6.20 | 67.52 | 16.64 |      | 130.0 |         |

|           |                                                        |   |       |        |       |       |       |         |
|-----------|--------------------------------------------------------|---|-------|--------|-------|-------|-------|---------|
| 10639-AAC | IEEE 802.11ac WiFi (160MHz, MCS3, 90pc duty cycle)     | X | 6.27  | 67.57  | 16.77 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.19  | 67.29  | 16.58 |       | 130.0 |         |
|           |                                                        | Z | 6.17  | 67.43  | 16.64 |       | 130.0 |         |
| 10640-AAC | IEEE 802.11ac WiFi (160MHz, MCS4, 90pc duty cycle)     | X | 6.30  | 67.66  | 16.77 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.20  | 67.34  | 16.55 |       | 130.0 |         |
|           |                                                        | Z | 6.18  | 67.47  | 16.61 |       | 130.0 |         |
| 10641-AAC | IEEE 802.11ac WiFi (160MHz, MCS5, 90pc duty cycle)     | X | 6.30  | 67.43  | 16.67 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.24  | 67.21  | 16.51 |       | 130.0 |         |
|           |                                                        | Z | 6.23  | 67.38  | 16.58 |       | 130.0 |         |
| 10642-AAC | IEEE 802.11ac WiFi (160MHz, MCS6, 90pc duty cycle)     | X | 6.35  | 67.69  | 16.96 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.27  | 67.44  | 16.78 |       | 130.0 |         |
|           |                                                        | Z | 6.25  | 67.57  | 16.84 |       | 130.0 |         |
| 10643-AAC | IEEE 802.11ac WiFi (160MHz, MCS7, 90pc duty cycle)     | X | 6.19  | 67.43  | 16.74 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.12  | 67.17  | 16.55 |       | 130.0 |         |
|           |                                                        | Z | 6.10  | 67.32  | 16.62 |       | 130.0 |         |
| 10644-AAC | IEEE 802.11ac WiFi (160MHz, MCS8, 90pc duty cycle)     | X | 6.42  | 68.12  | 17.10 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.30  | 67.73  | 16.85 |       | 130.0 |         |
|           |                                                        | Z | 6.27  | 67.83  | 16.89 |       | 130.0 |         |
| 10645-AAC | IEEE 802.11ac WiFi (160MHz, MCS9, 90pc duty cycle)     | X | 6.96  | 69.23  | 17.61 | 0.46  | 130.0 | ± 9.6 % |
|           |                                                        | Y | 6.81  | 68.82  | 17.36 |       | 130.0 |         |
|           |                                                        | Z | 6.64  | 68.54  | 17.21 |       | 130.0 |         |
| 10646-AAD | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,7)  | X | 36.14 | 117.31 | 38.90 | 9.30  | 60.0  | ± 9.6 % |
|           |                                                        | Y | 37.41 | 119.79 | 39.76 |       | 60.0  |         |
|           |                                                        | Z | 44.85 | 123.68 | 40.74 |       | 60.0  |         |
| 10647-AAC | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,7) | X | 38.37 | 119.57 | 39.70 | 9.30  | 60.0  | ± 9.6 % |
|           |                                                        | Y | 37.81 | 120.93 | 40.24 |       | 60.0  |         |
|           |                                                        | Z | 46.89 | 125.67 | 41.46 |       | 60.0  |         |
| 10648-AAA | CDMA2000 (1x Advanced)                                 | X | 0.76  | 64.71  | 11.69 | 0.00  | 150.0 | ± 9.6 % |
|           |                                                        | Y | 0.62  | 62.37  | 9.59  |       | 150.0 |         |
|           |                                                        | Z | 0.65  | 63.27  | 10.28 |       | 150.0 |         |
| 10652-AAB | LTE-TDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)         | X | 4.49  | 69.07  | 17.63 | 2.23  | 80.0  | ± 9.6 % |
|           |                                                        | Y | 4.22  | 68.27  | 17.06 |       | 80.0  |         |
|           |                                                        | Z | 4.35  | 68.92  | 17.36 |       | 80.0  |         |
| 10653-AAB | LTE-TDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)        | X | 4.93  | 68.17  | 17.64 | 2.23  | 80.0  | ± 9.6 % |
|           |                                                        | Y | 4.72  | 67.56  | 17.22 |       | 80.0  |         |
|           |                                                        | Z | 4.80  | 68.03  | 17.44 |       | 80.0  |         |
| 10654-AAB | LTE-TDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)        | X | 4.87  | 67.81  | 17.63 | 2.23  | 80.0  | ± 9.6 % |
|           |                                                        | Y | 4.67  | 67.22  | 17.23 |       | 80.0  |         |
|           |                                                        | Z | 4.76  | 67.67  | 17.45 |       | 80.0  |         |
| 10655-AAB | LTE-TDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)        | X | 4.93  | 67.83  | 17.67 | 2.23  | 80.0  | ± 9.6 % |
|           |                                                        | Y | 4.74  | 67.21  | 17.27 |       | 80.0  |         |
|           |                                                        | Z | 4.82  | 67.65  | 17.48 |       | 80.0  |         |
| 10658-AAA | Pulse Waveform (200Hz, 10%)                            | X | 13.17 | 86.89  | 23.60 | 10.00 | 50.0  | ± 9.6 % |
|           |                                                        | Y | 14.69 | 88.65  | 23.55 |       | 50.0  |         |
|           |                                                        | Z | 14.49 | 88.55  | 23.74 |       | 50.0  |         |
| 10659-AAA | Pulse Waveform (200Hz, 20%)                            | X | 50.09 | 107.91 | 28.24 | 6.99  | 60.0  | ± 9.6 % |
|           |                                                        | Y | 74.63 | 111.90 | 28.40 |       | 60.0  |         |
|           |                                                        | Z | 82.42 | 114.14 | 29.27 |       | 60.0  |         |

|           |                             |   |        |        |       |      |       |         |
|-----------|-----------------------------|---|--------|--------|-------|------|-------|---------|
| 10660-AAA | Pulse Waveform (200Hz, 40%) | X | 100.00 | 115.90 | 28.07 | 3.98 | 80.0  | ± 9.6 % |
|           |                             | Y | 100.00 | 112.84 | 26.35 |      | 80.0  |         |
|           |                             | Z | 100.00 | 114.41 | 27.18 |      | 80.0  |         |
| 10661-AAA | Pulse Waveform (200Hz, 60%) | X | 100.00 | 116.78 | 26.96 | 2.22 | 100.0 | ± 9.6 % |
|           |                             | Y | 100.00 | 111.69 | 24.44 |      | 100.0 |         |
|           |                             | Z | 100.00 | 114.68 | 25.86 |      | 100.0 |         |
| 10662-AAA | Pulse Waveform (200Hz, 80%) | X | 100.00 | 120.91 | 26.72 | 0.97 | 120.0 | ± 9.6 % |
|           |                             | Y | 100.00 | 108.87 | 21.46 |      | 120.0 |         |
|           |                             | Z | 100.00 | 116.35 | 24.67 |      | 120.0 |         |

<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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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **ES3-3131\_Mar18**

## CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3131**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6  
Calibration procedure for dosimetric E-field probes**

SC✓  
3/21/18

Calibration date: **March 13, 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 ( $22 \pm 3$ )°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-17 (No. 217-02521/02522)   | Apr-18                 |
| Power sensor NRP-Z91       | SN: 103244       | 04-Apr-17 (No. 217-02521)         | Apr-18                 |
| Power sensor NRP-Z91       | SN: 103245       | 04-Apr-17 (No. 217-02525)         | Apr-18                 |
| Reference 20 dB Attenuator | SN: S5277 (20x)  | 07-Apr-17 (No. 217-02528)         | Apr-18                 |
| Reference Probe ES3DV2     | SN: 3013         | 30-Dec-17 (No. ES3-3013_Dec17)    | Dec-18                 |
| DAE4                       | SN: 660          | 21-Dec-17 (No. DAE4-660_Dec17)    | Dec-18                 |
| Secondary Standards        | ID               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B         | SN: GB41293874   | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A        | SN: MY41498087   | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A        | SN: 000110210    | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| RF generator HP 8648C      | SN: US3642U01700 | 04-Aug-99 (in house check Jun-16) | In house check: Jun-18 |
| Network Analyzer HP 8753E  | SN: US37390585   | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |

|                |                               |                                          |               |
|----------------|-------------------------------|------------------------------------------|---------------|
| Calibrated by: | Name<br><b>Jeton Kastrati</b> | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:   | Name<br><b>Katja Pokovic</b>  | Function<br><b>Technical Manager</b>     | Signature<br> |

Issued: March 13, 2018

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



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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 $\varphi$   | $\varphi$ rotation around probe axis                                                                                                                    |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\vartheta = 0$ 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  $\vartheta = 0$  ( $f \leq 900$  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 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<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 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).

# Probe ES3DV3

## SN:3131

Manufactured: February 6, 2007  
Calibrated: March 13, 2018

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3131

### Basic Calibration Parameters

|                                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|-----------------------------------------------------------|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 1.27     | 1.26     | 1.21     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                                     | 104.8    | 101.0    | 102.1    |               |

### 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    | 190.2    | $\pm 3.5 \%$              |
|     |                           | Y | 0.0     | 0.0                          | 1.0 |         | 209.7    |                           |
|     |                           | Z | 0.0     | 0.0                          | 1.0 |         | 205.3    |                           |

Note: For details on UID parameters see Appendix.

### Sensor Model Parameters

|   | C1<br>fF | C2<br>fF | $\alpha$<br>$\text{V}^{-1}$ | T1<br>$\text{ms} \cdot \text{V}^{-2}$ | T2<br>$\text{ms} \cdot \text{V}^{-1}$ | T3<br>ms | T4<br>$\text{V}^{-2}$ | T5<br>$\text{V}^{-1}$ | T6    |
|---|----------|----------|-----------------------------|---------------------------------------|---------------------------------------|----------|-----------------------|-----------------------|-------|
| X | 59.71    | 424.3    | 34.95                       | 29.43                                 | 2.926                                 | 5.10     | 0.529                 | 0.536                 | 1.010 |
| Y | 55.55    | 399.2    | 35.49                       | 28.93                                 | 2.461                                 | 5.10     | 0.546                 | 0.521                 | 1.009 |
| Z | 63.86    | 454.3    | 34.89                       | 29.70                                 | 3.365                                 | 5.10     | 0.736                 | 0.556                 | 1.011 |

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  $E^2$ -field uncertainty inside TSL (see Pages 5 and 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.