

## Measurement Certificate / Material Test

|              |                                                 |
|--------------|-------------------------------------------------|
| Item Name    | Head Tissue Simulating Liquid (HBBL600-10000V6) |
| Product No.  | SL AAH U16 BC (Batch: 181031-2)                 |
| Manufacturer | SPEAG                                           |

## Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

## Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

## Test Condition

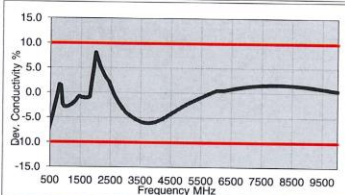
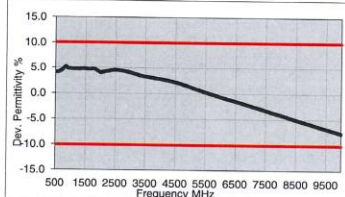
|                   |                     |
|-------------------|---------------------|
| Ambient Condition | 22°C ; 30% humidity |
| TSL Temperature   | 22°C                |
| Test Date         | 31-Oct-18           |
| Operator          | CL                  |

## Additional Information

|                   |
|-------------------|
| TSL Density       |
| TSL Heat-capacity |

## Results

| f [MHz] | Measured |      |       | Target |       | Diff.to Target [%] |         |
|---------|----------|------|-------|--------|-------|--------------------|---------|
|         | e'       | e''  | sigma | eps    | sigma | Δ-eps              | Δ-sigma |
| 800     | 43.8     | 20.5 | 0.91  | 41.7   | 0.90  | 5.1                | 1.4     |
| 825     | 43.8     | 20.1 | 0.92  | 41.6   | 0.91  | 5.3                | 1.5     |
| 835     | 43.8     | 19.9 | 0.93  | 41.5   | 0.91  | 5.4                | 2.0     |
| 850     | 43.7     | 19.7 | 0.93  | 41.5   | 0.92  | 5.3                | 1.5     |
| 900     | 43.5     | 18.9 | 0.95  | 41.5   | 0.97  | 4.8                | -2.1    |
| 1400    | 42.5     | 15.0 | 1.17  | 40.6   | 1.18  | 4.7                | -0.8    |
| 1450    | 42.5     | 14.8 | 1.19  | 40.5   | 1.20  | 4.9                | -0.8    |
| 1600    | 42.2     | 14.3 | 1.27  | 40.3   | 1.28  | 4.7                | -1.1    |
| 1625    | 42.2     | 14.2 | 1.29  | 40.3   | 1.30  | 4.8                | -0.7    |
| 1640    | 42.2     | 14.2 | 1.30  | 40.3   | 1.31  | 4.8                | -0.5    |
| 1650    | 42.1     | 14.2 | 1.30  | 40.2   | 1.31  | 4.6                | -1.0    |
| 1700    | 42.1     | 14.0 | 1.33  | 40.2   | 1.34  | 4.8                | -0.9    |
| 1750    | 42.0     | 13.9 | 1.36  | 40.1   | 1.37  | 4.8                | -0.8    |
| 1800    | 41.9     | 13.9 | 1.39  | 40.0   | 1.40  | 4.7                | -0.7    |
| 1810    | 41.9     | 13.8 | 1.40  | 40.0   | 1.40  | 4.7                | 0.0     |
| 1825    | 41.9     | 13.8 | 1.41  | 40.0   | 1.40  | 4.7                | 0.7     |
| 1850    | 41.8     | 13.8 | 1.42  | 40.0   | 1.40  | 4.5                | 1.4     |
| 1900    | 41.8     | 13.7 | 1.45  | 40.0   | 1.40  | 4.5                | 3.6     |
| 1950    | 41.7     | 13.7 | 1.48  | 40.0   | 1.40  | 4.3                | 5.7     |
| 2000    | 41.6     | 13.6 | 1.51  | 40.0   | 1.40  | 4.0                | 7.9     |
| 2050    | 41.6     | 13.6 | 1.55  | 39.9   | 1.44  | 4.2                | 7.3     |
| 2100    | 41.5     | 13.5 | 1.58  | 39.8   | 1.49  | 4.2                | 6.1     |
| 2150    | 41.4     | 13.5 | 1.62  | 39.7   | 1.53  | 4.2                | 5.7     |
| 2200    | 41.4     | 13.5 | 1.65  | 39.6   | 1.58  | 4.4                | 4.6     |
| 2250    | 41.3     | 13.5 | 1.69  | 39.6   | 1.62  | 4.4                | 4.2     |
| 2300    | 41.2     | 13.5 | 1.72  | 39.5   | 1.67  | 4.4                | 3.2     |
| 2350    | 41.1     | 13.5 | 1.76  | 39.4   | 1.71  | 4.4                | 2.9     |
| 2400    | 41.1     | 13.5 | 1.80  | 39.3   | 1.76  | 4.6                | 2.5     |
| 2450    | 41.0     | 13.5 | 1.84  | 39.2   | 1.80  | 4.6                | 2.2     |
| 2500    | 40.9     | 13.5 | 1.88  | 39.1   | 1.85  | 4.5                | 1.4     |
| 2550    | 40.8     | 13.5 | 1.92  | 39.1   | 1.91  | 4.4                | 0.6     |
| 2600    | 40.8     | 13.6 | 1.96  | 39.0   | 1.96  | 4.6                | -0.2    |
| 3500    | 39.2     | 14.1 | 2.74  | 37.9   | 2.91  | 3.3                | -5.8    |
| 3700    | 38.9     | 14.2 | 2.93  | 37.7   | 3.12  | 3.1                | -6.1    |



|       |      |      |       |      |       |      |      |
|-------|------|------|-------|------|-------|------|------|
| 5200  | 36.3 | 15.8 | 4.57  | 36.0 | 4.66  | 0.9  | -1.7 |
| 5250  | 36.2 | 15.9 | 4.63  | 35.9 | 4.71  | 0.8  | -1.6 |
| 5300  | 36.1 | 15.9 | 4.69  | 35.9 | 4.76  | 0.7  | -1.4 |
| 5500  | 35.8 | 16.1 | 4.92  | 35.6 | 4.96  | 0.3  | -0.9 |
| 5600  | 35.6 | 16.2 | 5.04  | 35.5 | 5.07  | 0.1  | -0.6 |
| 5700  | 35.4 | 16.2 | 5.15  | 35.4 | 5.17  | 0.0  | -0.3 |
| 5800  | 35.2 | 16.3 | 5.27  | 35.3 | 5.27  | -0.2 | 0.0  |
| 6000  | 34.9 | 16.5 | 5.50  | 35.1 | 5.48  | -0.6 | 0.5  |
| 6500  | 34.0 | 16.9 | 6.12  | 34.5 | 6.07  | -1.4 | 0.9  |
| 7000  | 33.1 | 17.3 | 6.74  | 33.9 | 6.65  | -2.3 | 1.3  |
| 7500  | 32.2 | 17.6 | 7.36  | 33.3 | 7.24  | -3.2 | 1.6  |
| 8000  | 31.4 | 17.9 | 7.97  | 32.7 | 7.84  | -4.1 | 1.7  |
| 8500  | 30.5 | 18.2 | 8.59  | 32.1 | 8.45  | -5.0 | 1.6  |
| 9000  | 29.7 | 18.4 | 9.20  | 31.5 | 9.08  | -5.9 | 1.3  |
| 9500  | 28.9 | 18.5 | 9.80  | 31.0 | 9.71  | -6.8 | 0.9  |
| 10000 | 28.1 | 18.7 | 10.40 | 30.4 | 10.36 | -7.6 | 0.4  |

Figure C-3  
600 – 5800 MHz Head Tissue Equivalent Matter

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/25/19 - 02/03/20 | DUT Type: Portable Handset                                                          |                       |                                                                                       | APPENDIX C:<br>Page 3 of 3      |

## APPENDIX D: SAR SYSTEM VALIDATION

Per FCC KDB Publication 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

**Table D-1**  
**SAR System Validation Summary – 1g**

| SAR SYSTEM # | FREQ. [MHz] | DATE       | PROBE SN | PROBE CAL. POINT |      | COND. | PERM.             | CW VALIDATION |                 |                | MOD. VALIDATION |             |      |
|--------------|-------------|------------|----------|------------------|------|-------|-------------------|---------------|-----------------|----------------|-----------------|-------------|------|
|              |             |            |          |                  |      | (σ)   | (ε <sub>r</sub> ) | SENSITIVITY   | PROBE LINEARITY | PROBE ISOTROPY | MOD. TYPE       | DUTY FACTOR | PAR  |
| E            | 750         | 9/12/2019  | 7417     | 750              | Head | 0.93  | 42.992            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| L            | 750         | 9/24/2019  | 7410     | 750              | Head | 0.878 | 42.471            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| D            | 835         | 4/12/2019  | 3914     | 835              | Head | 0.935 | 42.549            | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| P            | 1750        | 10/2/2019  | 7551     | 1750             | Head | 1.346 | 39.45             | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| H            | 1750        | 12/20/2019 | 7406     | 1750             | Head | 1.379 | 39.702            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| P            | 1900        | 10/2/2019  | 7551     | 1900             | Head | 1.444 | 39.26             | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| L            | 1900        | 9/24/2019  | 7410     | 1900             | Head | 1.442 | 39.947            | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| E            | 2300        | 9/6/2019   | 7417     | 2300             | Head | 1.737 | 39.748            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| E            | 2450        | 9/5/2019   | 7417     | 2450             | Head | 1.855 | 39.542            | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| E            | 2600        | 9/5/2019   | 7417     | 2600             | Head | 1.979 | 39.302            | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| H            | 3700        | 12/5/2019  | 3589     | 3700             | Head | 2.973 | 39.247            | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| H            | 5250        | 12/7/2019  | 7406     | 5250             | Head | 4.709 | 35.885            | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| H            | 5600        | 12/7/2019  | 7406     | 5600             | Head | 5.12  | 35.211            | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| H            | 5750        | 12/7/2019  | 7406     | 5750             | Head | 5.309 | 34.961            | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| L            | 750         | 8/20/2019  | 7410     | 750              | Body | 0.941 | 54.921            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| K            | 750         | 9/13/2019  | 7547     | 750              | Body | 0.961 | 55.74             | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| D            | 835         | 6/18/2019  | 3914     | 835              | Body | 0.945 | 52.698            | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| L            | 835         | 8/20/2019  | 7410     | 835              | Body | 0.974 | 54.739            | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| I            | 1750        | 5/21/2019  | 7357     | 1750             | Body | 1.442 | 55.384            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| P            | 1900        | 10/8/2019  | 7551     | 1900             | Body | 1.542 | 51.76             | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| L            | 2300        | 8/15/2019  | 7410     | 2300             | Body | 1.855 | 52.705            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| M            | 2450        | 10/10/2019 | 7308     | 2450             | Body | 1.962 | 51.23             | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| L            | 2450        | 8/15/2019  | 7410     | 2450             | Body | 2.018 | 52.505            | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| K            | 2450        | 9/6/2019   | 7547     | 2450             | Body | 1.996 | 51.898            | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| L            | 2600        | 8/16/2019  | 7410     | 2600             | Body | 2.161 | 52.297            | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| D            | 3500        | 6/12/2019  | 3914     | 3500             | Body | 3.377 | 51.09             | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| D            | 3700        | 6/12/2019  | 3914     | 3700             | Body | 3.593 | 50.776            | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| G            | 5250        | 10/4/2019  | 7409     | 5250             | Body | 5.223 | 47.07             | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G            | 5600        | 10/7/2019  | 7409     | 5600             | Body | 5.884 | 47.08             | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G            | 5750        | 10/7/2019  | 7409     | 5750             | Body | 6.111 | 46.78             | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |

**Table D-2**  
**SAR System Validation Summary – 10g**

| SAR SYSTEM # | FREQ. [MHz] | DATE      | PROBE SN | PROBE CAL. POINT |      | COND. | PERM.             | CW VALIDATION |                 |                | MOD. VALIDATION |             |      |
|--------------|-------------|-----------|----------|------------------|------|-------|-------------------|---------------|-----------------|----------------|-----------------|-------------|------|
|              |             |           |          |                  |      | (σ)   | (ε <sub>r</sub> ) | SENSITIVITY   | PROBE LINEARITY | PROBE ISOTROPY | MOD. TYPE       | DUTY FACTOR | PAR  |
| I            | 1750        | 5/21/2019 | 7357     | 1750             | Body | 1.442 | 55.384            | PASS          | PASS            | PASS           | N/A             | N/A         | N/A  |
| P            | 1900        | 10/8/2019 | 7551     | 1900             | Body | 1.542 | 51.76             | PASS          | PASS            | PASS           | GMSK            | PASS        | N/A  |
| L            | 2450        | 8/15/2019 | 7410     | 2450             | Body | 2.018 | 52.505            | PASS          | PASS            | PASS           | OFDM/TDD        | PASS        | PASS |
| L            | 2600        | 8/16/2019 | 7410     | 2600             | Body | 2.161 | 52.297            | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| D            | 3500        | 6/12/2019 | 3914     | 3500             | Body | 3.377 | 51.09             | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| D            | 3700        | 6/12/2019 | 3914     | 3700             | Body | 3.593 | 50.776            | PASS          | PASS            | PASS           | TDD             | PASS        | N/A  |
| G            | 5250        | 10/4/2019 | 7409     | 5250             | Body | 5.223 | 47.07             | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G            | 5600        | 10/7/2019 | 7409     | 5600             | Body | 5.884 | 47.08             | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |
| G            | 5750        | 10/7/2019 | 7409     | 5750             | Body | 6.111 | 46.78             | PASS          | PASS            | PASS           | OFDM            | N/A         | PASS |

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to FCC KDB Publication 865664 D01v01r04.

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Approved by:<br>Quality Manager |
| Test Dates:<br>11/25/19 - 02/03/20 | DUT Type: Portable Handset                                                          |                       |                                                                                       | APPENDIX D:<br>Page 1 of 1      |

# APPENDIX F: DOWNLINK LTE CA RF CONDUCTED POWERS

## 1.1 LTE Downlink Only Carrier Aggregation Test Reduction Methodology

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number of component carriers (CCs) supported by the product implementation. Per April 2018 TCBC Workshop Notes, the following test reduction methodology was applied to determine the combinations required for conducted power measurements.

### LTE DLCA Test Reduction Methodology:

- The supported combinations were arranged by the number of component carriers in columns.
- Any limitations on the PCC or SCC for each combination were identified alongside the combination (e.g. CA\_2A-2A-4A-12A, but B12 can only be configured as a SCC).
- Power measurements were performed for "supersets" (LTE CA combinations with multiple components carriers) and any "subsets" (LTE CA combinations with fewer component carriers) that were not completely covered by the supersets.
- Only subsets that have the exact same components as a superset were excluded for measurement.
- When there were certain restrictions on component carriers that existed in the superset that were not applied for the subset, the subset configuration was additionally evaluated.
- Both inter-band and intra-band downlink carrier aggregation scenarios were considered.
- Downlink CA combinations for SISO and 4x4 Downlink MIMO operations were measured independently, per May 2017 TCBC Workshop notes.

Table 1 – Example of Exclusion Table for SISO Configurations

| Index    | ACC        | Supported Channel Bandwidth (MHz) | Restriction | Completely Covered by Measurement Superset |
|----------|------------|-----------------------------------|-------------|--------------------------------------------|
| CCC #1   | CA [2C]    | 5, 10, 15, 20                     | CCC #1      | No                                         |
| CCC #2   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #2      | No                                         |
| CCC #3   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #3      | No                                         |
| CCC #4   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #4      | No                                         |
| CCC #5   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #5      | No                                         |
| CCC #6   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #6      | No                                         |
| CCC #7   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #7      | No                                         |
| CCC #8   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #8      | No                                         |
| CCC #9   | CA [2A]-2A | 5, 10, 15, 20                     | CCC #9      | No                                         |
| CCC #10  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #10     | No                                         |
| CCC #11  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #11     | No                                         |
| CCC #12  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #12     | No                                         |
| CCC #13  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #13     | No                                         |
| CCC #14  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #14     | No                                         |
| CCC #15  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #15     | No                                         |
| CCC #16  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #16     | No                                         |
| CCC #17  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #17     | No                                         |
| CCC #18  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #18     | No                                         |
| CCC #19  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #19     | No                                         |
| CCC #20  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #20     | No                                         |
| CCC #21  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #21     | No                                         |
| CCC #22  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #22     | No                                         |
| CCC #23  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #23     | No                                         |
| CCC #24  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #24     | No                                         |
| CCC #25  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #25     | No                                         |
| CCC #26  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #26     | No                                         |
| CCC #27  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #27     | No                                         |
| CCC #28  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #28     | No                                         |
| CCC #29  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #29     | No                                         |
| CCC #30  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #30     | No                                         |
| CCC #31  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #31     | No                                         |
| CCC #32  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #32     | No                                         |
| CCC #33  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #33     | No                                         |
| CCC #34  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #34     | No                                         |
| CCC #35  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #35     | No                                         |
| CCC #36  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #36     | No                                         |
| CCC #37  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #37     | No                                         |
| CCC #38  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #38     | No                                         |
| CCC #39  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #39     | No                                         |
| CCC #40  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #40     | No                                         |
| CCC #41  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #41     | No                                         |
| CCC #42  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #42     | No                                         |
| CCC #43  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #43     | No                                         |
| CCC #44  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #44     | No                                         |
| CCC #45  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #45     | No                                         |
| CCC #46  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #46     | No                                         |
| CCC #47  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #47     | No                                         |
| CCC #48  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #48     | No                                         |
| CCC #49  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #49     | No                                         |
| CCC #50  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #50     | No                                         |
| CCC #51  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #51     | No                                         |
| CCC #52  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #52     | No                                         |
| CCC #53  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #53     | No                                         |
| CCC #54  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #54     | No                                         |
| CCC #55  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #55     | No                                         |
| CCC #56  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #56     | No                                         |
| CCC #57  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #57     | No                                         |
| CCC #58  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #58     | No                                         |
| CCC #59  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #59     | No                                         |
| CCC #60  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #60     | No                                         |
| CCC #61  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #61     | No                                         |
| CCC #62  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #62     | No                                         |
| CCC #63  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #63     | No                                         |
| CCC #64  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #64     | No                                         |
| CCC #65  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #65     | No                                         |
| CCC #66  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #66     | No                                         |
| CCC #67  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #67     | No                                         |
| CCC #68  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #68     | No                                         |
| CCC #69  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #69     | No                                         |
| CCC #70  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #70     | No                                         |
| CCC #71  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #71     | No                                         |
| CCC #72  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #72     | No                                         |
| CCC #73  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #73     | No                                         |
| CCC #74  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #74     | No                                         |
| CCC #75  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #75     | No                                         |
| CCC #76  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #76     | No                                         |
| CCC #77  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #77     | No                                         |
| CCC #78  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #78     | No                                         |
| CCC #79  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #79     | No                                         |
| CCC #80  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #80     | No                                         |
| CCC #81  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #81     | No                                         |
| CCC #82  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #82     | No                                         |
| CCC #83  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #83     | No                                         |
| CCC #84  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #84     | No                                         |
| CCC #85  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #85     | No                                         |
| CCC #86  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #86     | No                                         |
| CCC #87  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #87     | No                                         |
| CCC #88  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #88     | No                                         |
| CCC #89  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #89     | No                                         |
| CCC #90  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #90     | No                                         |
| CCC #91  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #91     | No                                         |
| CCC #92  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #92     | No                                         |
| CCC #93  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #93     | No                                         |
| CCC #94  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #94     | No                                         |
| CCC #95  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #95     | No                                         |
| CCC #96  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #96     | No                                         |
| CCC #97  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #97     | No                                         |
| CCC #98  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #98     | No                                         |
| CCC #99  | CA [2A]-2A | 5, 10, 15, 20                     | CCC #99     | No                                         |
| CCC #100 | CA [2A]-2A | 5, 10, 15, 20                     | CCC #100    | No                                         |

Table 2 – Example of Exclusion Table for 4x4 Downlink MIMO Configurations

| Supported Channel Bandwidth (MHz) |            |               |               |           | Restriction | Completely Covered by Measurement Superset |
|-----------------------------------|------------|---------------|---------------|-----------|-------------|--------------------------------------------|
| Index                             | ACC        | CC1           | CC2           |           |             |                                            |
| CCC #M01                          | CA [2C]    | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M06  | No          |                                            |
| CCC #M02                          | CA [2A]-2A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M07  | No          |                                            |
| CCC #M03                          | CA [2A]-2A | 5, 10, 15, 20 | 5, 10, 15, 20 | No        |             |                                            |
| CCC #M04                          | CA [2A]-4A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M05  | No          |                                            |
| CCC #M05                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | No        |             |                                            |
| CCC #M06                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M01  | No          |                                            |
| CCC #M07                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M02  | No          |                                            |
| CCC #M08                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M03  | No          |                                            |
| CCC #M09                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M04  | No          |                                            |
| CCC #M10                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M05  | No          |                                            |
| CCC #M11                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M06  | No          |                                            |
| CCC #M12                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M07  | No          |                                            |
| CCC #M13                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M08  | No          |                                            |
| CCC #M14                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M09  | No          |                                            |
| CCC #M15                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M10  | No          |                                            |
| CCC #M16                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M11  | No          |                                            |
| CCC #M17                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M12  | No          |                                            |
| CCC #M18                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M13  | No          |                                            |
| CCC #M19                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M14  | No          |                                            |
| CCC #M20                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M15  | No          |                                            |
| CCC #M21                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M16  | No          |                                            |
| CCC #M22                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M17  | No          |                                            |
| CCC #M23                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M18  | No          |                                            |
| CCC #M24                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M19  | No          |                                            |
| CCC #M25                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M20  | No          |                                            |
| CCC #M26                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M21  | No          |                                            |
| CCC #M27                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M22  | No          |                                            |
| CCC #M28                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M23  | No          |                                            |
| CCC #M29                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M24  | No          |                                            |
| CCC #M30                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M25  | No          |                                            |
| CCC #M31                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M26  | No          |                                            |
| CCC #M32                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M27  | No          |                                            |
| CCC #M33                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M28  | No          |                                            |
| CCC #M34                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M29  | No          |                                            |
| CCC #M35                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M30  | No          |                                            |
| CCC #M36                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M31  | No          |                                            |
| CCC #M37                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M32  | No          |                                            |
| CCC #M38                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M33  | No          |                                            |
| CCC #M39                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M34  | No          |                                            |
| CCC #M40                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M35  | No          |                                            |
| CCC #M41                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M36  | No          |                                            |
| CCC #M42                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M37  | No          |                                            |
| CCC #M43                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M38  | No          |                                            |
| CCC #M44                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M39  | No          |                                            |
| CCC #M45                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M40  | No          |                                            |
| CCC #M46                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M41  | No          |                                            |
| CCC #M47                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M42  | No          |                                            |
| CCC #M48                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M43  | No          |                                            |
| CCC #M49                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M44  | No          |                                            |
| CCC #M50                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M45  | No          |                                            |
| CCC #M51                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M46  | No          |                                            |
| CCC #M52                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M47  | No          |                                            |
| CCC #M53                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M48  | No          |                                            |
| CCC #M54                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M49  | No          |                                            |
| CCC #M55                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M50  | No          |                                            |
| CCC #M56                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M51  | No          |                                            |
| CCC #M57                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M52  | No          |                                            |
| CCC #M58                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M53  | No          |                                            |
| CCC #M59                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M54  | No          |                                            |
| CCC #M60                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M55  | No          |                                            |
| CCC #M61                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M56  | No          |                                            |
| CCC #M62                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M57  | No          |                                            |
| CCC #M63                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M58  | No          |                                            |
| CCC #M64                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M59  | No          |                                            |
| CCC #M65                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M60  | No          |                                            |
| CCC #M66                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M61  | No          |                                            |
| CCC #M67                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M62  | No          |                                            |
| CCC #M68                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M63  | No          |                                            |
| CCC #M69                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M64  | No          |                                            |
| CCC #M70                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M65  | No          |                                            |
| CCC #M71                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M66  | No          |                                            |
| CCC #M72                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M67  | No          |                                            |
| CCC #M73                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M68  | No          |                                            |
| CCC #M74                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M69  | No          |                                            |
| CCC #M75                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M70  | No          |                                            |
| CCC #M76                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M71  | No          |                                            |
| CCC #M77                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M72  | No          |                                            |
| CCC #M78                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M73  | No          |                                            |
| CCC #M79                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M74  | No          |                                            |
| CCC #M80                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M75  | No          |                                            |
| CCC #M81                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M76  | No          |                                            |
| CCC #M82                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M77  | No          |                                            |
| CCC #M83                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M78  | No          |                                            |
| CCC #M84                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M79  | No          |                                            |
| CCC #M85                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M80  | No          |                                            |
| CCC #M86                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M81  | No          |                                            |
| CCC #M87                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M82  | No          |                                            |
| CCC #M88                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M83  | No          |                                            |
| CCC #M89                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M84  | No          |                                            |
| CCC #M90                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M85  | No          |                                            |
| CCC #M91                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M86  | No          |                                            |
| CCC #M92                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M87  | No          |                                            |
| CCC #M93                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M88  | No          |                                            |
| CCC #M94                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M89  | No          |                                            |
| CCC #M95                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M90  | No          |                                            |
| CCC #M96                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M91  | No          |                                            |
| CCC #M97                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M92  | No          |                                            |
| CCC #M98                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M93  | No          |                                            |
| CCC #M99                          | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M94  | No          |                                            |
| CCC #M100                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M95  | No          |                                            |
| CCC #M101                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M96  | No          |                                            |
| CCC #M102                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M97  | No          |                                            |
| CCC #M103                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M98  | No          |                                            |
| CCC #M104                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M99  | No          |                                            |
| CCC #M105                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M100 | No          |                                            |
| CCC #M106                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M101 | No          |                                            |
| CCC #M107                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M102 | No          |                                            |
| CCC #M108                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M103 | No          |                                            |
| CCC #M109                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M104 | No          |                                            |
| CCC #M110                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M105 | No          |                                            |
| CCC #M111                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M106 | No          |                                            |
| CCC #M112                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M107 | No          |                                            |
| CCC #M113                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M108 | No          |                                            |
| CCC #M114                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M109 | No          |                                            |
| CCC #M115                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M110 | No          |                                            |
| CCC #M116                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M111 | No          |                                            |
| CCC #M117                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M112 | No          |                                            |
| CCC #M118                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M113 | No          |                                            |
| CCC #M119                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M114 | No          |                                            |
| CCC #M120                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M115 | No          |                                            |
| CCC #M121                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M116 | No          |                                            |
| CCC #M122                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M117 | No          |                                            |
| CCC #M123                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M118 | No          |                                            |
| CCC #M124                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M119 | No          |                                            |
| CCC #M125                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M120 | No          |                                            |
| CCC #M126                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M121 | No          |                                            |
| CCC #M127                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M122 | No          |                                            |
| CCC #M128                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M123 | No          |                                            |
| CCC #M129                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M124 | No          |                                            |
| CCC #M130                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M125 | No          |                                            |
| CCC #M131                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M126 | No          |                                            |
| CCC #M132                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M127 | No          |                                            |
| CCC #M133                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M128 | No          |                                            |
| CCC #M134                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M129 | No          |                                            |
| CCC #M135                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M130 | No          |                                            |
| CCC #M136                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M131 | No          |                                            |
| CCC #M137                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M132 | No          |                                            |
| CCC #M138                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M133 | No          |                                            |
| CCC #M139                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M134 | No          |                                            |
| CCC #M140                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M135 | No          |                                            |
| CCC #M141                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M136 | No          |                                            |
| CCC #M142                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M137 | No          |                                            |
| CCC #M143                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M138 | No          |                                            |
| CCC #M144                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M139 | No          |                                            |
| CCC #M145                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M140 | No          |                                            |
| CCC #M146                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M141 | No          |                                            |
| CCC #M147                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M142 | No          |                                            |
| CCC #M148                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M143 | No          |                                            |
| CCC #M149                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M144 | No          |                                            |
| CCC #M150                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M145 | No          |                                            |
| CCC #M151                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M146 | No          |                                            |
| CCC #M152                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M147 | No          |                                            |
| CCC #M153                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M148 | No          |                                            |
| CCC #M154                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M149 | No          |                                            |
| CCC #M155                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M150 | No          |                                            |
| CCC #M156                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M151 | No          |                                            |
| CCC #M157                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M152 | No          |                                            |
| CCC #M158                         | CA [2A]-1A | 5, 10, 15, 20 | 5, 10, 15, 20 | CCC #M153 | No          |                                            |
| CCC #M159                         | CA [2A]-1A | 5, 10, 15, 20 |               |           |             |                                            |

## 1.2 LTE Downlink Only Carrier Aggregation Test Selection and Setup

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers (CCs) supported by the product implementation. For those configurations required by April 2018 TCBC Workshop Notes, conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink carrier aggregation is inactive on the PCC. Additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.

Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for carrier aggregation configurations when the maximum average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive. All bands required for SAR testing per FCC KDB procedures were considered. Based on the measured maximum powers below, no additional SAR tests were required for DLCA SAR configurations.

General PCC and SCC configuration selection procedure

- PCC uplink channel, channel bandwidth, modulation and RB configurations were selected based on section C)3)b)ii) of KDB 941225 D05 V01r02. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
- To maximize aggregated bandwidth, highest channel bandwidth available for that CA combination was selected for SCC. For inter-band CA, the SCC downlink channels were selected near the middle of their transmission bands. For contiguous intra-band CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521. For non-contiguous intra-band CA, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers.
- All selected PCC and SCC(s) remained fully within the uplink/downlink transmission band of the respective component carrier.

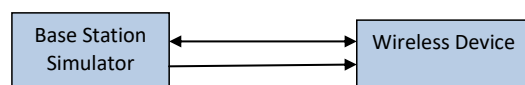


**Figure 1**  
**DL CA Power Measurement Setup**

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 - 02/03/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX F:<br>Page 2 of 9      |

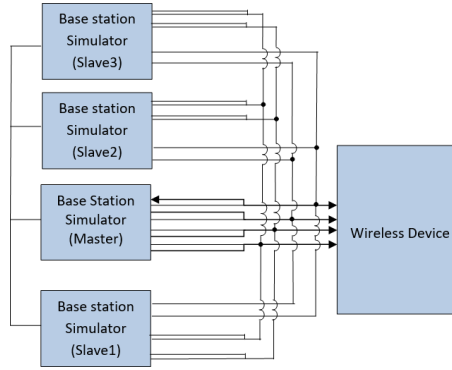


Figure 2  
DL CA with DL 4x4 MIMO Power Measurement Setup

## 1.3 Downlink Carrier Aggregation RF Conducted Powers

### 1.3.1 LTE Band 71 as PCC

Table 1  
Maximum Output Powers

| Combination       | PCC Band | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC [DL] Channel | PCC [DL] Freq. [MHz] | SCC 1    |              |                  |                      | SCC 2    |              |                  |                      | SCC 3    |              |                  |                      | Power                                 |                                   |
|-------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|
|                   |          |              |              |                      |      |           |                  |                  |                      | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA 46A-71A        | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B46  | 20           | 50665            | 5537.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.39                                 | 25.34                             |
| CA 46C-71A        | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B46  | 20           | 50665            | 5537.5               | LTE B46  | 20           | 50467            | 5517.7               | -        | -            | -                | -                    | 25.40                                 | 25.34                             |
| CA 4A-4A-71A      | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B4   | 20           | 2175             | 2132.5               | LTE B4   | 10           | 2350             | 2150                 | -        | -            | -                | -                    | 25.40                                 | 25.34                             |
| CA 2A-2A-4A-71A   | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B4   | 20           | 2175             | 2132.5               | 25.36                                 | 25.34                             |
| CA 2A-2A-66A-71A  | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B66  | 20           | 66786            | 2145                 | 25.35                                 | 25.34                             |
| CA 2A-66A-66A-71A | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 67236            | 2150                 | 25.39                                 | 25.34                             |
| CA 2A-66C-71A     | LTE B71  | 20           | 133297       | 680.5                | QPSK | 1         | 99               | 68761            | 634.5                | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 66984            | 2164.8               | 25.34                                 | 25.34                             |

### 1.3.2 LTE Band 12 as PCC

Table 2  
Maximum Output Powers

| Combination           | PCC Band | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC [DL] Channel | PCC [DL] Freq. [MHz] | SCC 1    |              |                  |                      | SCC 2    |              |                  |                      | SCC 3    |              |                  |                      | Power                                 |                                   |
|-----------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|
|                       |          |              |              |                      |      |           |                  |                  |                      | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA 12A-12A            | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.34                                 | 25.16                             |
| CA 12A-46A            | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B46  | 20           | 50665            | 5537.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.23                                 | 25.16                             |
| CA 12A-66A (1)        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B66  | 20           | 66786            | 2145                 | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.27                                 | 25.16                             |
| CA 12A-66A (2)        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B66  | 20           | 66786            | 2145                 | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.27                                 | 25.16                             |
| CA 4A-12A (1)         | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B4   | 20           | 2175             | 2132.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.40                                 | 25.16                             |
| CA 4A-12A (2)         | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B4   | 20           | 2175             | 2132.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | 25.25                                 | 25.16                             |
| CA 12A-46C            | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B46  | 20           | 50665            | 5537.5               | LTE B46  | 20           | 50467            | 5517.7               | -        | -            | -                | -                    | 25.25                                 | 25.16                             |
| CA 12A-46D            | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B46  | 20           | 50665            | 5537.5               | LTE B46  | 20           | 50467            | 5517.7               | -        | -            | -                | -                    | 25.20                                 | 25.16                             |
| CA 12A-66A-66A        | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 12               | 5095             | 737.5                | LTE B12  | 10           | 5107             | 738.7                | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 67236            | 2150                 | 25.16                                 | 25.16                             |
| CA 2A-12A-66C         | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 66984            | 2164.8               | 25.22                                 | 25.16                             |
| CA 2A-4A-12A-12A      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B4   | 20           | 2175             | 2132.5               | 25.23                                 | 25.16                             |
| CA 2A-4A-12A-12A      | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B7   | 20           | 3100             | 2655                 | 25.27                                 | 25.16                             |
| CA 2A-4A-12B          | LTE B12  | 5            | 23035        | 701.5                | QPSK | 5         | 12               | 5095             | 731.5                | LTE B12  | 10           | 5107             | 738.7                | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | 25.04                                 | 24.99                             |
| CA 2A-4A-4A-12A       | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B4   | 10           | 2350             | 2150                 | 25.23                                 | 25.16                             |
| CA 2A-4A-7A-12A       | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B7   | 20           | 3100             | 2655                 | 25.27                                 | 25.16                             |
| CA 4A-4A-12B          | LTE B12  | 5            | 23035        | 701.5                | QPSK | 5         | 12               | 5095             | 731.5                | LTE B12  | 10           | 5107             | 738.7                | LTE B4   | 20           | 2175             | 2132.5               | LTE B4   | 10           | 2350             | 2150                 | 25.04                                 | 24.99                             |
| CA 12A-46E            | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B46  | 20           | 50665            | 5537.5               | LTE B46  | 20           | 50467            | 5517.7               | LTE B46  | 20           | 50269            | 5497.9               | 25.24                                 | 25.16                             |
| CA 2A-12A-12A-66A-66A | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B66  | 20           | 66786            | 2145                 | 25.22                                 | 25.16                             |
| CA 2A-2A-12B-66A      | LTE B12  | 5            | 23035        | 701.5                | QPSK | 5         | 12               | 5095             | 731.5                | LTE B12  | 10           | 5107             | 738.7                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | 25.01                                 | 24.99                             |
| CA 2A-2A-7A-12A-66A   | LTE B12  | 10           | 23095        | 707.5                | QPSK | 5         | 49               | 5095             | 737.5                | LTE B2   | 20           | 900              | 1960                 | LTE B2   | 20           | 700              | 1940                 | LTE B7   | 20           | 3100             | 2655                 | 25.27                                 | 25.16                             |
| CA 2A-7A-12B-66A      | LTE B12  | 5            | 23035        | 701.5                | QPSK | 5         | 12               | 5095             | 731.5                | LTE B12  | 10           | 5107             | 738.7                | LTE B2   | 20           | 900              | 1960                 | LTE B7   | 20           | 3100             | 2655                 | 25.01                                 | 24.99                             |

### 1.3.3 LTE Band 13 as PCC

Table 3  
Maximum Output Powers

| Combination       | PCC Band | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC [DL] Channel | PCC [DL] Freq. [MHz] | SCC 1    |              |                  |                      | SCC 2    |              |                  |                      | SCC 3    |              |                  |                      | Power                                 |                                   |
|-------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|
|                   |          |              |              |                      |      |           |                  |                  |                      | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA 13A-13A-66A    | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B46  | 20           | 50665            | 5537.5               | LTE B66  | 20           | 66786            | 2145                 | -        | -            | -                | -                    | 25.15                                 | 25.16                             |
| CA 13A-66C        | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 66984            | 2164.8               | -        | -            | -                | -                    | 25.17                                 | 25.16                             |
| CA 2A-4A-13A      | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B4   | 20           | 2175             | 2132.5               | LTE B4   | 10           | 2350             | 2150                 | -        | -            | -                | -                    | 25.38                                 | 25.16                             |
| CA 13A-66A-66A    | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 66984            | 2164.8               | -        | -            | -                | -                    | 25.22                                 | 25.16                             |
| CA 13A-66A-66C    | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 67236            | 2150                 | -        | -            | -                | -                    | 25.21                                 | 25.16                             |
| CA 2A-13A-66A-66A | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 67236            | 2150                 | 25.25                                 | 25.16                             |
| CA 2A-13A-66A-66A | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B2   | 20           | 900              | 1960                 | LTE B66  | 20           | 66786            | 2145                 | LTE B66  | 20           | 66786            | 2145                 | 25.26                                 | 25.16                             |
| CA 13A-46E        | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B46  | 20           | 50665            | 5537.5               | LTE B46  | 20           | 50467            | 5517.7               | LTE B46  | 20           | 50361            | 5517.1               | 25.26                                 | 25.16                             |
| CA 2A-13A-46E-66A | LTE B13  | 10           | 23230        | 782                  | QPSK | 1         | 0                | 5230             | 751                  | LTE B2   | 20           | 900              | 1960                 | LTE B46  | 20           | 50467            | 5517.7               | LTE B66  | 20           | 66786            | 2145                 | 25.21                                 | 25.16                             |

|                                    |                               |                            |  |                                 |
|------------------------------------|-------------------------------|----------------------------|--|---------------------------------|
| FCC ID: ZNFV600TM                  |                               | SAR EVALUATION REPORT      |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 - 02/03/20 | DUT Type:<br>Portable Handset | APPENDIX F:<br>Page 3 of 9 |  |                                 |

### 1.3.4 LTE Band 26 as PCC

**Table 4**  
**Maximum Output Powers**

| Combination    | PCC Band | PCC          |              |                      |      |            |                  |                  |                      | SCC 1    |              |                  | SCC 2                |          |              |                  | Power                |                                       |                                   |
|----------------|----------|--------------|--------------|----------------------|------|------------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|---------------------------------------|-----------------------------------|
|                |          | PCC BW [MHz] | PCC (UL) Ch. | PCC (UL) Freq. [MHz] | Mod. | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA 25A-26A     | LTE B26  | 15           | 26865        | 831.5                | QPSK | 1          | 74               | 8865             | 876.5                | LTE B25  | 20           | 8365             | 1962.5               | -        | -            | -                | -                    | 25.33                                 | 25.29                             |
| CA 26A-41A     | LTE B26  | 15           | 26865        | 831.5                | QPSK | 1          | 74               | 8865             | 876.5                | LTE B41  | 20           | 40620            | 2593                 | -        | -            | -                | -                    | 25.33                                 | 25.29                             |
| CA 25A-25A-26A | LTE B26  | 5            | 26865        | 831.5                | QPSK | 1          | 24               | 8865             | 876.5                | LTE B25  | 20           | 8365             | 1962.5               | LTE B25  | 20           | 8590             | 1985                 | 25.17                                 | 25.11                             |
| CA 26A-41C     | LTE B26  | 15           | 26865        | 831.5                | QPSK | 1          | 74               | 8865             | 876.5                | LTE B41  | 20           | 40620            | 2593                 | LTE B41  | 20           | 40422            | 2573.2               | 25.29                                 | 25.29                             |

### 1.3.5 LTE Band 66 as PCC

**Table 5**  
**Maximum Output Powers**

[illegible]

### 1.3.6 LTE Band 25 as PCC

**Table 6**  
**Maximum Output Powers**

|                |            | SCC 1        |              |                      |      |            |                  |                  |                      |          |              |                  |                      |          |              |                  | SCC 2                |          |              | SCC 3            |                      |                                    |                                   | Power |       |
|----------------|------------|--------------|--------------|----------------------|------|------------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|------------------------------------|-----------------------------------|-------|-------|
| Combination    | PCC Band   | PCC BW [MHz] | PCC (UL) Ch. | PCC (UL) Freq. [MHz] | Mod. | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Channel | SCC (DL) Freq. [MHz] | LTE Tx Power with CL Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |       |       |
| CA_25A-26A     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B26  | 15           | 8805             | 876.5                | -        | -            | -                | -                    | -        | -            | -                | -                    | -                                  | 25.19                             | 25.20 |       |
| CA_25A-41A     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B41  | 20           | 40620            | 2593                 | -        | -            | -                | -                    | -        | -            | -                | -                    | -                                  | 25.17                             | 25.20 |       |
| CA_25A-49A     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B49  | 20           | 50665            | 5037.5               | -        | -            | -                | -                    | -        | -            | -                | -                    | -                                  | 25.19                             | 25.20 |       |
| CA_25A-25A-26A | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B25  | 20           | 8140             | 1940                 | LTE B26  | 5            | 8805             | 876.5                | -        | -            | -                | -                    | -                                  | 25.17                             | 25.20 |       |
|                | CA_25A-41C | LTE B25      | 10           | 26640                | 1910 | QPSK       | 1                | 49               | 8640                 | 1990     | LTE B41      | 20               | 40620                | 2593     | LTE B41      | 20               | 40422                | 2573.2   | -            | -                | -                    | -                                  | -                                 | 25.19 | 25.20 |
| CA_25A-49C     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B49  | 20           | 50665            | 5037.5               | LTE B49  | 20           | 50467            | 5017.7               | -        | -            | -                | -                    | -                                  | 25.18                             | 25.20 |       |
| CA_25A-41D     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B41  | 20           | 40422            | 2573.2               | LTE B41  | 20           | 40620            | 2593                 | -        | -            | -                | -                    | -                                  | 25.19                             | 25.20 |       |
| CA_25A-49D     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B49  | 20           | 50665            | 5037.5               | LTE B49  | 20           | 50467            | 5017.7               | LTE B41  | 20           | 40819            | 2612.8               | 25.18                              | 25.20                             |       |       |
| CA_25A-49D     | LTE B25    | 10           | 26640        | 1910                 | QPSK | 1          | 49               | 8640             | 1990                 | LTE B49  | 20           | 50665            | 5037.5               | LTE B49  | 20           | 50467            | 5017.7               | LTE B49  | 20           | 50883            | 5138                 | 25.18                              | 25.20                             |       |       |

### 1.3.7 LTE Band 30 as PCC

**Table 7**  
**Maximum Output Powers**

| Combination        |  | PCB Band | PCB BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCB UL RB | PCC UL RB Offset | PCC [UL] Channel | PCC [DL] Freq. [MHz] | SCC Band | SCC 1        |                  |                      |          | SCC 2        |                  |                      |          | SCC 3        |                  |                      |          | SCC 4        |                  |                      |                                      | Power                             |       |
|--------------------|--|----------|--------------|--------------|----------------------|------|-----------|------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|--------------------------------------|-----------------------------------|-------|
|                    |  |          |              |              |                      |      |           |                  |                  |                      |          | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC [DL] Channel | SCC [DL] Freq. [MHz] | LTE Tx Power with DR CA Scaled (dBm) | LTE Single Carrier Tx Power (dBm) |       |
| CA 2A-6A-12A-30A   |  | LTE B30  | 5            | 27TDD        | 2310                 | QPSK | 1         | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B12  | 20           | 5095             | 772.5                | -        | -            | -                | -                    | 22.27                                | 22.25                             |       |
| CA 2A-6A-30A       |  | LTE B30  | 5            | 27TDD        | 2310                 | QPSK | 1         | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B20  | 10           | 9115             | 727.5                | -        | -            | -                | -                    | 22.28                                | 22.25                             |       |
| CA 2A-4A-5A-30A    |  | LTE B30  | 5            | 27TDD        | 2310                 | QPSK | 1         | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B5   | 20           | 2525             | 883.5                | -        | -            | -                | -                    | 22.27                                | 22.25                             |       |
| CA 2A-12A-30A-6A   |  | LTE B30  | 5            | 27TDD        | 2310                 | QPSK | 1         | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B12  | 20           | 5095             | 747.5                | LTE B6   | 20           | 6878             | 2385                 | -        | -            | -                | -                    | 22.28                                | 22.25                             |       |
| CA 2A-5A-30A-6A-6A |  | LTE B30  | 5            | 27TDD        | 2310                 | QPSK | 1         | 12               | 9820             | 2355                 | LTE B2   | 20           | 900              | 1960                 | LTE B4   | 20           | 2175             | 2132.5               | LTE B50  | 20           | 2145             | 878.5                | 20       | 4726         | 2185             | 22.28                | 22.25                                | 22.28                             | 22.25 |

|                                           |                                                                                                                            |                                                                                                 |                                        |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|
| FCC ID: ZNFV600TM                         |  <b>PCTEST</b><br>SAR EVALUATION REPORT |  <b>LG</b> | <b>Reviewed by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/25/19 - 02/03/20 | <b>DUT Type:</b><br>Portable Handset                                                                                       | APPENDIX F:<br>Page 4 of 9                                                                      |                                        |

### 1.3.8 LTE Band 7 as PCC

**Table 8**  
**Maximum Output Powers**

[illegible]

### 1.3.9 LTE Band 41 PC3 as PCC

**Table 9**  
**Maximum Output Powers**

|                |          |              |            |                     |      |          |                 |                |                    |          |              |                 |                     |          |              |                 |                     |          | Power        |                 |                           |                                   |                     |       |       |       |       |
|----------------|----------|--------------|------------|---------------------|------|----------|-----------------|----------------|--------------------|----------|--------------|-----------------|---------------------|----------|--------------|-----------------|---------------------|----------|--------------|-----------------|---------------------------|-----------------------------------|---------------------|-------|-------|-------|-------|
| Combination    | PCB Band | PCB BW [MHz] | PCQ (U) Ch | PCQ (U) Freq. [MHz] | Mod. | PC UL RR | PC UL RB Offset | PC (U) Channel | SCC 1              |          |              | SCC 2           |                     |          | SCC 3        |                 |                     | SCC 4    |              |                 | LTE Tx Power (with DR CA) | LTE Single Carrier Tx Power (dBm) |                     |       |       |       |       |
|                |          |              |            |                     |      |          |                 |                | PC (D) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (U) Channel | SCC (D) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (U) Channel | SCC (D) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (U) Channel |                           |                                   | SCC (D) Freq. [MHz] |       |       |       |       |
| CA 41A-41A (1) | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 41460           | 2600                |          |              |                 |                     |          |              |                 | 25.18                     | 25.20                             |                     |       |       |       |       |
| CA 41A-41A-41C | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 40620           | 2600                | LTE B41  | 20           | 41460           | 2600                | LTE B41  | 20           | 41292           | 2600.2                    | -                                 | -                   | 25.18 | 25.20 |       |       |
| CA 41C-41A-41A | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 40620           | 2600                | LTE B41  | 20           | 41460           | 2600                | LTE B41  | 20           | 41292           | 2600.2                    | -                                 | -                   | 25.18 | 25.20 |       |       |
| CA 41A-41A     | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 41004           | 2604.0              | LTE B41  | 20           | 41292           | 2600.2              | LTE B41  | 20           | 41460           | 2600                      | -                                 | -                   | 25.18 | 25.20 |       |       |
| CA 40-41A      | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 40529           | 2564.9              | LTE B41  | 20           | 40529           | 2564.9              | LTE B41  | 20           | 40529           | 2564.9                    | -                                 | -                   | 25.18 | 25.20 |       |       |
| CA 41C-41C     | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 40529           | 2564.9              | LTE B41  | 20           | 40529           | 2564.9              | LTE B41  | 20           | 40529           | 2564.9                    | -                                 | -                   | 25.18 | 25.20 |       |       |
| CA 41E         | LTE B41  | 15           | 39750      | 2506                | QPSK | 1        | 74              | 39750          | 2506               | LTE B41  | 20           | 39901           | 2513.3              | LTE B41  | 20           | 40114           | 2542.9              | LTE B41  | 20           | 40317           | 2562.7                    | -                                 | -                   | 25.02 | 25.00 |       |       |
| CA 41C-41E     | LTE B41  | 10           | 40185      | 2549.5              | QPSK | 1        | 25              | 40185          | 2549.5             | LTE B41  | 20           | 40129           | 2563.3              | LTE B41  | 20           | 40134           | 2564.9              | LTE B41  | 20           | 41292           | 2600.2                    | LTE B41                           | 20                  | 41460 | 2600  | 25.18 | 25.20 |
| CA 41E-41E     | LTE B41  | 15           | 3945.5     | 2463.5              | QPSK | 1        | 74              | 3945.5         | 2463.5             | LTE B41  | 20           | 3945.5          | 2463.3              | LTE B41  | 20           | 40114           | 2542.9              | LTE B41  | 20           | 40317           | 2562.7                    | -                                 | -                   | 25.02 | 25.00 |       |       |

### 1.3.10 LTE Band 41 PC2 as PCC

**Table 10**  
**Maximum Output Powers**

| Combination    | PCC Band    | PCC BW [MHz] | PCC (UL) Freq. [MHz] | Mod. | PCC LRA RB | PCC SSB RB Offset | PCC (DL) Channel | PCC (DL) Freq. [MHz] | SSC 3    |              |                  |                      | SSC 2    |              |                  |                      | SSC 3    |              |                  |                      | SSC 4    |              |                  |                      | Power              |                                       |
|----------------|-------------|--------------|----------------------|------|------------|-------------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|----------|--------------|------------------|----------------------|--------------------|---------------------------------------|
|                |             |              |                      |      |            |                   |                  |                      | SSC Band | SSC BW [MHz] | SSC (DL) Channel | SSC (DL) Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC (DL) Channel | SSC (DL) Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC (DL) Channel | SSC (DL) Freq. [MHz] | SSC Band | SSC BW [MHz] | SSC (DL) Channel | SSC (DL) Freq. [MHz] | LTE Tx Power (dBm) | LTE Tx Power with UL CA Enabled (dBm) |
| CA 41A-41A(1)  | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2680     |              |                  |                      |          |              |                  |                      |          |              |                  |                      |                    |                                       |
| CA 41A-41A(1C) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2503     | LTE BA4-PC2  | 20               | 41600                | 2680     | LTE BA4-PC2  | 20               | 41250                | 2650     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41A-41A(1A) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2503     | LTE BA4-PC2  | 20               | 41600                | 2680     | LTE BA4-PC2  | 20               | 41250                | 2650     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41A-41A(1B) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2640     | LTE BA4-PC2  | 20               | 41250                | 2660     | LTE BA4-PC2  | 20               | 41600                | 2680     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41C-41C(1)  | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2640     | LTE BA4-PC2  | 20               | 41250                | 2660     | LTE BA4-PC2  | 20               | 41600                | 2680     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41C-41C(1A) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2503     | LTE BA4-PC2  | 20               | 41600                | 2680     | LTE BA4-PC2  | 20               | 41250                | 2650     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41C-41C(1B) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2640     | LTE BA4-PC2  | 20               | 41250                | 2660     | LTE BA4-PC2  | 20               | 41600                | 2680     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41C-41C(1C) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2503     | LTE BA4-PC2  | 20               | 41600                | 2680     | LTE BA4-PC2  | 20               | 41250                | 2650     | 2            | 27.46            | 27.38                |                    |                                       |
| CA 41C-41C(1D) | LTE BA4-PC2 | 20           | 39750                | 2506 | QPSK       | 1                 | 99               | 39750                | 2506     | LTE BA4-PC2  | 20               | 41600                | 2503     | LTE BA4-PC2  | 20               | 41600                | 2680     | LTE BA4-PC2  | 20               | 41250                | 2650     | 2            | 27.46            | 27.38                |                    |                                       |

### 1.3.11 LTE Band 48 as PCC

**Table 11**  
**Maximum Output Powers**

| Combination | PCB Band | SCC 1        |              |                       |      |            |                   |              |                          |          |              | SCC 2       |                         |          |              | SCC 3       |                         |          |              | Power       |                         |                                       |                                   |
|-------------|----------|--------------|--------------|-----------------------|------|------------|-------------------|--------------|--------------------------|----------|--------------|-------------|-------------------------|----------|--------------|-------------|-------------------------|----------|--------------|-------------|-------------------------|---------------------------------------|-----------------------------------|
|             |          | PCB BW [MHz] | PCCL [UL] CH | PCCL [UL] Freq. [MHz] | Mod. | PCCL UL RB | PCCL UL RB Offset | PCCL Channel | PCCL Channel Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC Channel Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC Channel Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC Channel | SCC Channel Freq. [MHz] | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |
| CA-4B/C     | LTE B4B  | 15           | 56965        | 3692.5                | QPSK | 1          | 0                 | 56965        | 3692.5                   | LTE B4B  | 20           | 56494       | 3675.4                  | -        | -            | -           | -                       | -        | -            | -           | -                       | 23.68                                 | 21.67                             |
| CA-4B+4B-A  | LTE B4B  | 15           | 56965        | 3692.5                | QPSK | 1          | 0                 | 56965        | 3692.5                   | LTE B4B  | 20           | 56494       | 3675.4                  | -        | -            | -           | -                       | -        | -            | -           | -                       | 23.68                                 | 21.67                             |
| CA-4B       | LTE B4B  | 15           | 56965        | 3692.5                | QPSK | 1          | 0                 | 56965        | 3692.5                   | LTE B4B  | 20           | 56494       | 3675.4                  | LTE B4B  | 20           | 56296       | 3655.6                  | -        | -            | -           | -                       | 23.68                                 | 21.67                             |
| CA-4B       | LTE B4B  | 15           | 56965        | 3692.5                | QPSK | 1          | 0                 | 56965        | 3692.5                   | LTE B4B  | 20           | 56494       | 3675.4                  | LTE B4B  | 20           | 56296       | 3655.6                  | LTE B4B  | 20           | 56500       | 3675.0                  | 23.68                                 | 21.67                             |

#### 1.4 DL CA with DL 4x4 MIMO RF Conduction Powers

This device supports downlink 4x4 MIMO operations for some LTE bands. Uplink transmission is limited to a single output stream. When carrier aggregation was applicable, the general test selection and setup procedures described in Section 1.2 were applied.

Per May 2017 TCB Workshop Notes, SAR for 4x4 DL MIMO was not needed since the maximum average output power in 4x4 DL MIMO mode was not more than 0.25 dB higher than the maximum output power with 4x4 DL MIMO inactive. Additionally, SAR for 4x4 MIMO Downlink Carrier Aggregation was not needed since the maximum average output power in 4x4 MIMO Downlink Carrier Aggregation mode was not more than 0.25 dB higher than the maximum output power with 4x4 MIMO Downlink and downlink carrier aggregation inactive.

|                                           |                                                                                                   |                            |                                                                                                 |                                 |
|-------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                         |  <b>PCTEST</b> | SAR EVALUATION REPORT      |  <b>LG</b> | Reviewed by:<br>Quality Manager |
| <b>Test Dates:</b><br>11/25/19 - 02/03/20 | <b>DUT Type:</b><br>Portable Handset                                                              | APPENDIX F:<br>Page 5 of 9 |                                                                                                 |                                 |

### 1.4.1 LTE 4x4 MIMO DL Standalone Powers

**Table 12**  
**Maximum Output Powers**

| LTE Band | Bandwidth [MHz] | Channel | Frequency [MHz] | Modulation | RB Size | RB Offset | 4x4 DL MIMO Tx. Power [dBm] | Single Antenna Tx. Power [dBm] | Target Power [dBm] |
|----------|-----------------|---------|-----------------|------------|---------|-----------|-----------------------------|--------------------------------|--------------------|
| 66       | 15              | 132322  | 1745            | QPSK       | 1       | 36        | 25.12                       | 25.14                          | 24.7               |
| 25       | 10              | 26640   | 1910            | QPSK       | 1       | 49        | 25.17                       | 25.20                          | 24.7               |
| 7        | 20              | 21100   | 2535            | QPSK       | 1       | 99        | 23.43                       | 23.39                          | 23.2               |
| 41 PC3   | 10              | 40185   | 2549.5          | QPSK       | 1       | 25        | 25.19                       | 25.20                          | 24.7               |
| 41 PC2   | 20              | 39750   | 2506            | QPSK       | 1       | 99        | 27.39                       | 27.38                          | 27.2               |
| 48       | 15              | 56665   | 3692.5          | QPSK       | 1       | 0         | 23.63                       | 23.67                          | 23.2               |

### 1.4.2 LTE Band 71 as PCC

**Table 13**  
**Maximum Output Powers**

| Combination       | PCC Band | PCC          |              |                      |      |           |                  |              |                      |                 |          | SSC 1        |                      |                 |          | SSC 2        |                      |                 |          | SSC 3        |                      |                 |                                   | Power                            |       |       |       |
|-------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|--------------|----------------------|-----------------|----------|--------------|----------------------|-----------------|----------|--------------|----------------------|-----------------|----------|--------------|----------------------|-----------------|-----------------------------------|----------------------------------|-------|-------|-------|
|                   |          | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC [DL] Ch. | PCC [DL] Freq. [MHz] | DL Ant. Config. | SSC Band | SSC [DL] Ch. | SSC [DL] Freq. [MHz] | DL Ant. Config. | SSC Band | SSC [DL] Ch. | SSC [DL] Freq. [MHz] | DL Ant. Config. | SSC Band | SSC [DL] Ch. | SSC [DL] Freq. [MHz] | DL Ant. Config. | LTE TxPower with CA Enabled (dBm) | LTE Single Carrier TxPower (dBm) |       |       |       |
| CA 2A-4A-71A      | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B2   | 20           | 900                  | 1960            | 2x2      | LTE B4       | 20                   | 2175            | 2132.5   | 4x4          | -                    | -               | -                                 | -                                | 25.33 | 25.34 |       |
| CA 2A-66A-71A     | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B2   | 20           | 900                  | 1960            | 2x2      | LTE B66      | 20                   | 66786           | 2145     | 4x4          | -                    | -               | -                                 | -                                | 25.36 | 25.34 |       |
| CA 4A-4A-71A      | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B4   | 20           | 2175                 | 2132.5          | 4x4      | LTE B4       | 10                   | 2330            | 2150     | 4x4          | -                    | -               | -                                 | -                                | 25.39 | 25.34 |       |
| CA 2A-2A-4A-71A   | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B2   | 20           | 900                  | 1960            | 4x4      | LTE B2       | 20                   | 700             | 1940     | 4x4          | LTE B4               | 20              | 2175                              | 2132.5                           | 4x4   | 25.42 | 25.34 |
| CA 2A-2A-66A-71A  | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B2   | 20           | 900                  | 1960            | 4x4      | LTE B2       | 20                   | 700             | 1940     | 4x4          | LTE B66              | 20              | 66786                             | 2145                             | 4x4   | 25.43 | 25.34 |
| CA 2A-66A-66A-71A | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B2   | 20           | 900                  | 1960            | 4x4      | LTE B66      | 20                   | 66786           | 2145     | 4x4          | LTE B66              | 20              | 66786                             | 2145                             | 4x4   | 25.44 | 25.34 |
| CA 4A-66A-71A     | LTE B71  | 20           | 133929       | 680.5                | QPSK | 1         | 99               | 68761        | 634.5                | 2x2             | LTE B2   | 20           | 900                  | 1960            | 4x4      | LTE B66      | 20                   | 66786           | 2145     | 4x4          | LTE B66              | 20              | 66786                             | 2145                             | 4x4   | 25.45 | 25.34 |

### 1.4.3 LTE Band 12 as PCC

**Table 14**  
**Maximum Output Powers**

| Combination              | PCB Band | PCB BW [MHz] | PCF [U] | PCC [U] | Freq. [MHz] | Mod. | PCC    |                  |        |         | SCC 1               |                 |          |              | SCC 2   |                     |                 |          | SCC 3        |         |                     |                 | SCC 4    |              |         |                     | Power           |          |              |
|--------------------------|----------|--------------|---------|---------|-------------|------|--------|------------------|--------|---------|---------------------|-----------------|----------|--------------|---------|---------------------|-----------------|----------|--------------|---------|---------------------|-----------------|----------|--------------|---------|---------------------|-----------------|----------|--------------|
|                          |          |              |         |         |             |      | PCB RB | PCU UL RB Offset | PCU DL | PCC [U] | PCC [DL Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [U] | SCC [DL Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [U] | SCC [DL Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [U] | SCC [DL Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] |
| CA 12A (66A) (1)         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 | 23.19    | 23.19        |
| CA 12A (66A) (2)         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 | 23.14    | 23.14        |
| CA 12A (12A) (1)         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 | 21.19    | 21.19        |
| CA 16A (12A) (1)         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B64             | 20              | 6175     | 2123.5       | 4x4     |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 | 21.14    | 21.14        |
| CA 16A (12A) (2)         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B64             | 20              | 6175     | 2123.5       | 4x4     |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 | 21.19    | 21.19        |
| CA 12A (66A) (66A)       | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     | LTE B66             | 20              | 67236    | 2190         | 2x2     |                     |                 |          |              |         |                     |                 | 25.15    | 25.15        |
| CA 16A (66A) (12A)       | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     | LTE B66             | 20              | 67236    | 2190         | 2x2     |                     |                 |          |              |         |                     |                 | 25.19    | 25.19        |
| CA 2A (4A) 12A           | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 2x2     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     |                     |                 |          |              |         |                     |                 | 21.17    | 21.16        |
| CA 16A (12A) 32A         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B30             | 10              | 9820     | 2355         | 2x2     |                     |                 |          |              |         |                     |                 | 26.13    | 26.13        |
| CA 16A (12A) 32A         | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     |                     |                 |          |              |         |                     |                 | 26.17    | 26.17        |
| CA 4A (16A) 12A (1)      | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B64             | 20              | 2175     | 2123.5       | 2x2     | LTE B67             | 20              | 3190     | 2055         | 4x4     |                     |                 |          |              |         |                     |                 | 21.14    | 21.14        |
| CA 4A (16A) 12A (2)      | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     | LTE B30             | 10              | 9820     | 2355         | 2x2     |                     |                 |          |              |         |                     |                 | 21.14    | 21.14        |
| CA 4A (16A) 12A (3)      | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     | LTE B30             | 10              | 9820     | 2355         | 2x2     |                     |                 |          |              |         |                     |                 | 21.14    | 21.14        |
| CA 4A (16A) 12A (4)      | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     | LTE B64             | 20              | 2310     | 2150         | 4x4     |                     |                 |          |              |         |                     |                 | 21.11    | 21.16        |
| CA 16A (12A) (16A) (1)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     | LTE B66             | 20              | 67236    | 2190         | 2x2     |                     |                 |          |              |         |                     |                 | 25.19    | 25.19        |
| CA 12A (12A) 66A (66A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B66             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 2x2     |                     |                 |          |              |         |                     |                 | 23.22    | 23.16        |
| CA 12A (12A) 66A (16A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     | LTE B66             | 20              | 67236    | 2190         | 4x4     |                     |                 | 23.20    | 23.16        |
| CA 12A (12A) (66C)       | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     | LTE B66             | 20              | 67236    | 2190         | 4x4     |                     |                 | 23.23    | 23.16        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 2x2     | LTE B62             | 20              | 66786    | 2145         | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 23.27    | 23.27        |
| CA 12A (12A) 66A (16A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 700      | 1940         | 2x2     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 23.27    | 23.16        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1940         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 23.29    | 23.16        |
| CA 16A (12A) 32A (16A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1940         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 23.29    | 23.16        |
| CA 16A (12A) 32A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1940         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 23.29    | 23.16        |
| CA 16A (12A) 32B         | LTE B12  | 5            | 23035   | 703.5   | QPSK        | 1    | 12     | 5335             | 731.5  | 2x2     | LTE B12             | 10              | 5107     | 7387         | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     |                     |                 | 24.97    | 24.89        |
| CA 12A (16A) 12A (1)     | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B64             | 20              | 2175     | 2123.5       | 4x4     | LTE B12             | 10              | 5107     | 7387         | 2x2     |                     |                 | 25.95    | 25.54        |
| CA 12A (16A) 12A (6A)    | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B67             | 20              | 3190     | 2055         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 2x2     |                     |                 | 25.95    | 25.54        |
| CA 16A (12A) 32A (16A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B67             | 20              | 3190     | 2055         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 25.96    | 25.54        |
| CA 16A (12A) 32A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B67             | 20              | 3190     | 2055         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 25.96    | 25.54        |
| CA 12A (12A) 66A (16A)   | LTE B12  | 5            | 23035   | 703.5   | QPSK        | 1    | 12     | 5335             | 731.5  | 2x2     | LTE B12             | 10              | 5107     | 7387         | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B12             | 10              | 5107     | 7387         | 2x2     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)   | LTE B12  | 10           | 23095   | 707.5   | QPSK        | 1    | 48     | 5095             | 737.5  | 2x2     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B62             | 20              | 900      | 1960         | 4x4     | LTE B66             | 20              | 66786    | 2145         | 4x4     |                     |                 | 26.20    | 26.01        |
| CA 12A (12A) 66A (12A)</ |          |              |         |         |             |      |        |                  |        |         |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 |          |              |         |                     |                 |          |              |

#### 1.4.4 LTE Band 13 as PCC

**Table 15**  
**Maximum Output Powers**

[illegible]

|                                           |                                                                                                                            |                                                                                                 |                                        |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|
| FCC ID: ZNFV600TM                         |  <b>PCTEST</b><br>SAR EVALUATION REPORT |  <b>LG</b> | <b>Reviewed by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/25/19 - 02/03/20 | <b>DUT Type:</b><br>Portable Handset                                                                                       | APPENDIX F:<br>Page 6 of 9                                                                      |                                        |

### 1.4.5 LTE Band 66 as PCC

**Table 16**  
**Maximum Output Powers**

[illegible]

### 1.4.6 LTE Band 25 as PCC

**Table 17**  
**Maximum Output Powers**

|                    |          | PCC          |              |                      |      |           |                  |              |                      |                 |          | SCC 1        |              |                      |                 |          |              | SCC 2        |                      |                 |          |              |              | SCC 3                |                 |                                    |                                   |  |  | Power |  |
|--------------------|----------|--------------|--------------|----------------------|------|-----------|------------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|------------------------------------|-----------------------------------|--|--|-------|--|
| Combination        | PCC Band | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC [DL] Ch. | PCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | LTE Tx Power with CA Enabled [dBm] | LTE Single Carrier Tx Power [dBm] |  |  |       |  |
| CA [25A]-[25A] (1) | LTE B25  | 10           | 26640        | 1910                 | QPSK | 1         | 49               | 8640         | 1990                 | 4x4             | LTE B25  | 20           | 8140         | 1940                 | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | -               | 25.19                              | 25.20                             |  |  |       |  |
| CA [25A]-[46C]     | LTE B25  | 10           | 26640        | 1910                 | QPSK | 1         | 49               | 8640         | 1990                 | 4x4             | LTE B46  | 20           | 50665        | 5537.5               | 2x2             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | -               | 25.19                              | 25.20                             |  |  |       |  |
| CA [25A]-[46C]     | LTE B25  | 10           | 26640        | 1910                 | QPSK | 1         | 49               | 8640         | 1990                 | 4x4             | LTE B46  | 20           | 50665        | 5537.5               | 2x2             | LTE B46  | 20           | 50467        | 5517.7               | 2x2             | -        | -            | -            | -                    | -               | 25.19                              | 25.20                             |  |  |       |  |
| CA [25A]-[46D]     | LTE B25  | 10           | 26640        | 1910                 | QPSK | 1         | 49               | 8640         | 1990                 | 4x4             | LTE B46  | 20           | 50665        | 5537.5               | 2x2             | LTE B46  | 20           | 50467        | 5517.7               | 2x2             | LTE B46  | 20           | 50683        | 5557.3               | 2x2             | 25.18                              | 25.20                             |  |  |       |  |

### 1.4.7 LTE Band 30 as PCC

**Table 18**  
**Maximum Output Powers**

| Combination          | PCC Band | PCC          |             |                      |      |           |                  |            |                      | SCC1            |          |              |            |                      |                 | SCC2     |              |            |                      |                 |          | SCC3         |            |                      |                 |                                    |                                   | Power |  |
|----------------------|----------|--------------|-------------|----------------------|------|-----------|------------------|------------|----------------------|-----------------|----------|--------------|------------|----------------------|-----------------|----------|--------------|------------|----------------------|-----------------|----------|--------------|------------|----------------------|-----------------|------------------------------------|-----------------------------------|-------|--|
|                      |          | PCC BW [MHz] | PCC U/L Ch. | PCC (UL) Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC DL Ch. | PCC (DL) Freq. [MHz] | Dl Ant. Config. | SCC Band | SCC BW [MHz] | SCC DL Ch. | SCC (DL) Freq. [MHz] | Dl Ant. Config. | SCC Band | SCC BW [MHz] | SCC DL Ch. | SCC (DL) Freq. [MHz] | Dl Ant. Config. | SCC Band | SCC BW [MHz] | SCC DL Ch. | SCC (DL) Freq. [MHz] | Dl Ant. Config. | LTE Tx Power with CA Enabled [dBm] | LTE Single Carrier Tx Power (dBm) |       |  |
| CA {2A}-4A-30A       | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B2   | 20           | 900        | 1960                 | 4x4             | LTE B4   | 20           | 2175       | 2132.5               | 2x2             | -        | -            | -          | -                    | -               | -                                  | 22.21                             | 22.25 |  |
| CA {2A}-5A-30A       | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B2   | 20           | 900        | 1960                 | 4x4             | LTE B5   | 10           | 2525       | 881.5                | 2x2             | -        | -            | -          | -                    | -               | -                                  | 22.26                             | 22.25 |  |
| CA 2A-{4A}-30A       | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B2   | 20           | 900        | 1960                 | 2x2             | LTE B4   | 20           | 2175       | 2132.5               | 4x4             | -        | -            | -          | -                    | -               | -                                  | 22.22                             | 22.25 |  |
| CA {2A}-12A-30A      | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B2   | 20           | 900        | 1960                 | 4x4             | LTE B12  | 10           | 5095       | 737.5                | 2x2             | -        | -            | -          | -                    | -               | -                                  | 22.19                             | 22.25 |  |
| CA {4A}-12A-30A      | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B4   | 20           | 2175       | 2132.5               | 4x4             | LTE B12  | 10           | 5095       | 737.5                | 2x2             | -        | -            | -          | -                    | -               | -                                  | 22.21                             | 22.25 |  |
| CA {4A}-5A-30A       | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B4   | 20           | 2175       | 2132.5               | 4x4             | LTE B5   | 10           | 2525       | 881.5                | 2x2             | -        | -            | -          | -                    | -               | -                                  | 22.21                             | 22.25 |  |
| CA {2A}-{4A}-20A-30A | LTE E30  | 5            | 27710       | 2310                 | QPSK | 1         | 12               | 9820       | 2355                 | 2x2             | LTE B2   | 20           | 900        | 1960                 | 4x4             | LTE B4   | 20           | 2175       | 2132.5               | 4x4             | LTE B20  | 10           | 9715       | 722.5                | 2x2             | 22.47                              | 22.25                             |       |  |

|                                           |                                                                                                   |                            |                                                                                                 |                                        |
|-------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|
| FCC ID: ZNFV600TM                         |  <b>PCTEST</b> | SAR EVALUATION REPORT      |  <b>LG</b> | <b>Reviewed by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/25/19 - 02/03/20 | <b>DUT Type:</b><br>Portable Handset                                                              | APPENDIX F:<br>Page 7 of 9 |                                                                                                 |                                        |

### 1.4.8 LTE Band 7 as PCC

**Table 19**  
**Maximum Output Powers**

[illegible]

#### 1.4.9 LTE Band 41 PC3 as PCC

**Table 20**  
**Maximum Output Powers**

| Combination    | PCC      |                |                     |               |            |                  |              |                     |                 |          | SEC 1        |              |                     |                 | SEC 2    |              |              |                     | SEC 3           |          |              |              | SEC 4               |                 |          |              | Power        |                     |                 |                   |                                  |  |
|----------------|----------|----------------|---------------------|---------------|------------|------------------|--------------|---------------------|-----------------|----------|--------------|--------------|---------------------|-----------------|----------|--------------|--------------|---------------------|-----------------|----------|--------------|--------------|---------------------|-----------------|----------|--------------|--------------|---------------------|-----------------|-------------------|----------------------------------|--|
|                | PCC Band | PCC Freq [MHz] | PCC [kQ] Freq [MHz] | PCC [kQ] Mod. | PCC-ULF RB | PCC-UL RB Offset | PCC [DL] Ch. | PCC [DL] Freq [MHz] | DL Ant. Config. | SEC Band | SEC BW [MHz] | SEC [DL] Ch. | SEC [DL] Freq [MHz] | DL Ant. Config. | SEC Band | SEC BW [MHz] | SEC [DL] Ch. | SEC [DL] Freq [MHz] | DL Ant. Config. | SEC Band | SEC BW [MHz] | SEC [DL] Ch. | SEC [DL] Freq [MHz] | DL Ant. Config. | SEC Band | SEC BW [MHz] | SEC [DL] Ch. | SEC [DL] Freq [MHz] | DL Ant. Config. | LE Tx Power (dBm) | LE Single Carrier Tx Power (dBm) |  |
| CA_41A-41A (1) | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 2x2      |              |              |                     |                 |          |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A-41A (2) | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 2x2      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A-41A (3) | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A-41C     | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 2x2      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41C-41A     | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41C-41A (2) | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 2x2      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (12)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (13)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (14)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (15)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (16)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (17)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (18)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (19)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |
| CA_41A (20)    | LTE B41  | 10             | 40180               | 25A9.5        | QPSK       | 1                | 25           | 40180               | 25A9.5          | 4x4      | LTE B41      | 20           | 41290               | 26B0.2          | 4x4      | LTE B41      | 20           | 41490               | 26B0            | 4x4      |              |              |                     |                 |          |              |              |                     |                 |                   |                                  |  |

#### 1.4.10 LTE Band 41 PC2 as PCC

**Table 21**  
**Maximum Output Powers**

| Combination     | PCC          |              |                      |               |            |                  |                   |                          |                 |              | SEC 1        |                      |                 |          | SEC 2        |                      |                 |          | SEC 3        |                      |                 |          | SEC 4        |                      |                 |                             | Power                       |       |       |
|-----------------|--------------|--------------|----------------------|---------------|------------|------------------|-------------------|--------------------------|-----------------|--------------|--------------|----------------------|-----------------|----------|--------------|----------------------|-----------------|----------|--------------|----------------------|-----------------|----------|--------------|----------------------|-----------------|-----------------------------|-----------------------------|-------|-------|
|                 | PCC Band     | PCC BW [MHz] | PCC [CA] Freq. [MHz] | PCC [CA] Mod. | PCC LUT RB | PCC US RB Offset | PCC [CA] DC [MHz] | PCC [CA] DLS Freq. [MHz] | DL Ant. Config. | SBC Band     | SBC BW [MHz] | SBC [CA] Freq. [MHz] | DL Ant. Config. | SBC Band | SBC BW [MHz] | SBC [CA] Freq. [MHz] | DL Ant. Config. | SBC Band | SBC BW [MHz] | SBC [CA] Freq. [MHz] | DL Ant. Config. | SBC Band | SBC BW [MHz] | SBC [CA] Freq. [MHz] | DL Ant. Config. | LTE Power with US CA (EnbH) | LTE Single Carrier Tx Power |       |       |
| CA 4A4A-4A (1)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41490                | 2680            | 2x2      | -            | -                    | -               | -        | -            | -                    | -               | -        | -            | -                    | -               | -                           | 27.38                       | 27.38 |       |
| CA 4A4A-4A (2)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 2x2             | LTE B4A PCC2 | 20           | 41490                | 2680            | 4A4      | -            | -                    | -               | -        | -            | -                    | -               | -        | -            | -                    | -               | -                           | 27.38                       | 27.38 |       |
| CA 4A4A-4A (3)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41490                | 2680            | 2x2      | -            | -                    | -               | -        | -            | -                    | -               | -        | -            | -                    | -               | -                           | 27.38                       | 27.38 |       |
| CA 4A4A-4A (4)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 2x2             | LTE B4A PCC2 | 20           | 41490                | 2680            | 4A4      | -            | -                    | -               | -        | -            | -                    | -               | -        | -            | -                    | -               | -                           | 27.38                       | 27.38 |       |
| CA 4A4A-4A (5)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 2x2             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41490           | 2680     | 4A4          | -                    | -               | -        | -            | -                    | -               | -                           | 27.39                       | 27.38 |       |
| CA 4A4A-4A (6)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 39948                | 2525.8          | 4A4      | LTE B4A PCC2 | 20                   | 41490           | 2680     | 2x2          | -                    | -               | -        | -            | -                    | -               | -                           | 27.39                       | 27.38 |       |
| CA 4A4A-4A (7)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 2x2      | LTE B4A PCC2 | 20                   | 41490           | 2680     | 4A4          | -                    | -               | -        | -            | -                    | -               | -                           | 27.38                       | 27.38 |       |
| CA 4A4A-4A (8)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 2x2             | LTE B4A PCC2 | 20           | 39948                | 2525.8          | 2x2      | LTE B4A PCC2 | 20                   | 41490           | 2680     | 4A4          | -                    | -               | -        | -            | -                    | -               | -                           | 27.38                       | 27.38 |       |
| CA 4A4A-4A (9)  | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (10) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (11) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 39948                | 2525.8          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (12) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 39948                | 2525.8          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (13) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (14) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (15) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (16) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (17) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (18) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (19) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (20) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (21) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (22) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (23) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (24) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (25) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (26) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (27) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (28) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (29) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (30) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (31) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (32) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (33) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (34) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (35) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (36) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (37) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (38) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (39) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (40) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (41) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (42) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (43) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (44) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         | 20              | 41490    | 2680         | 4A4                  | -               | -                           | -                           | 27.45 | 27.38 |
| CA 4A4A-4A (45) | LTE B4A PCC2 | 20           | 39750                | 256Q          | OPMx       | 1                | 39750             | 200                      | 4A4             | LTE B4A PCC2 | 20           | 41292                | 2660.2          | 4A4      | LTE B4A PCC2 | 20                   | 41292           | 2660.2   | 4A4          | LTE B4A PCC2         |                 |          |              |                      |                 |                             |                             |       |       |

#### 1.4.11 LTE Band 48 as PCC

**Table 22**  
**Maximum Output Powers**

| PCC            |          |              |              |                      |      |           |                  |              |                      | SCC1            |          |              |              | SCC2                 |                 |          |              | SCC3         |                      |                 |          | Power        |              |                      |                 |                                       |                                   |       |
|----------------|----------|--------------|--------------|----------------------|------|-----------|------------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|----------|--------------|--------------|----------------------|-----------------|---------------------------------------|-----------------------------------|-------|
| Combination    | PCC Band | PCC BW [MHz] | PCC [UL] Ch. | PCC [UL] Freq. [MHz] | Mod. | PCC UL RB | PCC UL RB Offset | PCC [DL] Ch. | PCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | SCC Band | SCC BW [MHz] | SCC [DL] Ch. | SCC [DL] Freq. [MHz] | DL Ant. Config. | LTE Tx Power with DL CA Enabled (dBm) | LTE Single Carrier Tx Power (dBm) |       |
| CA {4BA}+{4BA} | LTE B4B  | 15           | 56665        | 3692.5               | QPSK | 1         | 0                | 56665        | 3692.5               | 4x4             | LTE B4B  | 20           | 55340        | 3560                 | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | -               | -                                     | -                                 |       |
| CA {4BC}       | LTE B4B  | 15           | 56665        | 3692.5               | QPSK | 1         | 0                | 56665        | 3692.5               | 4x4             | LTE B4B  | 20           | 56494        | 3675.4               | 4x4             | -        | -            | -            | -                    | -               | -        | -            | -            | -                    | -               | -                                     | 23.67                             |       |
| CA {4BD}       | LTE B4B  | 15           | 56665        | 3692.5               | QPSK | 1         | 0                | 56665        | 3692.5               | 4x4             | LTE B4B  | 20           | 56494        | 3675.4               | 4x4             | LTE B4B  | 20           | 56296        | 3655.6               | 4x4             | -        | -            | -            | -                    | -               | -                                     | 23.67                             |       |
| CA {4BE}       | LTE B4B  | 15           | 56665        | 3692.5               | QPSK | 1         | 0                | 56665        | 3692.5               | 4x4             | LTE B4B  | 20           | 56494        | 3675.4               | 4x4             | LTE B4B  | 20           | 56296        | 3655.6               | 4x4             | -        | -            | -            | -                    | -               | -                                     | 23.67                             |       |
| CA {4BD}       | LTE B4B  | 15           | 56665        | 3692.5               | QPSK | 1         | 0                | 56665        | 3692.5               | 4x4             | LTE B4B  | 20           | 56494        | 3675.4               | 4x4             | LTE B4B  | 20           | 56296        | 3655.6               | 4x4             | LTE B4B  | 20           | 56098        | 3635.8               | 4x4             | -                                     | 23.70                             | 23.67 |

|                                           |                                                                                                   |                       |                                                                                                 |                                        |
|-------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|
| FCC ID: ZNFV600TM                         |  <b>PCTEST</b> | SAR EVALUATION REPORT |  <b>LG</b> | <b>Reviewed by:</b><br>Quality Manager |
| <b>Test Dates:</b><br>11/25/19 - 02/03/20 | <b>DUT Type:</b><br>Portable Handset                                                              |                       |                                                                                                 | APPENDIX F:<br>Page 8 of 9             |

## 1.5 Downlink Carrier Aggregation with CA\_41C Uplink Carrier Aggregation enabled

This device supports uplink carrier aggregation (ULCA) with additional Carrier Aggregation configurations active in the downlink. Power measurements were performed with ULCA active and additional CA configurations active in the downlink for the configuration per Fall 2017 TCB Workshop Notes.

Per FCC Guidance, additional SAR measurements for these configurations were not required since their maximum output power was not more than 0.25 dB higher than the maximum output power for with only ULCA active.

### 1.5.1 DL Carrier Aggregation RF Conducted Powers

**Table 23**  
Maximum Output Powers with LTE Band 41 PC3 as PCC

| Combination | PCC Band | PCC          |              |                      |            |            |                  |              |                      | SCC 1    |              |              |                      |            |            |                  |              | SCC 2                |          |              |              | Power                |                                                        |                     |
|-------------|----------|--------------|--------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|------------|------------|------------------|--------------|----------------------|----------|--------------|--------------|----------------------|--------------------------------------------------------|---------------------|
|             |          | PCC BW [MHz] | PCC (UL) Ch. | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (UL) Ch. | SCC (UL) Freq. [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | SCC Band | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | ULCA Tx Power with add'l CA config. active on DL (dBm) | ULCA Tx Power (dBm) |
| CA_41D      | LTE B41  | 20           | 39750        | 2506                 | QPSK       | 1          | 99               | 39750        | 2506                 | LTE B41  | 20           | 39948        | 2525.8               | QPSK       | 1          | 0                | 39948        | 2525.8               | LTE B41  | 20           | 40146        | 2545.6               | 25.20                                                  | 25.20               |

**Table 24**  
Maximum Output Powers with LTE Band 41 PC2 as PCC

| Combination | PCC Band    | PCC          |              |                      |            |            |                  |              |                      |             |              | SCC 1        |                      |            |            |                  |              |                      |             |              |              | SCC 2                |                                                        |                     |  | Power |  |
|-------------|-------------|--------------|--------------|----------------------|------------|------------|------------------|--------------|----------------------|-------------|--------------|--------------|----------------------|------------|------------|------------------|--------------|----------------------|-------------|--------------|--------------|----------------------|--------------------------------------------------------|---------------------|--|-------|--|
|             |             | PCC BW [MHz] | PCC (UL) Ch. | PCC (UL) Freq. [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Ch. | PCC (DL) Freq. [MHz] | SCC Band    | SCC BW [MHz] | SCC (UL) Ch. | SCC (UL) Freq. [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | SCC Band    | SCC BW [MHz] | SCC (DL) Ch. | SCC (DL) Freq. [MHz] | ULCA Tx Power with add'l CA config. active on DL (dBm) | ULCA Tx Power (dBm) |  |       |  |
|             |             |              |              |                      |            |            |                  |              |                      |             |              |              |                      |            |            |                  |              |                      |             |              |              |                      |                                                        |                     |  |       |  |
| CA_41D      | LTE B41 PC2 | 20           | 39750        | 2506                 | QPSK       | 1          | 99               | 39750        | 2506                 | LTE B41 PC2 | 20           | 39948        | 2525.8               | QPSK       | 1          | 0                | 39948        | 2525.8               | LTE B41 PC2 | 20           | 40146        | 2545.6               | 27.22                                                  | 27.24               |  |       |  |

### 1.5.2 DL Carrier Aggregation with DL 4x4 MIMO RF Conducted Powers

Note: 4x4 DL MIMO is only operating in the downlink. Uplink transmission is limited to a single output stream for each component carrier of ULCA.

**Table 25**  
Maximum Output Powers with LTE Band 41 PC3 as PCC

| Combination | PCC      |                     |                  |                          |            |            |                  |                  |                          |                 | SCC      |                     |                  |                          |                 | Power                                                  |                     |
|-------------|----------|---------------------|------------------|--------------------------|------------|------------|------------------|------------------|--------------------------|-----------------|----------|---------------------|------------------|--------------------------|-----------------|--------------------------------------------------------|---------------------|
|             | PCC Band | PCC Bandwidth [MHz] | PCC (UL) Channel | PCC (UL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Frequency [MHz] | DL Ant. Config. | SCC Band | SCC Bandwidth [MHz] | SCC (DL) Channel | SCC (DL) Frequency [MHz] | DL Ant. Config. | ULCA Tx Power with add'l CA config. active on DL (dbm) | ULCA Tx Power (dbm) |
| CA_41C (1)  | LTE B41  | 20                  | 39750            | 2506                     | QPSK       | 1          | 99               | 39750            | 2506                     | 4x4             | LTE B41  | 20                  | 39948            | 2525.8                   | 4x4             | 25.16                                                  | 25.20               |

| Combination | PCC           |                  |                          |            |            |                  |                  |                          |                 |          | SCC 1         |              |                      |            |            |                  |                  |                          |                 |          | SCC 2         |                  |                          |                 |                                                        |                     |       |  |  |  | Power |  |
|-------------|---------------|------------------|--------------------------|------------|------------|------------------|------------------|--------------------------|-----------------|----------|---------------|--------------|----------------------|------------|------------|------------------|------------------|--------------------------|-----------------|----------|---------------|------------------|--------------------------|-----------------|--------------------------------------------------------|---------------------|-------|--|--|--|-------|--|
|             | PCC Bandwidth | PCC (UL) Channel | PCC (UL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Frequency [MHz] | DL Ant. Config. | SCC Band | SCC Bandwidth | SCC (UL) Ch. | SCC (UL) Freq. [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | SCC (DL) Channel | SCC (DL) Frequency [MHz] | DL Ant. Config. | SCC Band | SCC Bandwidth | SCC (DL) Channel | SCC (DL) Frequency [MHz] | DL Ant. Config. | ULCA Tx Power with add'l CA config. active on DL (dBm) | ULCA Tx Power (dBm) |       |  |  |  |       |  |
| CA_41D1     | LTE B41       | 20               | 39750                    | 2506       | CPHSE      | 1                | 99               | 39750                    | 2506            | 4x4      | LTE B41       | 20           | 39948                | 2525.8     | CPHSE      | 1                | 0                | 39948                    | 2525.8          | 4x4      | LTE B41       | 20               | 40146                    | 2545.6          | 4x4                                                    | 25.18               | 25.20 |  |  |  |       |  |

**Table 26**  
Maximum Output Powers with LTE Band 41 PC2 as PCC

| Combination | PCC         |                     |                  |                          |            |            |                  |                  |                          | SCC             |             |                     |                  |                          | Power           |                                                        |                     |
|-------------|-------------|---------------------|------------------|--------------------------|------------|------------|------------------|------------------|--------------------------|-----------------|-------------|---------------------|------------------|--------------------------|-----------------|--------------------------------------------------------|---------------------|
|             | PCC Band    | PCC Bandwidth [MHz] | PCC (UL) Channel | PCC (UL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Frequency [MHz] | DL Ant. Config. | SCC Band    | SCC Bandwidth [MHz] | SCC (DL) Channel | SCC (DL) Frequency [MHz] | DL Ant. Config. | ULCA Tx Power with add'l CA config. active on DL (dbm) | ULCA Tx Power (dbm) |
| CA_41C (1)  | LTE B41 PC2 | 20                  | 39750            | 2506                     | QPSK       | 1          | 99               | 39750            | 2506                     | 4x4             | LTE B41 PC2 | 20                  | 39948            | 2525.8                   | 4x4             | 27.21                                                  | 27.24               |

| Combination | PCC         |                     |                  |                          |            |            |                  |                  |                          |                 | SCC 1       |                     |              |                      |            |            |                  |                  |                          |                 | SCC 2       |                     |                  |                          |                 |                                                        |                     |  |  |  | Power |  |
|-------------|-------------|---------------------|------------------|--------------------------|------------|------------|------------------|------------------|--------------------------|-----------------|-------------|---------------------|--------------|----------------------|------------|------------|------------------|------------------|--------------------------|-----------------|-------------|---------------------|------------------|--------------------------|-----------------|--------------------------------------------------------|---------------------|--|--|--|-------|--|
|             | PCC Band    | PCC Bandwidth [MHz] | PCC (UL) Channel | PCC (UL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | PCC (DL) Channel | PCC (DL) Frequency [MHz] | DL Ant. Config. | SCC Band    | SCC Bandwidth [MHz] | SCC (UL) Ch. | SCC (UL) Freq. [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | SCC (DL) Channel | SCC (DL) Frequency [MHz] | DL Ant. Config. | SCC Band    | SCC Bandwidth [MHz] | SCC (DL) Channel | SCC (DL) Frequency [MHz] | DL Ant. Config. | ULCA Tx Power with add'l CA config. active on DL (dBm) | ULCA Tx Power (dBm) |  |  |  |       |  |
| CA_41D      | LTE B41 PC2 | 20                  | 39750            | 2506                     | QPSK       | 1          | 99               | 39750            | 2506                     | 4x4             | LTE B41 PC2 | 20                  | 39948        | 2525.8               | QPSK       | 1          | 0                | 39948            | 2525.8                   | 4x4             | LTE B41 PC2 | 20                  | 40146            | 2545.6                   | 4x4             | 27.22                                                  | 27.24               |  |  |  |       |  |

|                                    |                                                                                                           |                                                                                       |                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 - 02/03/20 | DUT Type:<br>Portable Handset                                                                             |                                                                                       | APPENDIX F:<br>Page 9 of 9      |

## APPENDIX G POWER REDUCTION VERIFICATION

Per the May 2017 TCBC Workshop Notes, demonstration of proper functioning of the power reduction mechanisms is required to support the corresponding SAR configurations. The verification process was divided into two parts: (1) evaluation of output power levels for individual or multiple triggering mechanisms and (2) evaluation of the triggering distances for proximity-based sensors.

### G.1 Power Verification Procedure

The power verification was performed according to the following procedure:

1. A base station simulator was used to establish a conducted RF connection and the output power was monitored. The power measurements were confirmed to be within expected tolerances for all states before and after a power reduction mechanism was triggered.
2. Step 1 was repeated for all relevant modes and frequency bands for the mechanism being investigated.
3. Steps 1 and 2 were repeated for all individual power reduction mechanisms and combinations thereof. For the combination cases, one mechanism was switched to a 'triggered' state at a time; powers were confirmed to be within tolerances after each additional mechanism was activated.

### G.2 Distance Verification Procedure

The distance verification procedure was performed according to the following procedure:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 and FCC Guidance. Each applicable test position was evaluated. The distances were confirmed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
3. Steps 1 and 2 were repeated for low, mid, and high bands, as appropriate (see note below Table G-2 for more details).
4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX G:<br>Page 1 of 3      |

### G.3 Main Antenna Verification Summary

**Table G-1**  
**Power Measurement Verification for Main Antenna**

| Mechanism(s) |            | Mode/Band       | Conducted Power (dBm) |                        |                        |
|--------------|------------|-----------------|-----------------------|------------------------|------------------------|
| 1st          | 2nd        |                 | Un-triggered (Max)    | Mechanism #1 (Reduced) | Mechanism #2 (Reduced) |
| Hotspot On   |            | UMTS 1750       | 25.06                 | 22.54                  |                        |
| Hotspot On   | Grip       | UMTS 1750       | 25.04                 | 22.54                  | 22.56                  |
| Grip         |            | UMTS 1750       | 25.05                 | 22.55                  |                        |
| Grip         | Hotspot On | UMTS 1750       | 25.04                 | 22.57                  | 22.54                  |
| Hotspot On   |            | UMTS 1900       | 25.02                 | 22.42                  |                        |
| Hotspot On   | Grip       | UMTS 1900       | 24.98                 | 22.42                  | 22.44                  |
| Grip         |            | UMTS 1900       | 24.99                 | 22.45                  |                        |
| Grip         | Hotspot On | UMTS 1900       | 25.01                 | 22.44                  | 22.43                  |
| Hotspot On   |            | PCS EVDO        | 25.18                 | 22.67                  |                        |
| Hotspot On   | Grip       | PCS EVDO        | 25.19                 | 22.70                  | 22.66                  |
| Grip         |            | PCS EVDO        | 25.15                 | 22.67                  |                        |
| Grip         | Hotspot On | PCS EVDO        | 25.16                 | 22.68                  | 22.69                  |
| Hotspot On   |            | LTE FDD Band 4  | 25.02                 | 22.53                  |                        |
| Hotspot On   | Grip       | LTE FDD Band 4  | 25.02                 | 22.52                  | 22.51                  |
| Grip         |            | LTE FDD Band 4  | 25.01                 | 22.53                  |                        |
| Grip         | Hotspot On | LTE FDD Band 4  | 25.03                 | 22.52                  | 22.50                  |
| Hotspot On   |            | LTE FDD Band 66 | 24.90                 | 22.43                  |                        |
| Hotspot On   | Grip       | LTE FDD Band 66 | 24.91                 | 22.40                  | 22.40                  |
| Grip         |            | LTE FDD Band 66 | 24.95                 | 22.41                  |                        |
| Grip         | Hotspot On | LTE FDD Band 66 | 24.92                 | 22.44                  | 22.43                  |
| Hotspot On   |            | LTE FDD Band 2  | 24.82                 | 22.39                  |                        |
| Hotspot On   | Grip       | LTE FDD Band 2  | 24.81                 | 22.36                  | 22.33                  |
| Grip         |            | LTE FDD Band 2  | 24.80                 | 22.35                  |                        |
| Grip         | Hotspot On | LTE FDD Band 2  | 24.79                 | 22.37                  | 22.32                  |
| Hotspot On   |            | LTE FDD Band 25 | 25.15                 | 22.67                  |                        |
| Hotspot On   | Grip       | LTE FDD Band 25 | 25.12                 | 22.68                  | 22.69                  |
| Grip         |            | LTE FDD Band 25 | 25.17                 | 22.67                  |                        |
| Grip         | Hotspot On | LTE FDD Band 25 | 25.18                 | 22.68                  | 22.66                  |
| Hotspot On   |            | LTE FDD Band 7  | 23.49                 | 21.52                  |                        |
| Hotspot On   | Grip       | LTE FDD Band 7  | 23.52                 | 21.50                  | 21.51                  |
| Grip         |            | LTE FDD Band 7  | 23.51                 | 21.52                  |                        |
| Grip         | Hotspot On | LTE FDD Band 7  | 23.50                 | 21.51                  | 21.53                  |

|                                    |                                                                                                   |                       |                                                                                                 |                                 |
|------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  <b>PCTEST</b> | SAR EVALUATION REPORT |  <b>LG</b> | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                                     |                       |                                                                                                 | APPENDIX G:<br>Page 2 of 3      |

**Table G-2**  
**Distance Measurement Verification for Main Antenna**

| Mechanism(s) | Test Condition        | Band | Distance Measurements (mm) |             | Minimum Distance per Manufacturer (mm) |
|--------------|-----------------------|------|----------------------------|-------------|----------------------------------------|
|              |                       |      | Moving Toward              | Moving Away |                                        |
| Grip         | Phablet - Back Side   | Mid  | 4                          | 6           | 3                                      |
| Grip         | Phablet - Back Side   | High | 4                          | 6           | 3                                      |
| Grip         | Phablet - Front Side  | Mid  | 4                          | 6           | 2                                      |
| Grip         | Phablet - Front Side  | High | 4                          | 6           | 2                                      |
| Grip         | Phablet - Bottom Edge | Mid  | 5                          | 7           | 4                                      |
| Grip         | Phablet - Bottom Edge | High | 5                          | 7           | 4                                      |

\*Note: Mid band refers to: CDMA BC1, UMTS B2/4, LTE B4/66/2/25. High band refers to LTE B7.

## G.4 WIFI Verification Summary

**Table G-3**  
**Power Measurement Verification WIFI – Antenna 1**

| Mechanism(s) | Mode/Band         | Conducted Power (dBm) |                        |
|--------------|-------------------|-----------------------|------------------------|
|              |                   | Un-triggered (Max)    | Mechanism #1 (Reduced) |
| 1st          |                   |                       |                        |
| Held-to-Ear  | 802.11b           | 18.99                 | 15.12                  |
| Held-to-Ear  | 802.11g           | 19.28                 | 15.45                  |
| Held-to-Ear  | 802.11n (2.4GHz)  | 16.54                 | 15.14                  |
| Held-to-Ear  | 802.11ac (2.4GHz) | 16.69                 | 15.16                  |

\*Note: MIMO WIFI modes were not evaluated due to equipment limitations.

**Table G-4**  
**Power Measurement Verification WIFI – Antenna 2**

| Mechanism(s) | Mode/Band         | Conducted Power (dBm) |                        |
|--------------|-------------------|-----------------------|------------------------|
|              |                   | Un-triggered (Max)    | Mechanism #1 (Reduced) |
| 1st          |                   |                       |                        |
| Held-to-Ear  | 802.11b           | 19.06                 | 15.23                  |
| Held-to-Ear  | 802.11g           | 19.45                 | 15.49                  |
| Held-to-Ear  | 802.11n (2.4GHz)  | 16.78                 | 15.31                  |
| Held-to-Ear  | 802.11ac (2.4GHz) | 17.10                 | 15.44                  |

\*Note: MIMO WIFI modes were not evaluated due to equipment limitations.

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX G:<br>Page 3 of 3      |

## APPENDIX H: IEEE 802.11AX RU SAR EXCLUSION

### 1.1 IEEE 802.11ax RU SAR Exclusion

To make the most efficient use of the additional available subcarriers (data tones), IEEE 802.11ax can utilize Orthogonal Frequency-Division Multiple Access (OFDMA) which divides the existing 802.11 channels into smaller subchannels called Resource Units (RUs). Possible RU sizes are: 26T, 52T, 106T, 242T, 484T and 996T.

Per FCC Guidance, 802.11ax was considered a higher order 802.11 mode when compared to a/b/g/n/ac to apply KDB Publication 248227 D01v02r02 for OFDM mode selection. Therefore, SAR tests were not required for 802.11ax based on the maximum allowed output powers of OFDM modes and the reported SAR values. Per FCC Guidance, maximum conducted powers were performed for each RU size to demonstrate that the output powers would not be higher than the other OFDM 802.11 modes.

### 1.2 IEEE 802.11ax RU Target Powers

#### 1.2.1 Maximum 802.11ax RU WLAN Output Power

| Tones |         | SISO (ANT1/2) /in dBm |            |            |            | MIMO (ALL) /in dBm |            |            |            |
|-------|---------|-----------------------|------------|------------|------------|--------------------|------------|------------|------------|
|       |         | 2.4GHz                | 5GHz/20MHz | 5GHz/40MHz | 5GHz/80MHz | 2.4GHz             | 5GHz/20MHz | 5GHz/40MHz | 5GHz/80MHz |
| 26T   | Maximum | 10.0                  | 10.0       | 10.0       | 10.0       | 13.0               | 13.0       | 13.0       | 13.0       |
|       | Nominal | 9.0                   | 9.0        | 9.0        | 9.0        | 12.0               | 12.0       | 12.0       | 12.0       |
| 52T   | Maximum | 10.0                  | 10.0       | 10.0       | 10.0       | 13.0               | 13.0       | 13.0       | 13.0       |
|       | Nominal | 9.0                   | 9.0        | 9.0        | 9.0        | 12.0               | 12.0       | 12.0       | 12.0       |
| 106T  | Maximum | 10.0                  | 10.0       | 10.0       | 10.0       | 13.0               | 13.0       | 13.0       | 13.0       |
|       | Nominal | 9.0                   | 9.0        | 9.0        | 9.0        | 12.0               | 12.0       | 12.0       | 12.0       |
| 242T  | Maximum | 10.0                  | 10.0       | 10.0       | 10.0       | 13.0               | 13.0       | 13.0       | 13.0       |
|       | Nominal | 9.0                   | 9.0        | 9.0        | 9.0        | 12.0               | 12.0       | 12.0       | 12.0       |
| 484T  | Maximum |                       |            | 10.0       | 10.0       |                    |            | 13.0       | 13.0       |
|       | Nominal |                       |            | 9.0        | 9.0        |                    |            | 12.0       | 12.0       |
| 996T  | Maximum |                       |            |            | 10.0       |                    |            |            | 13.0       |
|       | Nominal |                       |            |            | 9.0        |                    |            |            | 12.0       |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 1 of 9      |

### 1.3 IEEE 802.11ax Measured Powers

**Table 1**  
**Maximum 2.4 GHz 802.11ax RU Output Power – Ant 1**

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 26T   | 0        | 8.80                       |
|            |         |       | 4        | 8.78                       |
|            |         |       | 8        | 9.37                       |
| 2437       | 6       | 26T   | 0        | 9.16                       |
|            |         |       | 4        | 9.02                       |
|            |         |       | 8        | 8.45                       |
| 2462       | 11      | 26T   | 0        | 8.41                       |
|            |         |       | 4        | 8.61                       |
|            |         |       | 8        | 8.33                       |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 52T   | 37       | 8.85                       |
|            |         |       | 38       | 8.82                       |
|            |         |       | 40       | 9.23                       |
| 2437       | 6       | 52T   | 37       | 9.13                       |
|            |         |       | 38       | 9.18                       |
|            |         |       | 40       | 8.50                       |
| 2462       | 11      | 52T   | 37       | 8.50                       |
|            |         |       | 38       | 8.69                       |
|            |         |       | 40       | 8.44                       |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 106T  | 53       | 9.05                       |
|            |         |       | 54       | 9.32                       |
| 2437       | 6       | 106T  | 53       | 9.32                       |
|            |         |       | 54       | 9.02                       |
| 2462       | 11      | 106T  | 53       | 8.77                       |
|            |         |       | 54       | 9.03                       |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 242T  | 61       | 9.09                       |
| 2437       | 6       | 242T  | 61       | 9.26                       |
| 2462       | 11      | 242T  | 61       | 9.15                       |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 2 of 9      |

**Table 2**  
**Maximum 2.4 GHz 802.11ax RU Output Power – Ant 2**

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 26T   | 0        | 9.63                       |
|            |         |       | 4        | 9.09                       |
|            |         |       | 8        | 9.47                       |
| 2437       | 6       | 26T   | 0        | 9.36                       |
|            |         |       | 4        | 9.55                       |
|            |         |       | 8        | 9.05                       |
| 2462       | 11      | 26T   | 0        | 9.11                       |
|            |         |       | 4        | 9.31                       |
|            |         |       | 8        | 9.22                       |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 52T   | 37       | 9.56                       |
|            |         |       | 38       | 9.28                       |
|            |         |       | 40       | 9.33                       |
| 2437       | 6       | 52T   | 37       | 9.49                       |
|            |         |       | 38       | 9.65                       |
|            |         |       | 40       | 9.19                       |
| 2462       | 11      | 52T   | 37       | 9.24                       |
|            |         |       | 38       | 9.23                       |
|            |         |       | 40       | 9.27                       |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 106T  | 53       | 9.52                       |
|            |         |       | 54       | 9.45                       |
| 2437       | 6       | 106T  | 53       | 9.68                       |
|            |         |       | 54       | 9.34                       |
| 2462       | 11      | 106T  | 53       | 9.35                       |
|            |         |       | 54       | 9.42                       |

| Freq [MHz] | Channel | Tones | RU Index | Avg Conducted Powers (dBm) |
|------------|---------|-------|----------|----------------------------|
| 2412       | 1       | 242T  | 61       | 9.63                       |
| 2437       | 6       | 242T  | 61       | 9.77                       |
| 2462       | 11      | 242T  | 61       | 9.56                       |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
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| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 3 of 9      |

**Table 3**  
**Maximum 5 GHz 802.11ax RU Output Power – Ant 1**

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 0                         | 4    | 8    |
| 1        |      | 5180       | 36      | 26T   | 9.03                      | 9.16 | 9.21 |
|          |      | 5200       | 40      | 26T   | 9.02                      | 9.07 | 9.06 |
|          |      | 5240       | 48      | 26T   | 9.06                      | 9.06 | 9.06 |
| 2A       |      | 5260       | 52      | 26T   | 9.03                      | 9.04 | 9.04 |
|          |      | 5280       | 56      | 26T   | 9.03                      | 9.02 | 9.03 |
|          |      | 5320       | 64      | 26T   | 9.06                      | 9.06 | 9.01 |
| 2C       |      | 5500       | 100     | 26T   | 9.07                      | 9.11 | 9.05 |
|          |      | 5600       | 120     | 26T   | 9.17                      | 9.05 | 9.09 |
|          |      | 5720       | 144     | 26T   | 9.12                      | 9.10 | 9.18 |
| 3        |      | 5745       | 149     | 26T   | 9.09                      | 9.06 | 9.02 |
|          |      | 5785       | 157     | 26T   | 9.59                      | 9.59 | 9.55 |
|          |      | 5825       | 165     | 26T   | 9.12                      | 9.45 | 9.44 |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 37                        | 39   | 40   |
| 1        |      | 5180       | 36      | 52T   | 9.31                      | 9.35 | 9.29 |
|          |      | 5200       | 40      | 52T   | 9.12                      | 9.27 | 9.11 |
|          |      | 5240       | 48      | 52T   | 9.09                      | 9.15 | 9.04 |
| 2A       |      | 5260       | 52      | 52T   | 9.08                      | 9.14 | 9.01 |
|          |      | 5280       | 56      | 52T   | 9.05                      | 9.05 | 9.03 |
|          |      | 5320       | 64      | 52T   | 9.03                      | 9.13 | 9.04 |
| 2C       |      | 5500       | 100     | 52T   | 9.13                      | 9.17 | 9.15 |
|          |      | 5600       | 120     | 52T   | 9.15                      | 9.27 | 9.17 |
|          |      | 5720       | 144     | 52T   | 9.29                      | 9.28 | 9.18 |
| 3        |      | 5745       | 149     | 52T   | 9.11                      | 9.23 | 9.11 |
|          |      | 5785       | 157     | 52T   | 9.63                      | 9.74 | 9.54 |
|          |      | 5825       | 165     | 52T   | 9.58                      | 9.65 | 9.49 |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |     |
|----------|------|------------|---------|-------|---------------------------|------|-----|
|          |      |            |         |       | RU Index                  |      |     |
|          |      |            |         |       | 53                        | 54   | N/A |
| 1        |      | 5180       | 36      | 106T  | 9.40                      | 9.42 |     |
|          |      | 5200       | 40      | 106T  | 9.18                      | 9.25 |     |
|          |      | 5240       | 48      | 106T  | 9.19                      | 9.23 |     |
| 2A       |      | 5260       | 52      | 106T  | 9.22                      | 9.14 |     |
|          |      | 5280       | 56      | 106T  | 9.16                      | 9.14 |     |
|          |      | 5320       | 64      | 106T  | 9.15                      | 9.17 |     |
| 2C       |      | 5500       | 100     | 106T  | 9.25                      | 9.33 |     |
|          |      | 5600       | 120     | 106T  | 9.29                      | 9.25 |     |
|          |      | 5720       | 144     | 106T  | 9.38                      | 9.34 |     |
| 3        |      | 5745       | 149     | 106T  | 9.30                      | 9.30 |     |
|          |      | 5785       | 157     | 106T  | 9.75                      | 9.75 |     |
|          |      | 5825       | 165     | 106T  | 9.66                      | 9.65 |     |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 61                        | N/A | N/A |
| 1        |      | 5180       | 36      | 242T  | 9.54                      |     |     |
|          |      | 5200       | 40      | 242T  | 9.31                      |     |     |
|          |      | 5240       | 48      | 242T  | 9.41                      |     |     |
| 2A       |      | 5260       | 52      | 242T  | 9.35                      |     |     |
|          |      | 5280       | 56      | 242T  | 9.30                      |     |     |
|          |      | 5320       | 64      | 242T  | 9.36                      |     |     |
| 2C       |      | 5500       | 100     | 242T  | 9.45                      |     |     |
|          |      | 5600       | 120     | 242T  | 9.47                      |     |     |
|          |      | 5720       | 144     | 242T  | 9.54                      |     |     |
| 3        |      | 5745       | 149     | 242T  | 9.45                      |     |     |
|          |      | 5785       | 157     | 242T  | 9.92                      |     |     |
|          |      | 5825       | 165     | 242T  | 9.83                      |     |     |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
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| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 0                         | 8    | 17   |
| 1        | 2A   | 5190       | 38      | 26T   | 9.05                      | 9.53 | 9.03 |
|          |      | 5230       | 46      | 26T   | 9.03                      | 9.46 | 9.02 |
|          |      | 5270       | 54      | 26T   | 9.02                      | 9.45 | 9.04 |
| 2C       | 2A   | 5310       | 62      | 26T   | 9.02                      | 9.58 | 9.03 |
|          |      | 5510       | 102     | 26T   | 9.25                      | 9.79 | 9.18 |
|          |      | 5590       | 118     | 26T   | 9.09                      | 9.63 | 9.15 |
| 3        | 2C   | 5710       | 142     | 26T   | 9.26                      | 9.54 | 9.16 |
|          |      | 5755       | 151     | 26T   | 9.36                      | 9.48 | 9.29 |
|          |      | 5795       | 159     | 26T   | 9.71                      | 9.97 | 9.12 |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 37                        | 40   | 44   |
| 1        | 2A   | 5190       | 38      | 52T   | 9.17                      | 9.54 | 9.07 |
|          |      | 5230       | 46      | 52T   | 9.14                      | 9.52 | 9.05 |
|          |      | 5270       | 54      | 52T   | 9.07                      | 9.43 | 9.01 |
| 2C       | 2A   | 5310       | 62      | 52T   | 9.13                      | 9.54 | 9.02 |
|          |      | 5510       | 102     | 52T   | 9.37                      | 9.71 | 9.33 |
|          |      | 5590       | 118     | 52T   | 9.16                      | 9.63 | 9.20 |
| 3        | 2C   | 5710       | 142     | 52T   | 9.31                      | 9.75 | 9.23 |
|          |      | 5755       | 151     | 52T   | 9.52                      | 9.86 | 9.34 |
|          |      | 5795       | 159     | 52T   | 9.77                      | 9.97 | 9.67 |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 53                        | 54   | 56   |
| 1        | 2A   | 5190       | 38      | 106T  | 9.38                      | 9.61 | 9.23 |
|          |      | 5230       | 46      | 106T  | 9.31                      | 9.57 | 9.24 |
|          |      | 5270       | 54      | 106T  | 9.22                      | 9.51 | 9.15 |
| 2C       | 2A   | 5310       | 62      | 106T  | 9.35                      | 9.54 | 9.25 |
|          |      | 5510       | 102     | 106T  | 9.59                      | 9.87 | 9.51 |
|          |      | 5590       | 118     | 106T  | 9.40                      | 9.70 | 9.45 |
| 3        | 2C   | 5710       | 142     | 106T  | 9.55                      | 9.80 | 9.50 |
|          |      | 5755       | 151     | 106T  | 9.74                      | 9.95 | 9.67 |
|          |      | 5795       | 159     | 106T  | 9.94                      | 9.99 | 9.90 |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |     |
|----------|------|------------|---------|-------|---------------------------|------|-----|
|          |      |            |         |       | RU Index                  |      |     |
|          |      |            |         |       | 61                        | 62   | N/A |
| 1        | 2A   | 5190       | 38      | 242T  | 9.55                      | 9.51 |     |
|          |      | 5230       | 46      | 242T  | 9.46                      | 9.46 |     |
|          |      | 5270       | 54      | 242T  | 9.41                      | 9.41 |     |
| 2C       | 2A   | 5310       | 62      | 242T  | 9.49                      | 9.46 |     |
|          |      | 5510       | 102     | 242T  | 9.69                      | 9.67 |     |
|          |      | 5590       | 118     | 242T  | 9.59                      | 9.55 |     |
| 3        | 2C   | 5710       | 142     | 242T  | 9.74                      | 9.66 |     |
|          |      | 5755       | 151     | 242T  | 9.83                      | 9.78 |     |
|          |      | 5795       | 159     | 242T  | 9.98                      | 9.94 |     |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 65                        | N/A | N/A |
| 1        | 2A   | 5190       | 38      | 484T  | 9.49                      |     |     |
|          |      | 5230       | 46      | 484T  | 9.41                      |     |     |
|          |      | 5270       | 54      | 484T  | 9.45                      |     |     |
| 2C       | 2A   | 5310       | 62      | 484T  | 9.48                      |     |     |
|          |      | 5510       | 102     | 484T  | 9.75                      |     |     |
|          |      | 5590       | 118     | 484T  | 9.67                      |     |     |
| 3        | 2C   | 5710       | 142     | 484T  | 9.75                      |     |     |
|          |      | 5755       | 151     | 484T  | 9.90                      |     |     |
|          |      | 5795       | 159     | 484T  | 9.97                      |     |     |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
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| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 0                         | 18   | 36   |
|          | 1    | 5210       | 42      | 26T   | 9.08                      | 9.35 | 9.03 |
|          | 2A   | 5290       | 58      | 26T   | 9.07                      | 9.39 | 9.06 |
|          | 2C   | 5530       | 106     | 26T   | 9.23                      | 9.59 | 9.09 |
|          |      | 5610       | 122     | 26T   | 9.03                      | 9.34 | 9.06 |
|          |      | 5690       | 138     | 26T   | 9.37                      | 9.62 | 9.18 |
|          | 3    | 5775       | 155     | 26T   | 9.61                      | 9.90 | 9.32 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 37                        | 44   | 52   |
|          | 1    | 5210       | 42      | 52T   | 9.03                      | 9.25 | 9.53 |
|          | 2A   | 5290       | 58      | 52T   | 9.09                      | 9.34 | 9.03 |
|          | 2C   | 5530       | 106     | 52T   | 9.18                      | 9.53 | 9.35 |
|          |      | 5610       | 122     | 52T   | 9.05                      | 9.39 | 9.17 |
|          |      | 5690       | 138     | 52T   | 9.35                      | 9.68 | 9.24 |
|          | 3    | 5775       | 155     | 52T   | 9.68                      | 9.50 | 9.55 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 53                        | 56   | 60   |
|          | 1    | 5210       | 42      | 106T  | 9.16                      | 9.46 | 9.03 |
|          | 2A   | 5290       | 58      | 106T  | 9.17                      | 9.44 | 9.06 |
|          | 2C   | 5530       | 106     | 106T  | 9.27                      | 9.60 | 9.35 |
|          |      | 5610       | 122     | 106T  | 9.14                      | 9.48 | 9.21 |
|          |      | 5690       | 138     | 106T  | 9.40                      | 9.75 | 9.24 |
|          | 3    | 5775       | 155     | 106T  | 9.79                      | 9.95 | 9.57 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 61                        | 62   | 64   |
|          | 1    | 5210       | 42      | 242T  | 9.33                      | 9.48 | 9.24 |
|          | 2A   | 5290       | 58      | 242T  | 9.46                      | 9.57 | 9.22 |
|          | 2C   | 5530       | 106     | 242T  | 9.48                      | 9.65 | 9.49 |
|          |      | 5610       | 122     | 242T  | 9.39                      | 9.55 | 9.23 |
|          |      | 5690       | 138     | 242T  | 9.58                      | 9.80 | 9.39 |
|          | 3    | 5775       | 155     | 242T  | 9.92                      | 9.97 | 9.78 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |     |
|----------|------|------------|---------|-------|---------------------------|------|-----|
|          |      |            |         |       | RU Index                  |      |     |
|          |      |            |         |       | 65                        | 66   | N/A |
|          | 1    | 5210       | 42      | 484T  | 9.47                      | 9.40 |     |
|          | 2A   | 5290       | 58      | 484T  | 9.53                      | 9.44 |     |
|          | 2C   | 5530       | 106     | 484T  | 9.65                      | 9.59 |     |
|          |      | 5610       | 122     | 484T  | 9.49                      | 9.41 |     |
|          |      | 5690       | 138     | 484T  | 9.75                      | 9.55 |     |
|          | 3    | 5775       | 155     | 484T  | 9.98                      | 9.92 |     |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 67                        | N/A | N/A |
|          | 1    | 5210       | 42      | 996T  | 9.31                      |     |     |
|          | 2A   | 5290       | 58      | 996T  | 9.31                      |     |     |
|          | 2C   | 5530       | 106     | 996T  | 9.49                      |     |     |
|          |      | 5610       | 122     | 996T  | 9.33                      |     |     |
|          |      | 5690       | 138     | 996T  | 9.63                      |     |     |
|          | 3    | 5775       | 155     | 996T  | 9.85                      |     |     |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 6 of 9      |

**Table 4**  
**Maximum 5 GHz 802.11ax RU Output Power – Ant 2**

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 0                         | 4    | 8    |
| 1        |      | 5180       | 36      | 26T   | 9.25                      | 9.59 | 9.45 |
|          |      | 5200       | 40      | 26T   | 9.66                      | 9.70 | 9.62 |
|          |      | 5240       | 48      | 26T   | 9.68                      | 9.75 | 9.63 |
| 2A       |      | 5260       | 52      | 26T   | 9.77                      | 9.76 | 9.62 |
|          |      | 5280       | 56      | 26T   | 9.71                      | 9.72 | 9.62 |
|          |      | 5320       | 64      | 26T   | 9.59                      | 9.20 | 9.49 |
| 2C       |      | 5500       | 100     | 26T   | 9.31                      | 9.25 | 9.35 |
|          |      | 5600       | 120     | 26T   | 9.66                      | 9.84 | 9.82 |
|          |      | 5720       | 144     | 26T   | 9.50                      | 9.72 | 9.62 |
| 3        |      | 5745       | 149     | 26T   | 9.28                      | 9.43 | 9.37 |
|          |      | 5785       | 157     | 26T   | 9.52                      | 9.59 | 9.58 |
|          |      | 5825       | 165     | 26T   | 9.38                      | 9.45 | 9.56 |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 37                        | 39   | 40   |
| 1        |      | 5180       | 36      | 52T   | 9.64                      | 9.74 | 9.60 |
|          |      | 5200       | 40      | 52T   | 9.62                      | 9.75 | 9.63 |
|          |      | 5240       | 48      | 52T   | 9.71                      | 9.79 | 9.65 |
| 2A       |      | 5260       | 52      | 52T   | 9.85                      | 9.85 | 9.71 |
|          |      | 5280       | 56      | 52T   | 9.72                      | 9.79 | 9.59 |
|          |      | 5320       | 64      | 52T   | 9.61                      | 9.56 | 9.38 |
| 2C       |      | 5500       | 100     | 52T   | 9.51                      | 9.59 | 9.47 |
|          |      | 5600       | 120     | 52T   | 9.75                      | 9.89 | 9.81 |
|          |      | 5720       | 144     | 52T   | 9.66                      | 9.60 | 9.65 |
| 3        |      | 5745       | 149     | 52T   | 9.35                      | 9.50 | 9.41 |
|          |      | 5785       | 157     | 52T   | 9.53                      | 9.66 | 9.55 |
|          |      | 5825       | 165     | 52T   | 9.35                      | 9.63 | 9.50 |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |     |
|----------|------|------------|---------|-------|---------------------------|------|-----|
|          |      |            |         |       | RU Index                  |      |     |
|          |      |            |         |       | 53                        | 54   | N/A |
| 1        |      | 5180       | 36      | 106T  | 9.73                      | 9.80 |     |
|          |      | 5200       | 40      | 106T  | 9.83                      | 9.79 |     |
|          |      | 5240       | 48      | 106T  | 9.87                      | 9.86 |     |
| 2A       |      | 5260       | 52      | 106T  | 9.89                      | 9.69 |     |
|          |      | 5280       | 56      | 106T  | 9.92                      | 9.80 |     |
|          |      | 5320       | 64      | 106T  | 9.75                      | 9.63 |     |
| 2C       |      | 5500       | 100     | 106T  | 9.65                      | 9.65 |     |
|          |      | 5600       | 120     | 106T  | 9.87                      | 9.97 |     |
|          |      | 5720       | 144     | 106T  | 9.81                      | 9.78 |     |
| 3        |      | 5745       | 149     | 106T  | 9.51                      | 9.53 |     |
|          |      | 5785       | 157     | 106T  | 9.56                      | 9.73 |     |
|          |      | 5825       | 165     | 106T  | 9.69                      | 9.74 |     |

| 20MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 61                        | N/A | N/A |
| 1        |      | 5180       | 36      | 242T  | 9.93                      |     |     |
|          |      | 5200       | 40      | 242T  | 9.96                      |     |     |
|          |      | 5240       | 48      | 242T  | 9.94                      |     |     |
| 2A       |      | 5260       | 52      | 242T  | 9.98                      |     |     |
|          |      | 5280       | 56      | 242T  | 9.97                      |     |     |
|          |      | 5320       | 64      | 242T  | 9.88                      |     |     |
| 2C       |      | 5500       | 100     | 242T  | 9.81                      |     |     |
|          |      | 5600       | 120     | 242T  | 9.96                      |     |     |
|          |      | 5720       | 144     | 242T  | 9.91                      |     |     |
| 3        |      | 5745       | 149     | 242T  | 9.70                      |     |     |
|          |      | 5785       | 157     | 242T  | 9.90                      |     |     |
|          |      | 5825       | 165     | 242T  | 9.88                      |     |     |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 7 of 9      |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 0                         | 8    | 17   |
| 1        |      | 5190       | 38      | 26T   | 9.63                      | 9.95 | 9.57 |
|          |      | 5230       | 46      | 26T   | 9.66                      | 9.97 | 9.49 |
|          |      | 5270       | 54      | 26T   | 9.85                      | 9.47 | 9.65 |
| 2A       |      | 5310       | 62      | 26T   | 9.75                      | 9.96 | 9.40 |
|          |      | 5510       | 102     | 26T   | 9.63                      | 9.92 | 9.59 |
|          |      | 5590       | 118     | 26T   | 9.69                      | 9.24 | 9.89 |
| 2C       |      | 5710       | 142     | 26T   | 9.70                      | 9.96 | 9.51 |
|          |      | 5755       | 151     | 26T   | 9.48                      | 9.93 | 9.51 |
|          |      | 5795       | 159     | 26T   | 9.24                      | 9.32 | 9.87 |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 37                        | 40   | 44   |
| 1        |      | 5190       | 38      | 52T   | 9.65                      | 9.94 | 9.65 |
|          |      | 5230       | 46      | 52T   | 9.74                      | 9.96 | 9.56 |
|          |      | 5270       | 54      | 52T   | 9.86                      | 9.49 | 9.69 |
| 2A       |      | 5310       | 62      | 52T   | 9.84                      | 9.98 | 9.47 |
|          |      | 5510       | 102     | 52T   | 9.78                      | 9.95 | 9.66 |
|          |      | 5590       | 118     | 52T   | 9.82                      | 9.26 | 9.94 |
| 2C       |      | 5710       | 142     | 52T   | 9.77                      | 9.97 | 9.83 |
|          |      | 5755       | 151     | 52T   | 9.52                      | 9.90 | 9.58 |
|          |      | 5795       | 159     | 52T   | 9.82                      | 9.32 | 9.91 |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 53                        | 54   | 56   |
| 1        |      | 5190       | 38      | 106T  | 9.87                      | 9.98 | 9.89 |
|          |      | 5230       | 46      | 106T  | 9.89                      | 9.97 | 9.79 |
|          |      | 5270       | 54      | 106T  | 9.97                      | 9.61 | 9.93 |
| 2A       |      | 5310       | 62      | 106T  | 9.91                      | 9.96 | 9.78 |
|          |      | 5510       | 102     | 106T  | 9.95                      | 9.98 | 9.86 |
|          |      | 5590       | 118     | 106T  | 9.96                      | 9.33 | 9.97 |
| 2C       |      | 5710       | 142     | 106T  | 9.96                      | 9.26 | 9.96 |
|          |      | 5755       | 151     | 106T  | 9.70                      | 9.93 | 9.77 |
|          |      | 5795       | 159     | 106T  | 9.92                      | 9.41 | 9.95 |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |     |
|----------|------|------------|---------|-------|---------------------------|------|-----|
|          |      |            |         |       | RU Index                  |      |     |
|          |      |            |         |       | 61                        | 62   | N/A |
| 1        |      | 5190       | 38      | 242T  | 9.96                      | 9.91 |     |
|          |      | 5230       | 46      | 242T  | 9.93                      | 9.95 |     |
|          |      | 5270       | 54      | 242T  | 9.41                      | 9.96 |     |
| 2A       |      | 5310       | 62      | 242T  | 9.97                      | 9.94 |     |
|          |      | 5510       | 102     | 242T  | 9.95                      | 9.95 |     |
|          |      | 5590       | 118     | 242T  | 9.93                      | 9.97 |     |
| 2C       |      | 5710       | 142     | 242T  | 9.94                      | 9.96 |     |
|          |      | 5755       | 151     | 242T  | 9.89                      | 9.85 |     |
|          |      | 5795       | 159     | 242T  | 9.97                      | 9.26 |     |

| 40MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 65                        | N/A | N/A |
| 1        |      | 5190       | 38      | 484T  | 9.92                      |     |     |
|          |      | 5230       | 46      | 484T  | 9.96                      |     |     |
|          |      | 5270       | 54      | 484T  | 9.98                      |     |     |
| 2A       |      | 5310       | 62      | 484T  | 9.95                      |     |     |
|          |      | 5510       | 102     | 484T  | 9.97                      |     |     |
|          |      | 5590       | 118     | 484T  | 9.93                      |     |     |
| 2C       |      | 5710       | 142     | 484T  | 9.96                      |     |     |
|          |      | 5755       | 151     | 484T  | 9.85                      |     |     |
|          |      | 5795       | 159     | 484T  | 9.98                      |     |     |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 8 of 9      |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 0                         | 18   | 36   |
|          | 1    | 5210       | 42      | 26T   | 9.70                      | 9.90 | 9.56 |
|          | 2A   | 5290       | 58      | 26T   | 9.91                      | 9.70 | 9.38 |
|          | 2C   | 5530       | 106     | 26T   | 9.50                      | 9.71 | 9.40 |
|          |      | 5610       | 122     | 26T   | 9.75                      | 9.25 | 9.23 |
|          |      | 5690       | 138     | 26T   | 9.60                      | 9.96 | 9.90 |
|          | 3    | 5775       | 155     | 26T   | 9.33                      | 9.85 | 9.63 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 37                        | 44   | 52   |
|          | 1    | 5210       | 42      | 52T   | 9.66                      | 9.93 | 9.63 |
|          | 2A   | 5290       | 58      | 52T   | 9.94                      | 9.96 | 9.55 |
|          | 2C   | 5530       | 106     | 52T   | 9.53                      | 9.78 | 9.51 |
|          |      | 5610       | 122     | 52T   | 9.81                      | 9.22 | 9.22 |
|          |      | 5690       | 138     | 52T   | 9.65                      | 9.98 | 9.94 |
|          | 3    | 5775       | 155     | 52T   | 9.56                      | 9.82 | 9.21 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 53                        | 56   | 60   |
|          | 1    | 5210       | 42      | 106T  | 9.84                      | 9.96 | 9.65 |
|          | 2A   | 5290       | 58      | 106T  | 9.95                      | 9.98 | 9.49 |
|          | 2C   | 5530       | 106     | 106T  | 9.63                      | 9.80 | 9.50 |
|          |      | 5610       | 122     | 106T  | 9.90                      | 9.23 | 9.24 |
|          |      | 5690       | 138     | 106T  | 9.75                      | 9.94 | 9.94 |
|          | 3    | 5775       | 155     | 106T  | 9.59                      | 9.85 | 9.62 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |      |
|----------|------|------------|---------|-------|---------------------------|------|------|
|          |      |            |         |       | RU Index                  |      |      |
|          |      |            |         |       | 61                        | 62   | 64   |
|          | 1    | 5210       | 42      | 242T  | 9.91                      | 9.96 | 9.77 |
|          | 2A   | 5290       | 58      | 242T  | 9.12                      | 9.12 | 9.75 |
|          | 2C   | 5530       | 106     | 242T  | 9.78                      | 9.89 | 9.66 |
|          |      | 5610       | 122     | 242T  | 9.91                      | 9.26 | 9.43 |
|          |      | 5690       | 138     | 242T  | 9.90                      | 9.95 | 9.95 |
|          | 3    | 5775       | 155     | 242T  | 9.73                      | 9.92 | 9.83 |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |      |     |
|----------|------|------------|---------|-------|---------------------------|------|-----|
|          |      |            |         |       | RU Index                  |      |     |
|          |      |            |         |       | 65                        | 66   | N/A |
|          | 1    | 5210       | 42      | 484T  | 9.93                      | 9.97 |     |
|          | 2A   | 5290       | 58      | 484T  | 9.15                      | 9.90 |     |
|          | 2C   | 5530       | 106     | 484T  | 9.86                      | 9.79 |     |
|          |      | 5610       | 122     | 484T  | 9.98                      | 9.48 |     |
|          |      | 5690       | 138     | 484T  | 9.96                      | 9.98 |     |
|          | 3    | 5775       | 155     | 484T  | 9.83                      | 9.96 |     |

| 80MHz BW | Band | Freq [MHz] | Channel | Tones | Avg Conducted Power (dBm) |     |     |
|----------|------|------------|---------|-------|---------------------------|-----|-----|
|          |      |            |         |       | RU Index                  |     |     |
|          |      |            |         |       | 67                        | N/A | N/A |
|          | 1    | 5210       | 42      | 996T  | 9.81                      |     |     |
|          | 2A   | 5290       | 58      | 996T  | 9.80                      |     |     |
|          | 2C   | 5530       | 106     | 996T  | 9.65                      |     |     |
|          |      | 5610       | 122     | 996T  | 9.98                      |     |     |
|          |      | 5690       | 138     | 996T  | 9.96                      |     |     |
|          | 3    | 5775       | 155     | 996T  | 9.83                      |     |     |

|                                    |                                                                                     |                       |                                                                                       |                                 |
|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------|
| FCC ID: ZNFV600TM                  |  | SAR EVALUATION REPORT |  | Reviewed by:<br>Quality Manager |
| Test Dates:<br>11/25/19 – 02/03/20 | DUT Type:<br>Portable Handset                                                       |                       |                                                                                       | APPENDIX H:<br>Page 9 of 9      |

## APPENDIX I: PROBE AND DIPOLE CALIBRATION CERTIFICATES

**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**

Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D750V3-1003\_Jan18**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN:1003**

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

Calibration date: **January 15, 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: **Leli Klysner** Name  
Function: **Laboratory Technician**

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

Signature

*Leli Klysner*

*Katja Pokovic*

Issued: January 15, 2018

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

## Calibration Laboratory of

Schmid & Partner

Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

### 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 | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 mm    |             |
| Frequency                    | 750 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 41.9           | 0.89 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.9 $\pm$ 6 % | 0.90 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.10 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.28 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.37 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.42 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

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

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.15 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 8.58 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.43 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 5.71 W/kg $\pm$ 16.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.8 $\Omega$ - 2.1 j $\Omega$ |
| Return Loss                          | - 27.6 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.2 $\Omega$ - 6.2 j $\Omega$ |
| Return Loss                          | - 24.0 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.043 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

|                 |                  |
|-----------------|------------------|
| Manufactured by | SPEAG            |
| Manufactured on | January 21, 2009 |

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 1.98 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 7.94 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.33 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.32 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 2.05 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.22 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.38 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.52 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 2.01 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.06 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.38 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.52 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 1.67 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 6.70 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.15 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 4.60 W/kg ± 16.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 12.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003**

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.9$  S/m;  $\epsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

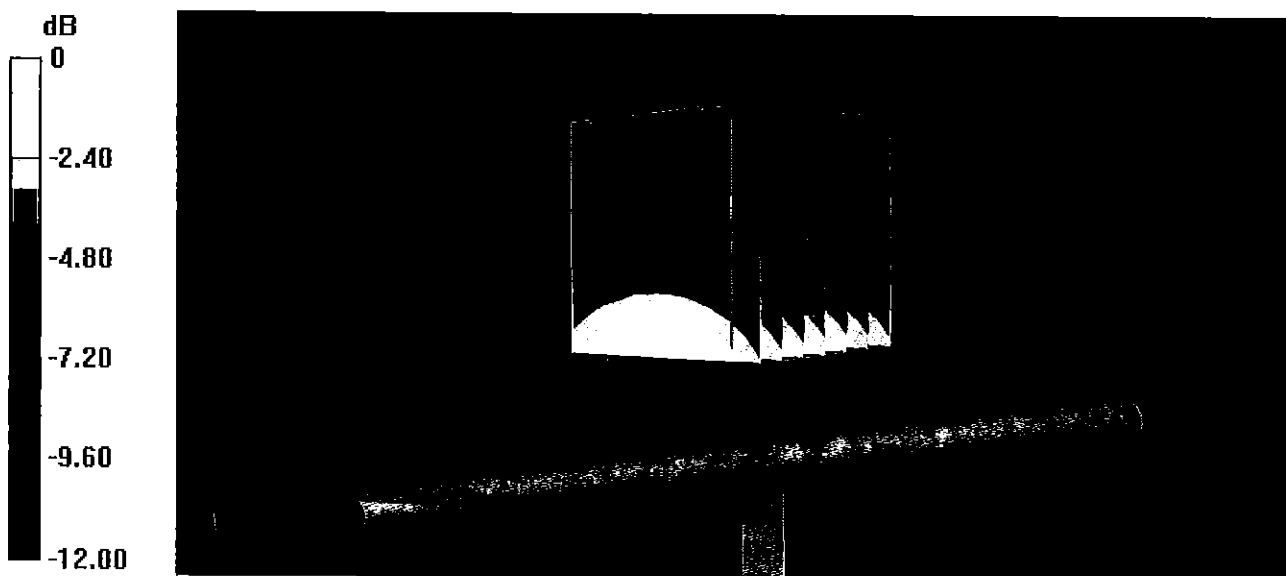
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 59.11 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.15 W/kg

**SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.37 W/kg**

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

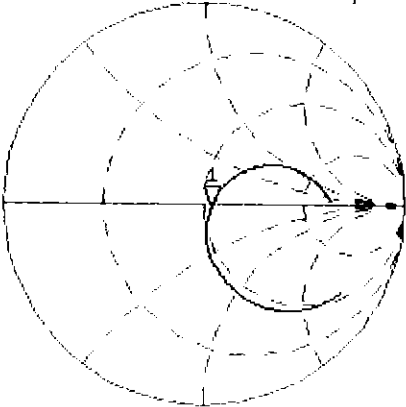


0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL

12 Jan 2018 13:14:07  
CH1 S11 1 U FS 1: 53.754  $\Omega$  -2.0996  $\Omega$  101.07 pF 750.000 000 MHz

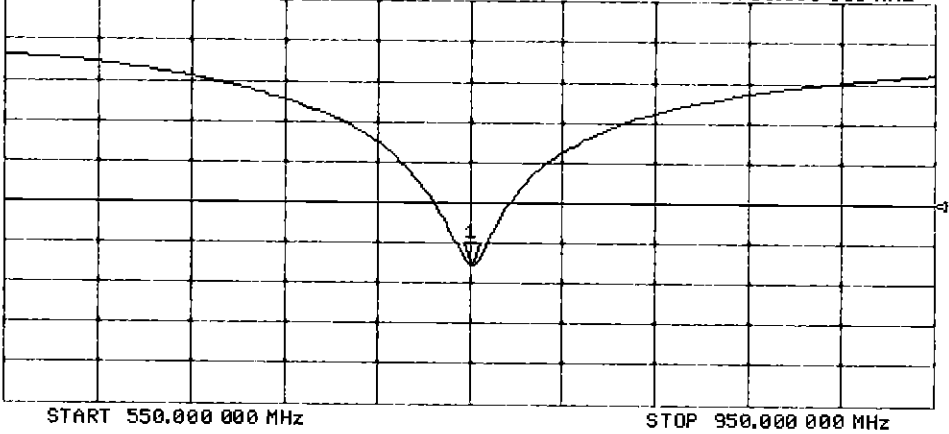
\*  
De1  
CA



Avg  
16  
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.643 dB 750.000 000 MHz

CA  
Avg  
16  
H1d



## DASY5 Validation Report for Body TSL

Date: 12.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 55$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x8x7)/Cube 0:**

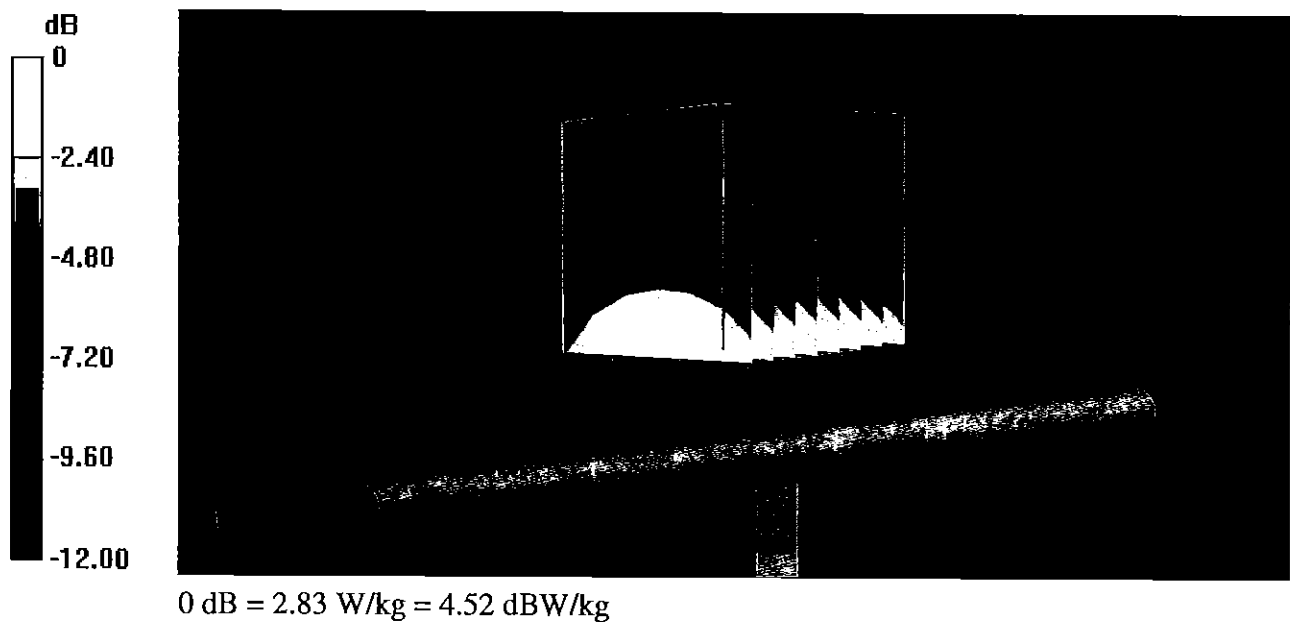
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 57.31 V/m; Power Drift = -0.01 dB

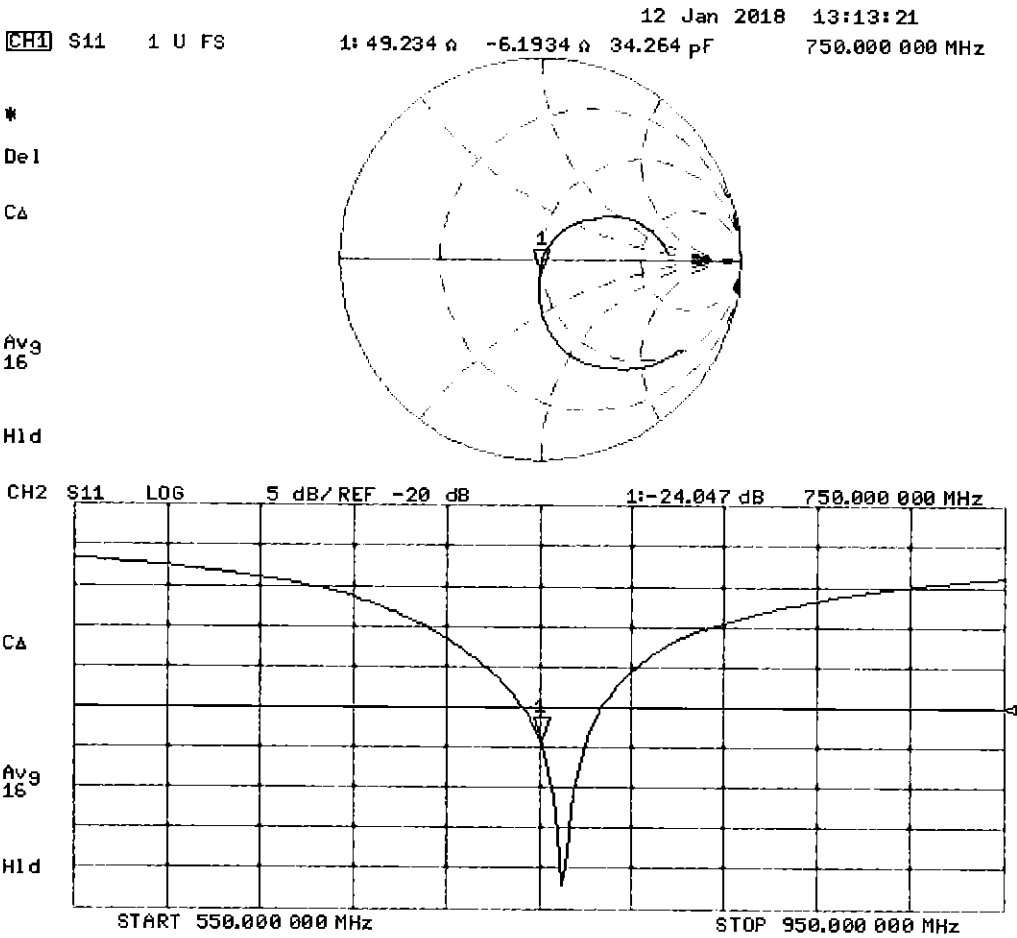
Peak SAR (extrapolated) = 3.17 W/kg

**SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.43 W/kg**

Maximum value of SAR (measured) = 2.83 W/kg



Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 15.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.9 \text{ S/m}$ ;  $\epsilon_r = 44.2$ ;  $\rho = 1000 \text{ kg/m}^3$

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: SAM Head
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**SAM Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.79 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 2.89 W/kg

**SAR(1 g) = 1.98 W/kg; SAR(10 g) = 1.33 W/kg**

Maximum value of SAR (measured) = 2.58 W/kg

**SAM Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.85 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 2.94 W/kg

**SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.62 W/kg

**SAM Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.29 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.78 W/kg

**SAR(1 g) = 2.01 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.56 W/kg

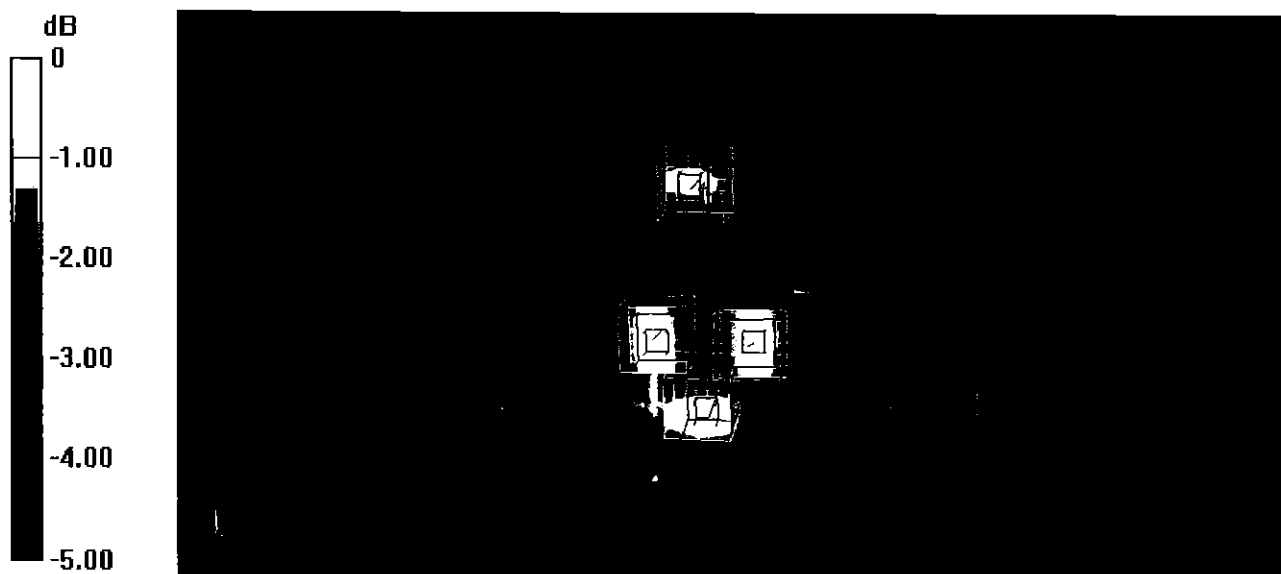
**SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 51.01 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 2.31 W/kg

**SAR(1 g) = 1.67 W/kg; SAR(10 g) = 1.15 W/kg**

Maximum value of SAR (measured) = 2.11 W/kg



0 dB = 2.58 W/kg = 4.12 dBW/kg

# Certification of Calibration

Object D750V3 – SN: 1003

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

Extension Calibration date: 1/15/2019

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                            | 2/8/2018   | Annual       | 2/8/2019   | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1207364       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1339018       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./Clock/Humidity Monitor                           | 3/31/2017  | Biennial     | 3/31/2019  | 170232394     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 5/2/2017   | Biennial     | 5/2/2019   | 170330156     |
| 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    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| Narda                 | 4772-3    | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Pasternack            | PE2208-6  | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 10/3/2018  | Annual       | 10/3/2019  | 1558          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 8/23/2018  | Annual       | 8/23/2019  | 7308          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 6/25/2018  | Annual       | 6/25/2019  | 7409          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

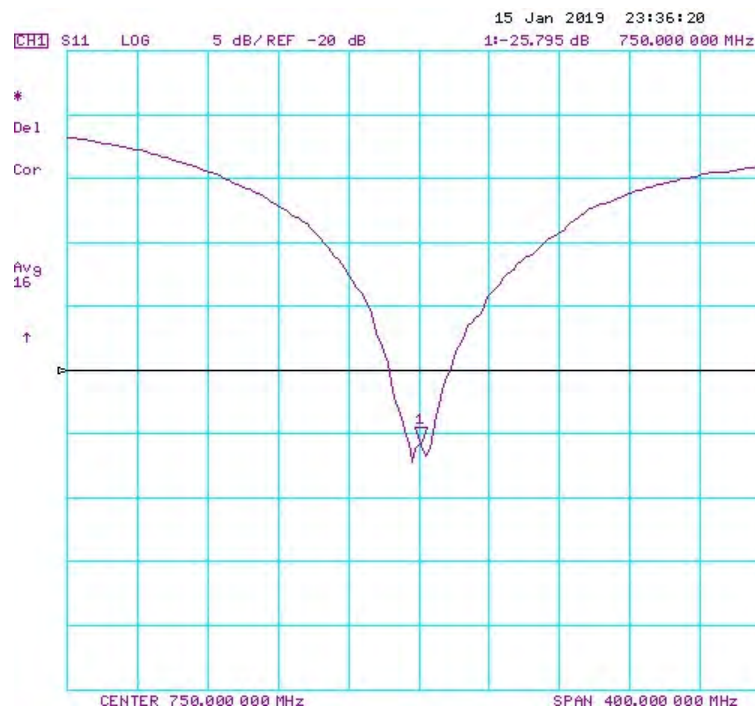
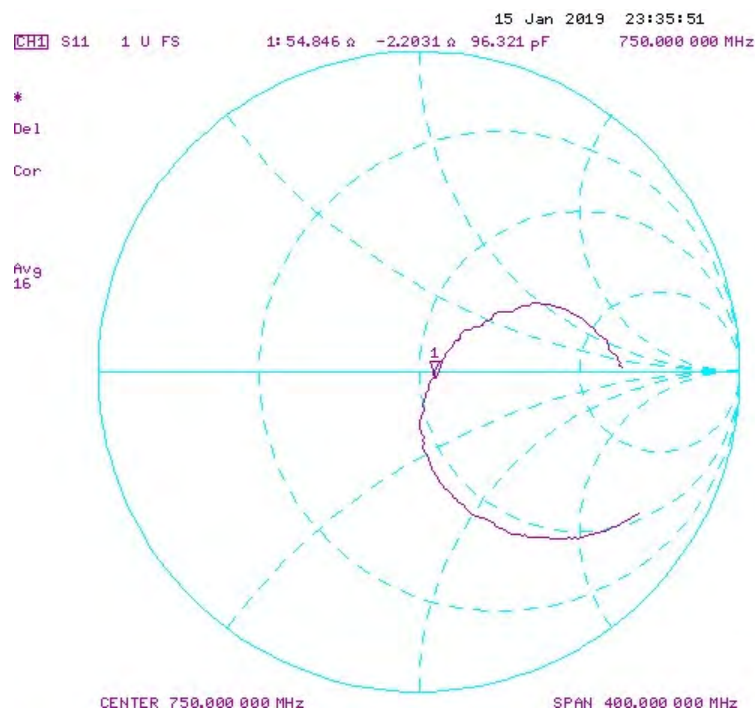
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

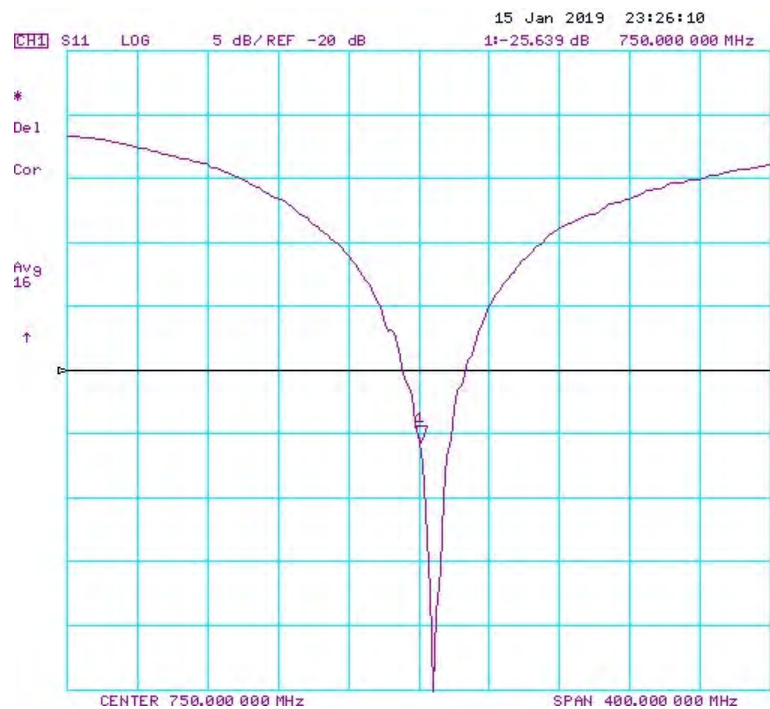
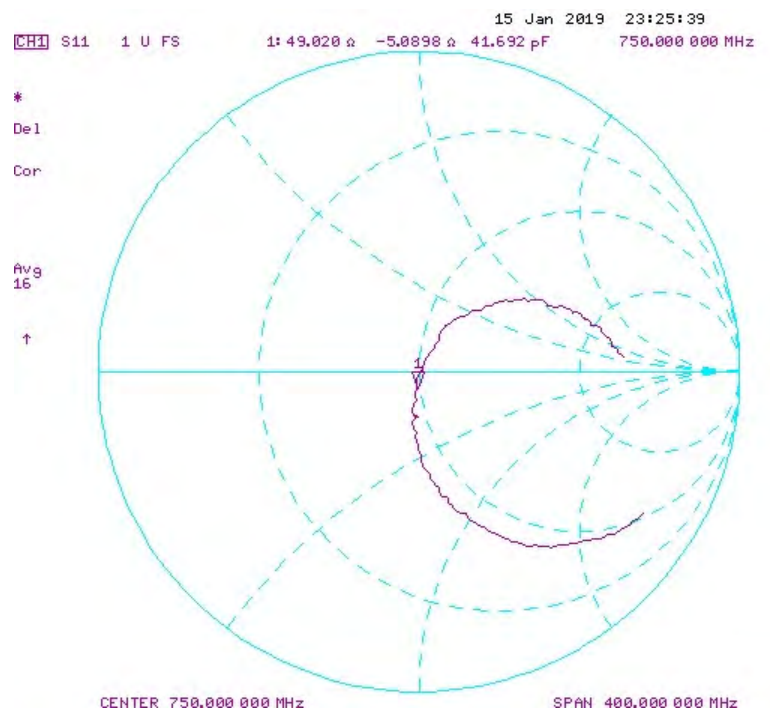
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 Head (10g) W/kg @ 23.0 dBm | Measured Head 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 1/15/2018        | 1/15/2019      | 1.043                             | 1.656                                            | 1.75                                   | 5.88%            | 1.08                                              | 1.15                                    | 6.09%             | 53.8                                  | 54.8                               | 1                     | -2.1                                       | -2.2                                    | 0.1                        | -27.6                             | -25.8                          | 6.50%         | 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 |
| 1/15/2018        | 1/15/2019      | 1.043                             | 1.716                                            | 1.84                                   | 7.23%            | 1.14                                              | 1.23                                    | 7.71%             | 49.2                                  | 49                                 | 0.2                   | -6.2                                       | -5.1                                    | 1.1                        | -24                               | -25.6                          | -6.80%        | 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: **D750V3-1054\_Mar19/2**

## CALIBRATION CERTIFICATE (Replacement of No:D750V3-1154\_Mar19)

Object **D750V3 - SN:1054**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

*BNV*  
*4-29-2019*

Calibration date: **March 18, 2019**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&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           | 31-Dec-18 (No. EX3-7349_Dec18)    | Dec-19                 |
| DAE4                            | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)    | Oct-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 07-Oct-15 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Manu Seitz**      Name: **Manu Seitz**      Function: **Laboratory Technician**

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

*[Signature of Manu Seitz]*  
*[Signature of Katja Pokovic]*

Issued: April 12, 2019

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Accreditation No.: **SCS 0108**

### Glossary:

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

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

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 mm    |             |
| Frequency                    | 750 MHz $\pm$ 1 MHz    |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 41.9           | 0.89 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 42.1 $\pm$ 6 % | 0.89 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.07 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.29 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.37 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.48 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.5           | 0.96 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 54.5 $\pm$ 6 % | 0.98 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 2.18 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 8.55 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 1.44 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 5.67 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 | 54.5 $\Omega$ - 0.3 j $\Omega$ |
| Return Loss                          | - 27.2 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.2 $\Omega$ - 3.0 j $\Omega$ |
| Return Loss                          | - 30.3 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.035 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 |
|-----------------|-------|

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 1.93 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 7.72 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.31 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.23 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 2.05 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.20 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.39 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.55 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 2.00 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 8.00 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.38 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.51 W/kg ± 16.9 % (k=2) |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 1.66 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 6.64 W/kg ± 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 1.14 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 4.55 W/kg ± 16.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1054**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.89 \text{ S/m}$ ;  $\epsilon_r = 42.1$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.32, 10.32, 10.32) @ 750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

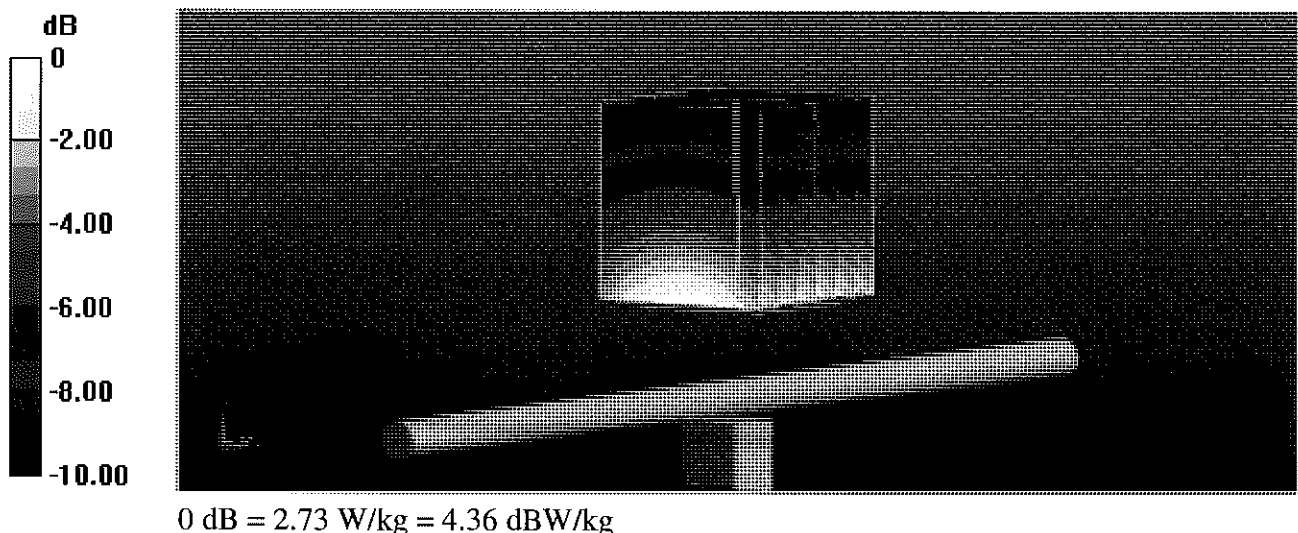
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.96 V/m; Power Drift = 0.00 dB

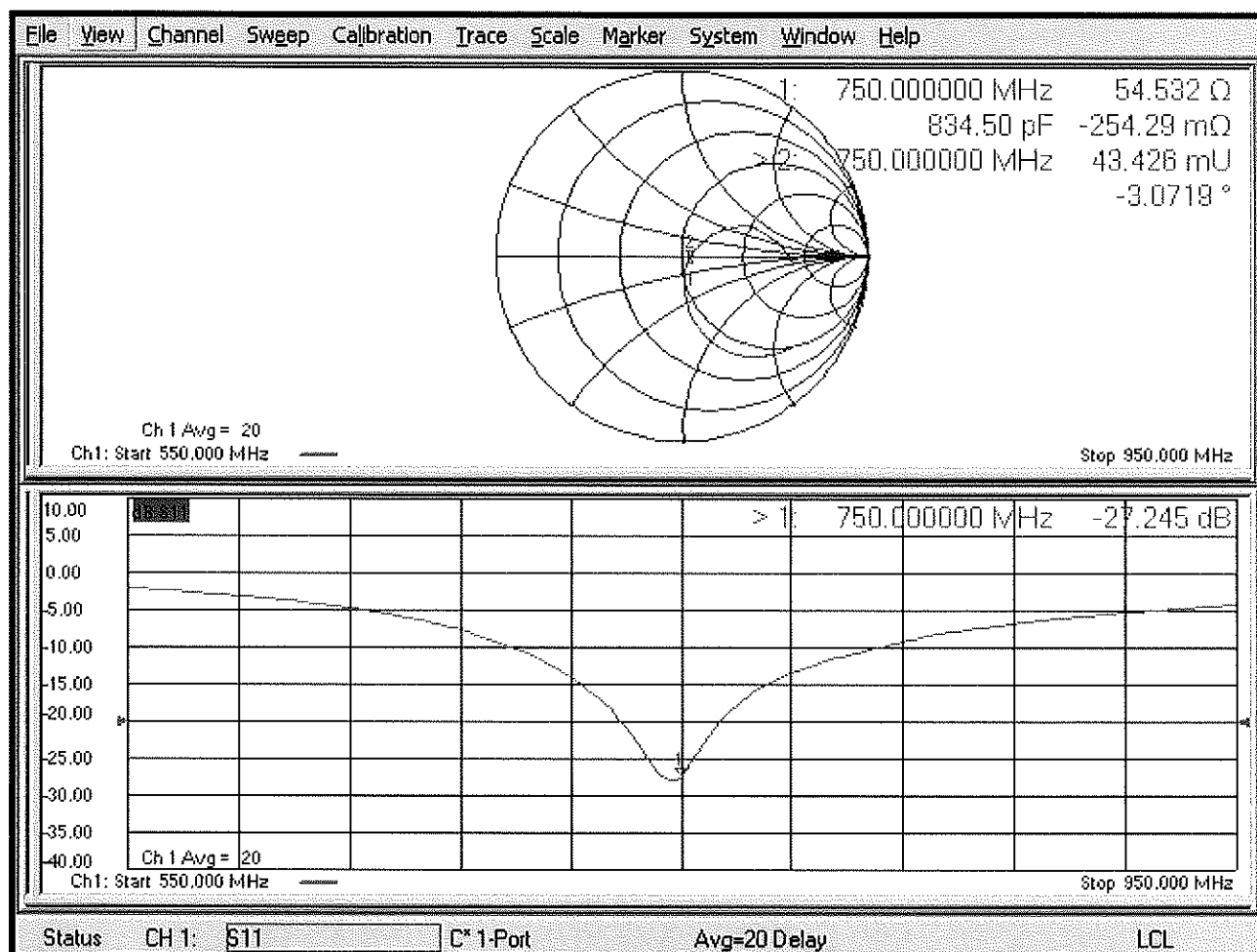
Peak SAR (extrapolated) = 3.06 W/kg

**SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.37 W/kg**

Maximum value of SAR (measured) = 2.73 W/kg



## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1054**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.98 \text{ S/m}$ ;  $\epsilon_r = 54.5$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.29, 10.29, 10.29) @ 750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

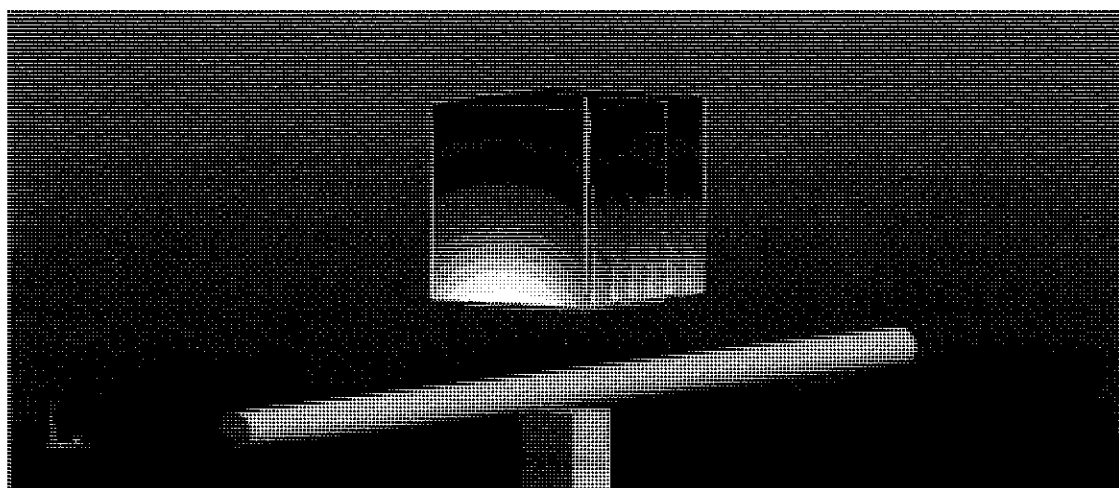
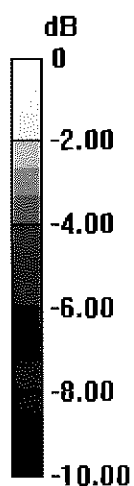
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 57.37 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

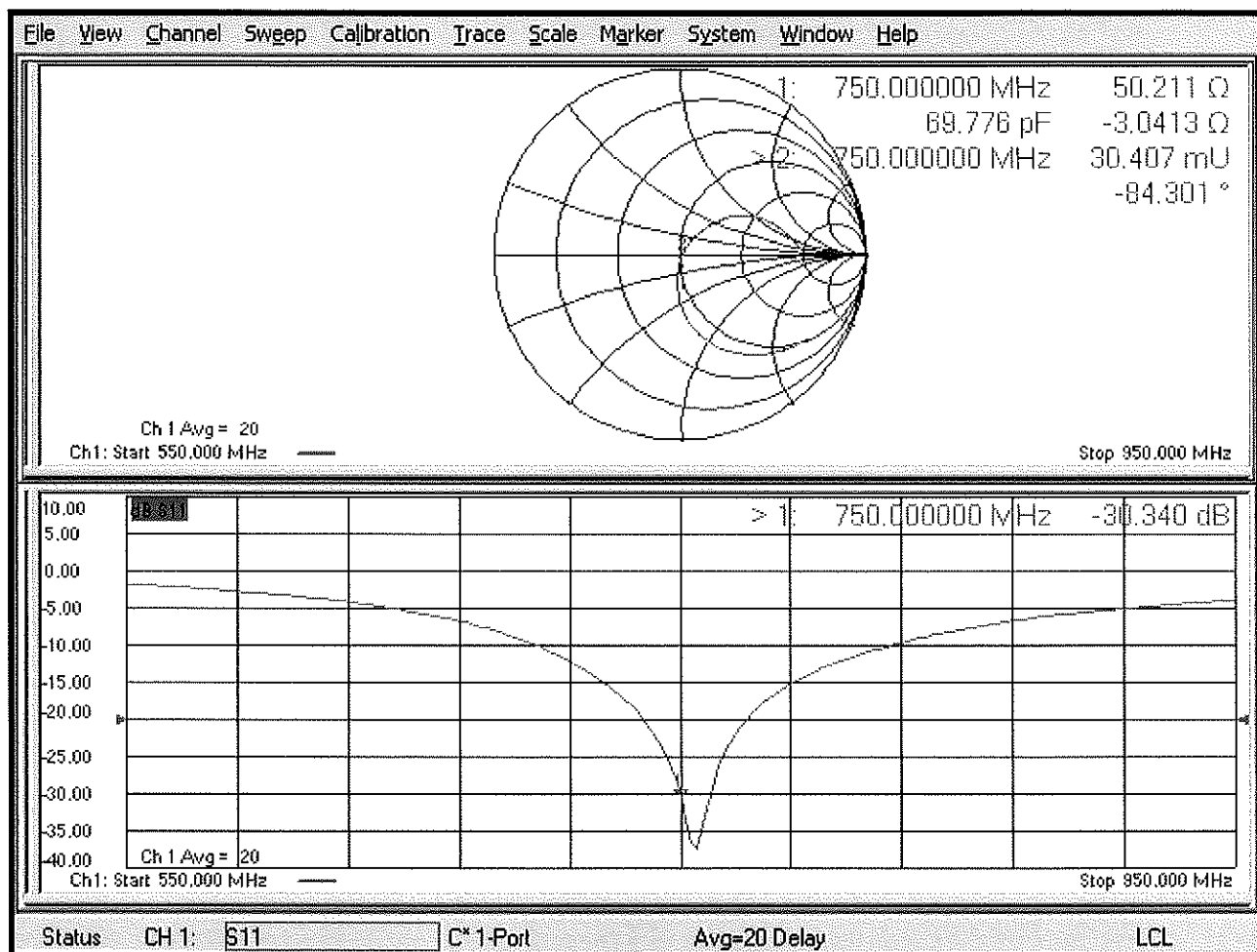
**SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.44 W/kg**

Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 4.58 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 18.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1054**

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.904$  S/m;  $\epsilon_r = 44.22$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.32, 10.32, 10.32) @ 750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: SAM Head
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**SAM Right/Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.66 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.80 W/kg

**SAR(1 g) = 1.93 W/kg; SAR(10 g) = 1.31 W/kg**

Maximum value of SAR (measured) = 2.52 W/kg

**SAM Right/Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.68 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 2.98 W/kg

**SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.39 W/kg**

Maximum value of SAR (measured) = 2.68 W/kg

**SAM Right/Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.23 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 2.82 W/kg

**SAR(1 g) = 2 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.56 W/kg

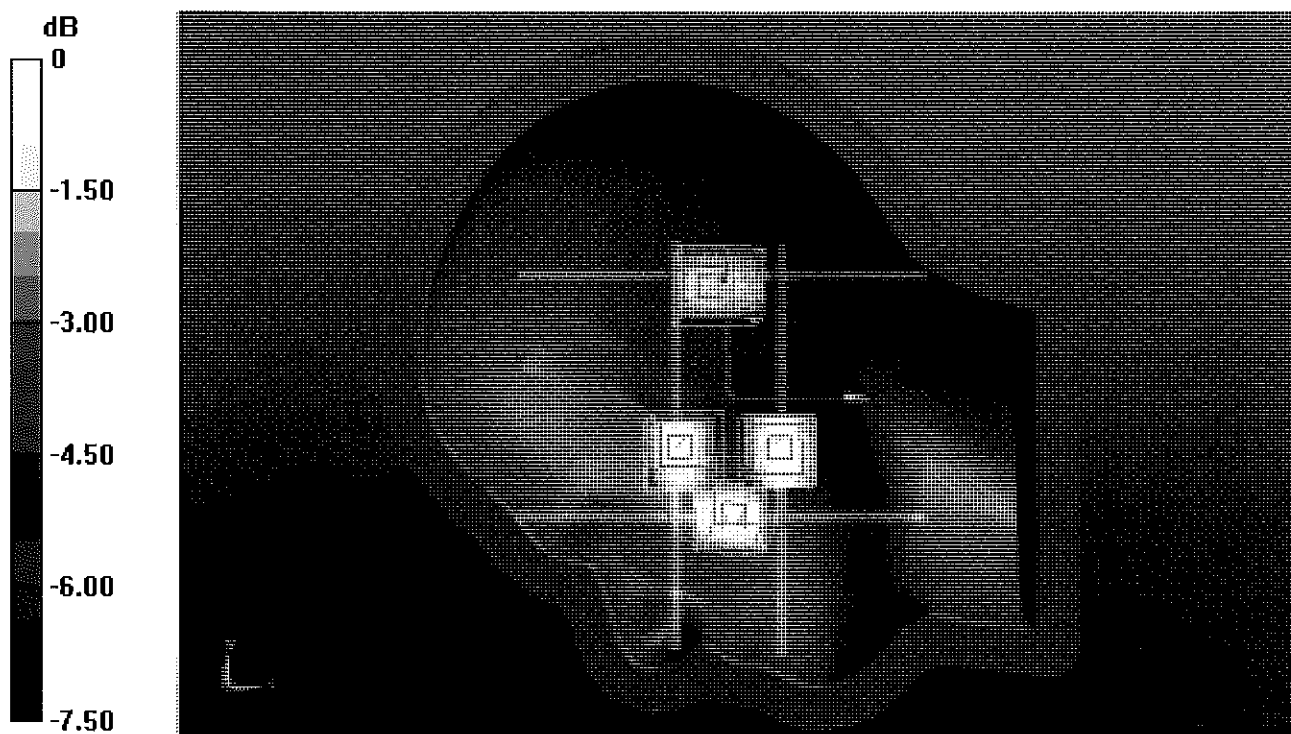
**SAM Right/Head/Ear/Zoom Scan (8x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 50.76 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.32 W/kg

**SAR(1 g) = 1.66 W/kg; SAR(10 g) = 1.14 W/kg**

Maximum value of SAR (measured) = 2.11 W/kg



0 dB = 2.11 W/kg = 3.24 dBW/kg



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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D750V3-1161\_Oct18**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN:1161**

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

Calibration date: **October 19, 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            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A            | SN: GB37480704 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |               |                       |                  |
|----------------|---------------|-----------------------|------------------|
|                | <b>Name</b>   | <b>Function</b>       | <b>Signature</b> |
| Calibrated by: | Manu Seitz    | Laboratory Technician |                  |
| Approved by:   | Katja Pokovic | Technical Manager     |                  |

Issued: October 22, 2018

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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                  | V52.10.2    |
| <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>                    | 750 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             | 41.9           | 0.89 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 40.8 $\pm$ 6 % | 0.89 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 | 2.02 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>8.03 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 | 1.32 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>5.26 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             | 55.5           | 0.96 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 55.1 $\pm$ 6 % | 0.96 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 | 2.11 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>8.43 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 | 1.39 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>5.55 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 | 55.6 $\Omega$ - 1.9 j $\Omega$ |
| Return Loss                          | - 25.0 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.6 $\Omega$ - 4.2 j $\Omega$ |
| Return Loss                          | - 27.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.032 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 | November 19, 2015 |

## DASY5 Validation Report for Head TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.89 \text{ S/m}$ ;  $\epsilon_r = 40.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

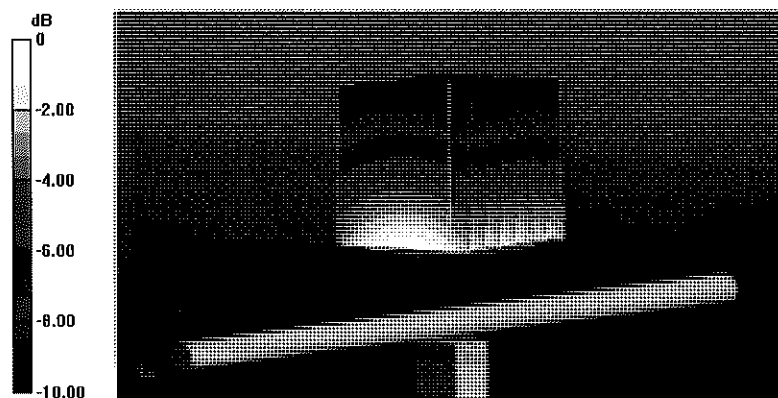
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.51 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.04 W/kg

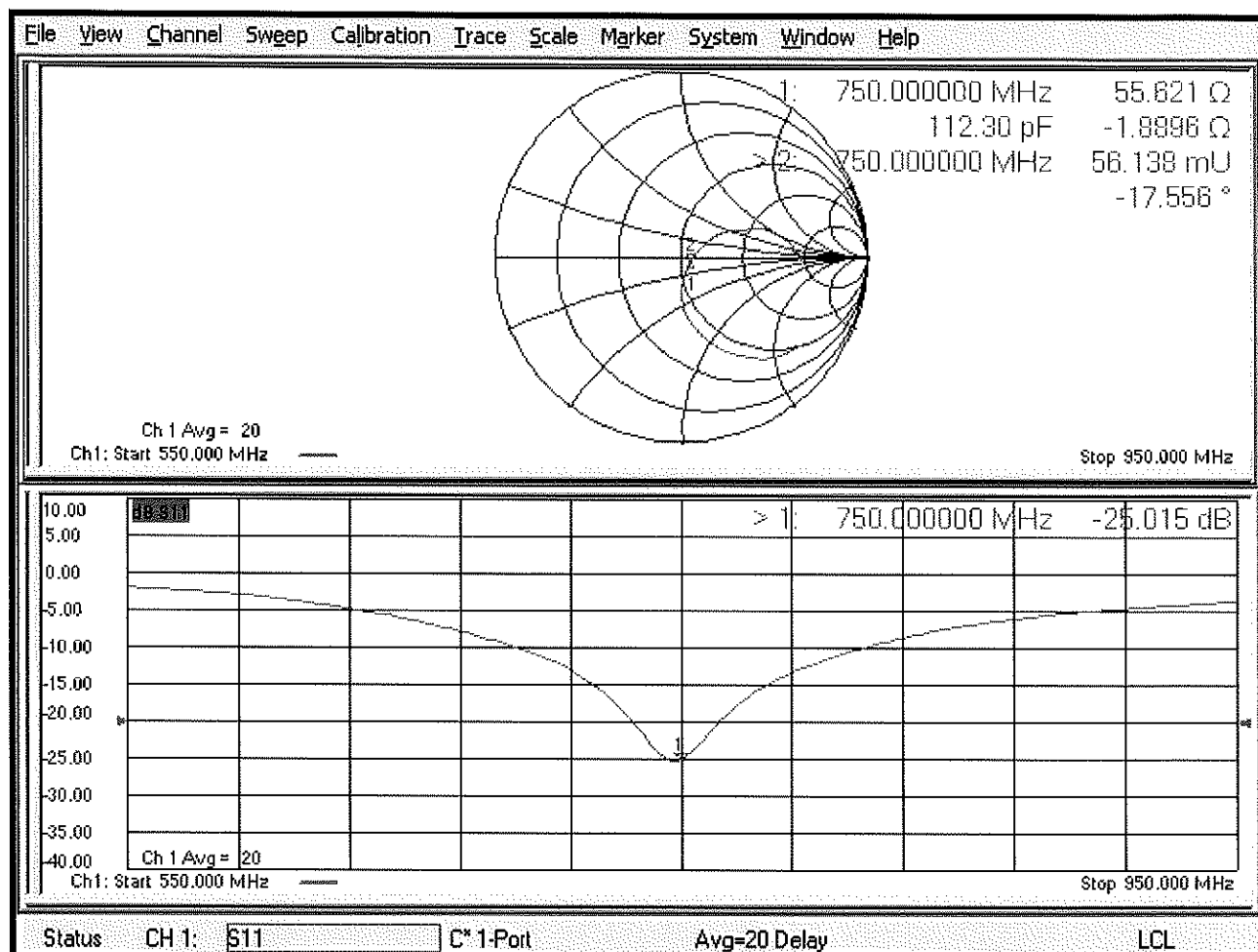
**SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.32 W/kg**

Maximum value of SAR (measured) = 2.70 W/kg



0 dB = 2.70 W/kg = 4.31 dBW/kg

# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161**

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

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 55.1$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

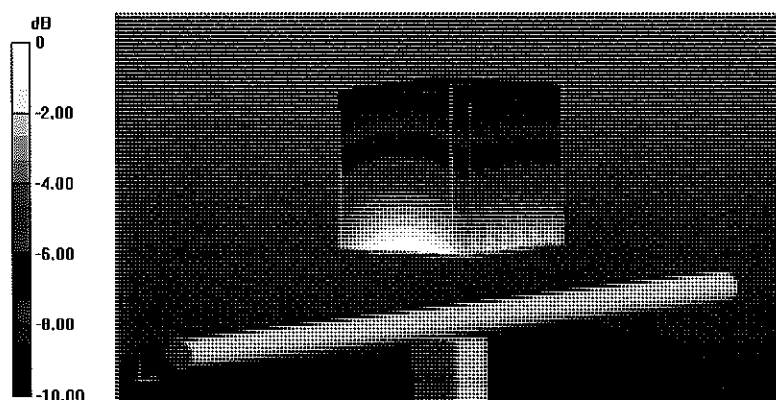
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 57.57 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.18 W/kg

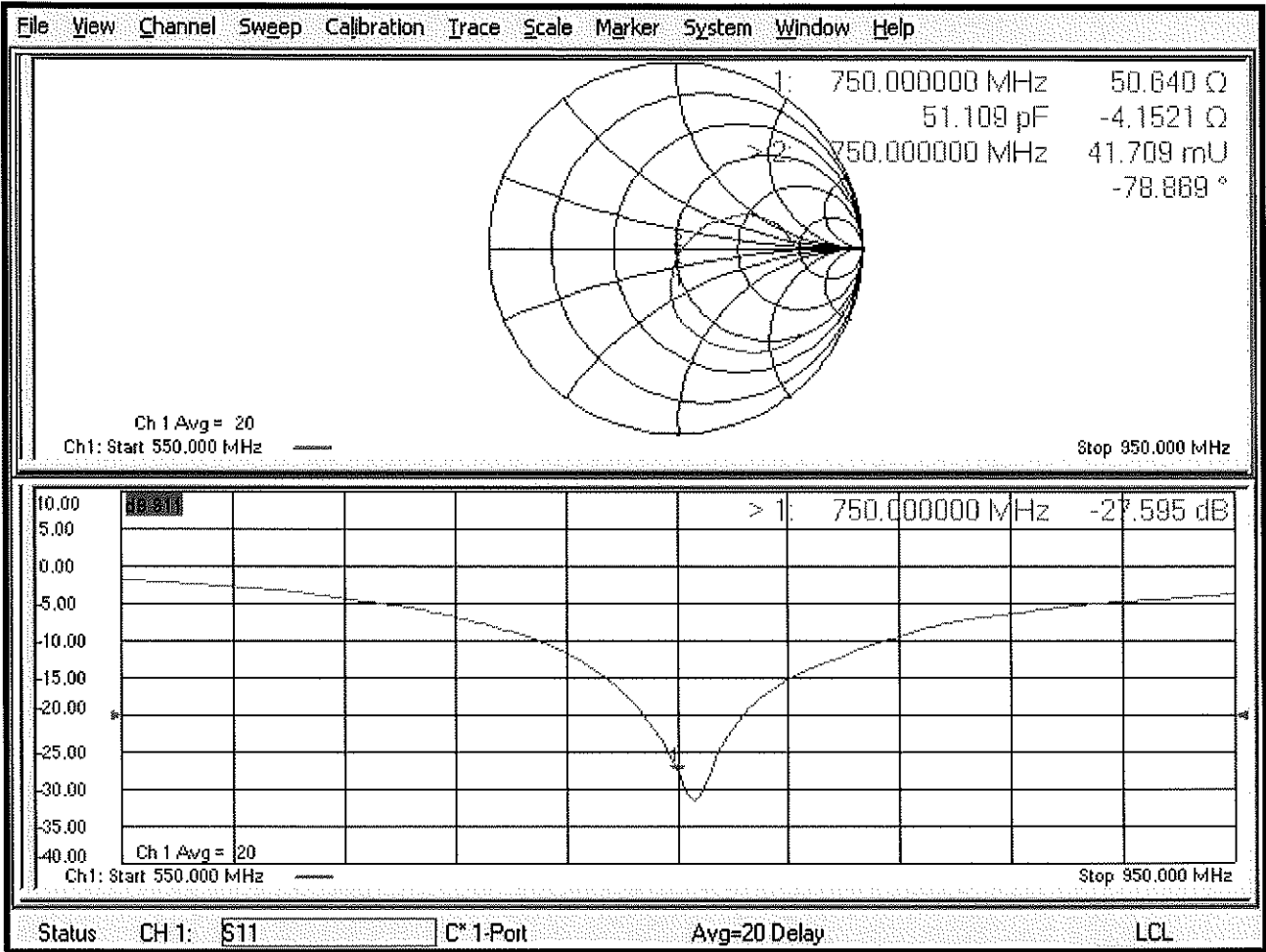
**SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.39 W/kg**

Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D750V3 – SN:1161

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 4/24/2019  | Annual       | 4/24/2020  | 7357          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 7/16/2019  | Annual       | 7/16/2020  | 7410          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 7/11/2019  | Annual       | 7/11/2020  | 1322          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 4/18/2019  | Annual       | 4/18/2020  | 1407          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

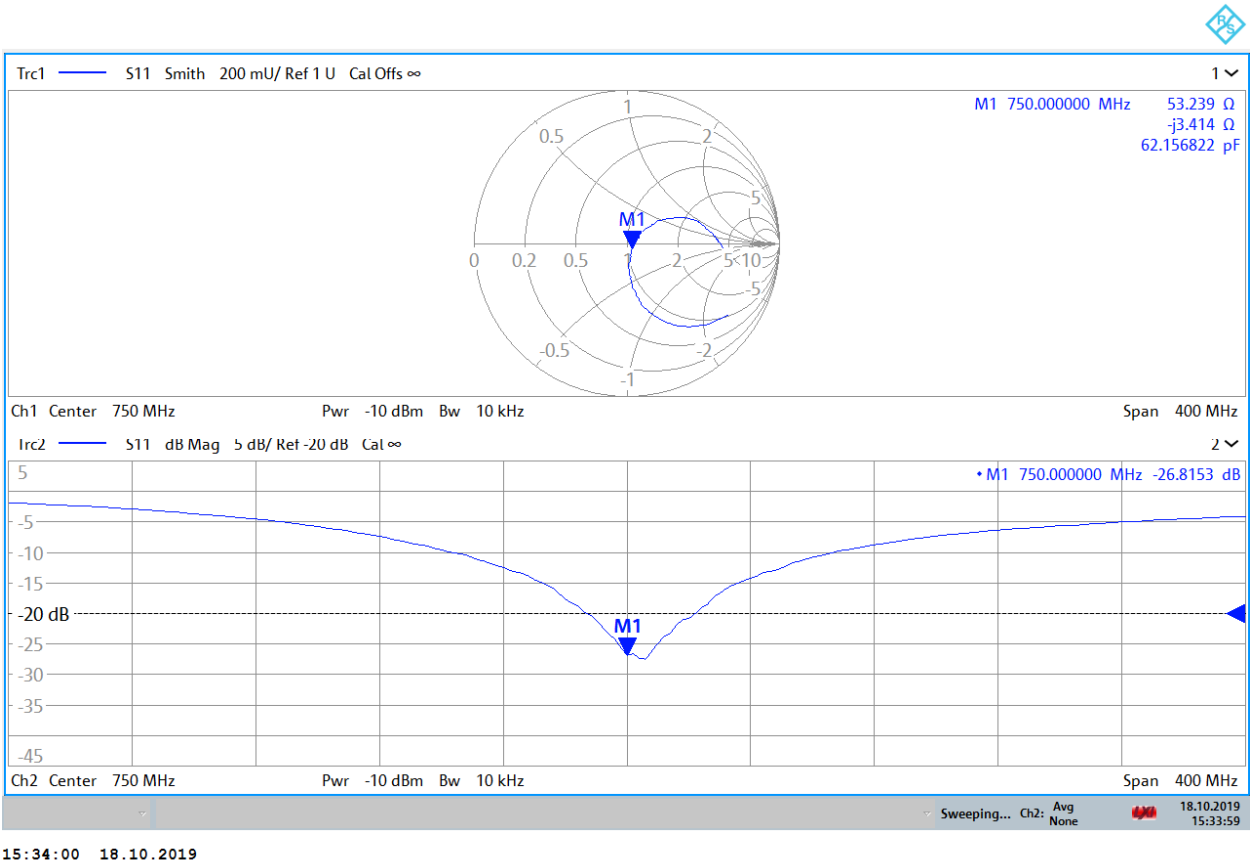
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

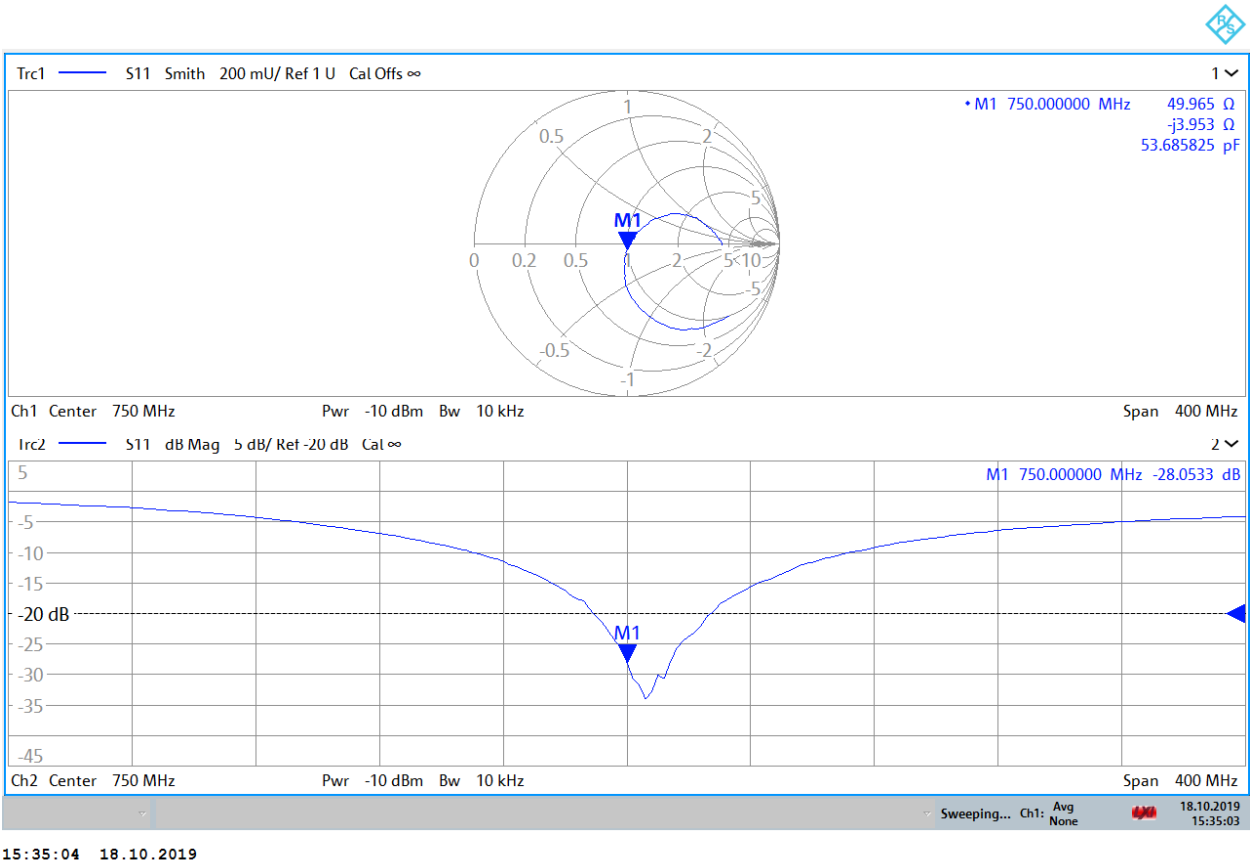
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 Head (10g) W/kg @ 23.0 dBm | Measured Head 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/19/2018       | 10/18/2019     | 1.032                             | 1.61                                             | 1.64                                   | 2.12%            | 1.05                                              | 1.08                                    | 2.86%             | 55.6                                  | 53.2                               | 2.4                   | -1.9                                       | -3.4                                    | 1.5                        | -25                               | -25.8                          | -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 |
| 10/19/2018       | 10/18/2019     | 1.032                             | 1.69                                             | 1.76                                   | 4.39%            | 1.11                                              | 1.17                                    | 5.41%             | 50.6                                  | 50                                 | 0.6                   | -4.2                                       | -4                                      | 0.2                        | -27.6                             | -28.1                          | -1.80%        | 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: **D835V2-4d047\_Mar19**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d047**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **March 13, 2019**

*BN*  
*04-12-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (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           | 31-Dec-18 (No. EX3-7349_Dec18)  | Dec-19                |
| DAE4                        | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 07-Oct-15 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

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

Issued: March 13, 2019

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



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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                  | V52.10.2    |
| <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.

|                                                | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|------------------------------------------------|---------------------|---------------------|----------------------|
| <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 | 41.9 $\pm$ 6 %      | 0.91 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 | 2.37 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>9.42 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 | 1.54 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>6.13 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|------------------------------------------------|---------------------|---------------------|----------------------|
| <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 | 54.3 $\pm$ 6 %      | 1.01 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 | 2.45 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>9.47 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 | 1.61 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>6.27 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 | 51.4 $\Omega$ - 2.6 j $\Omega$ |
| Return Loss                          | - 30.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.8 $\Omega$ - 6.1 j $\Omega$ |
| Return Loss                          | - 22.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.387 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

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

## DASY5 Validation Report for Head TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d047**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.91 \text{ S/m}$ ;  $\epsilon_r = 41.9$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

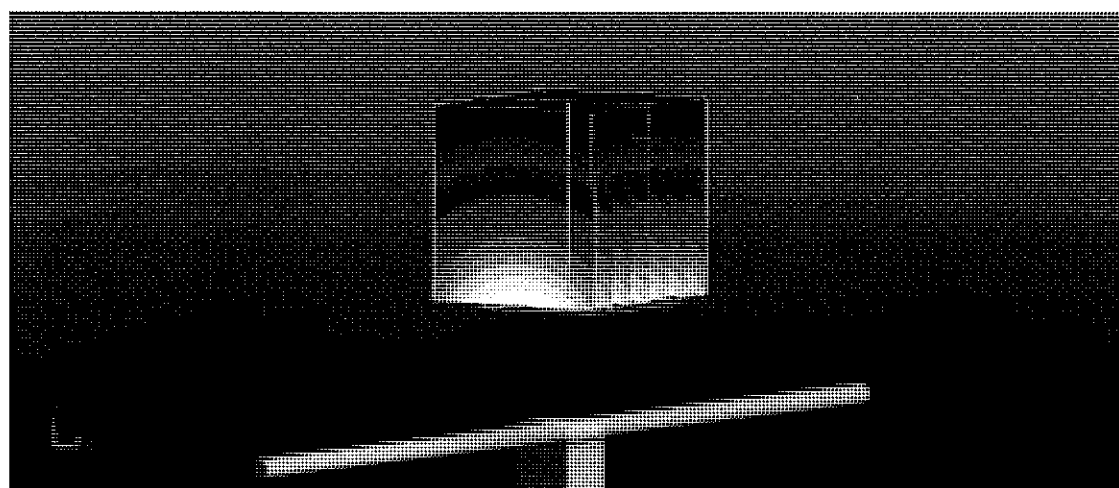
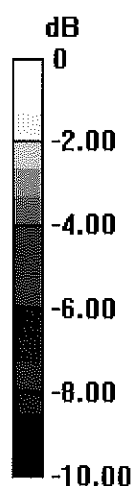
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 62.48 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.60 W/kg

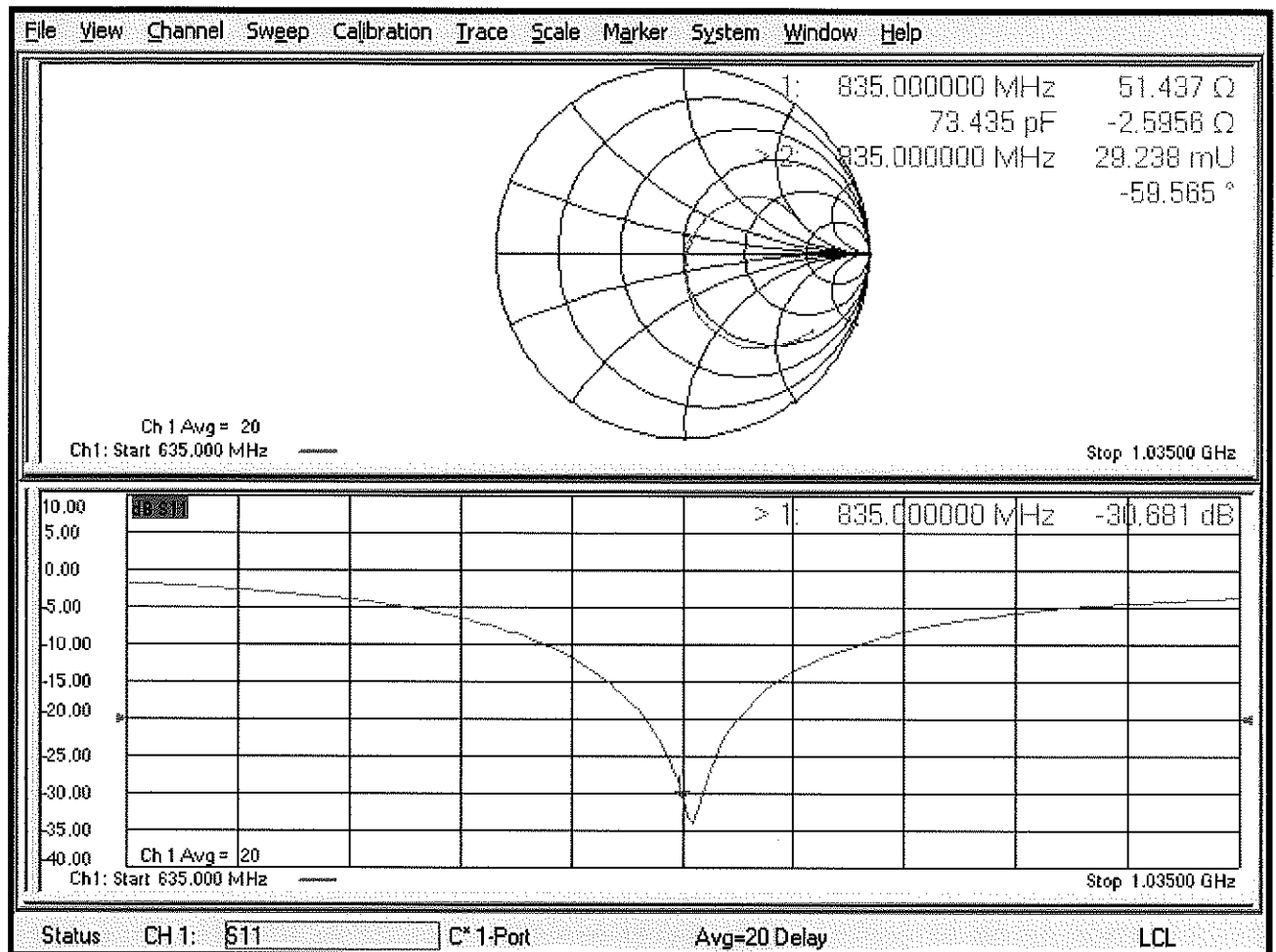
**SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg**

Maximum value of SAR (measured) = 3.18 W/kg



0 dB = 3.18 W/kg = 5.02 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d047**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1.01 \text{ S/m}$ ;  $\epsilon_r = 54.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.15, 10.15, 10.15) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

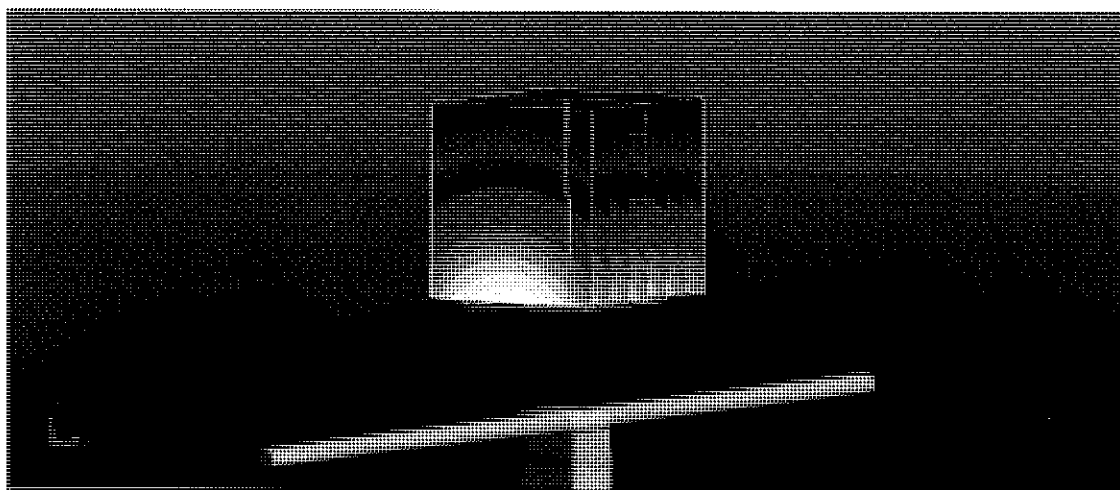
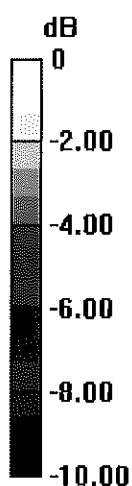
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 60.49 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.58 W/kg

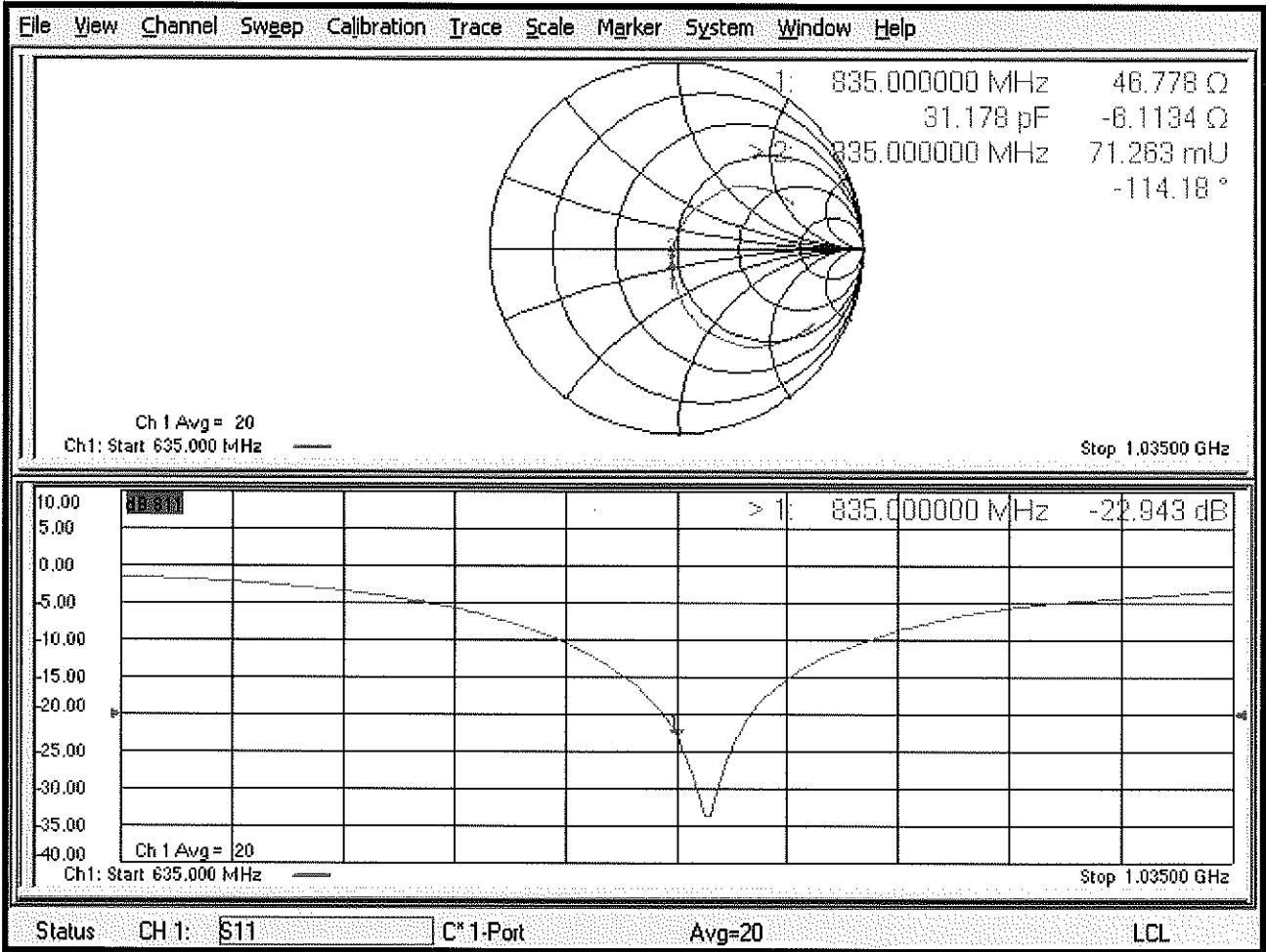
**SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.61 W/kg**

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



0 dB = 3.23 W/kg = 5.09 dBW/kg

Impedance Measurement Plot for Body TSL





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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D835V2-4d132\_Jan19**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d132**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

*BN ✓*  
*02/06/2019*

Calibration date: **January 22, 2019**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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           | 31-Dec-18 (No. EX3-7349_Dec18)  | Dec-19                |
| DAE4                        | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A            | SN: GB37480704 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Leif Klysner** **Laboratory Technician**

Signature

*Leif Klysner*

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

*Katja Pokovic*

Issued: January 22, 2019

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                  | V52.10.2    |
| <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 = 5.0 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 | 41.3 $\pm$ 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 | 2.44 W/kg                                      |
| SAR for nominal Head 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 Head TSL</b> | condition          |                                                |
| SAR measured                                                  | 250 mW input power | 1.58 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>6.23 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 | 2.46 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>9.67 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 | 1.61 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>6.35 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 | 49.6 $\Omega$ - 3.6 j $\Omega$ |
| Return Loss                          | - 28.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.4 $\Omega$ - 6.2 j $\Omega$ |
| Return Loss                          | - 23.2 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.387 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 |
|-----------------|-------|

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.35 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.38 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.57 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.26 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.47 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.86 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.65 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.58 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.36 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.42 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.60 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.38 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 2.02 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>8.06 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 1.36 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>5.42 W/kg ± 16.9 % (k=2)</b> |

## DASY5 Validation Report for Head TSL

Date: 17.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 41.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

### Dipole Calibration for Head Tissue/Pin=250 mW, $d=15\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

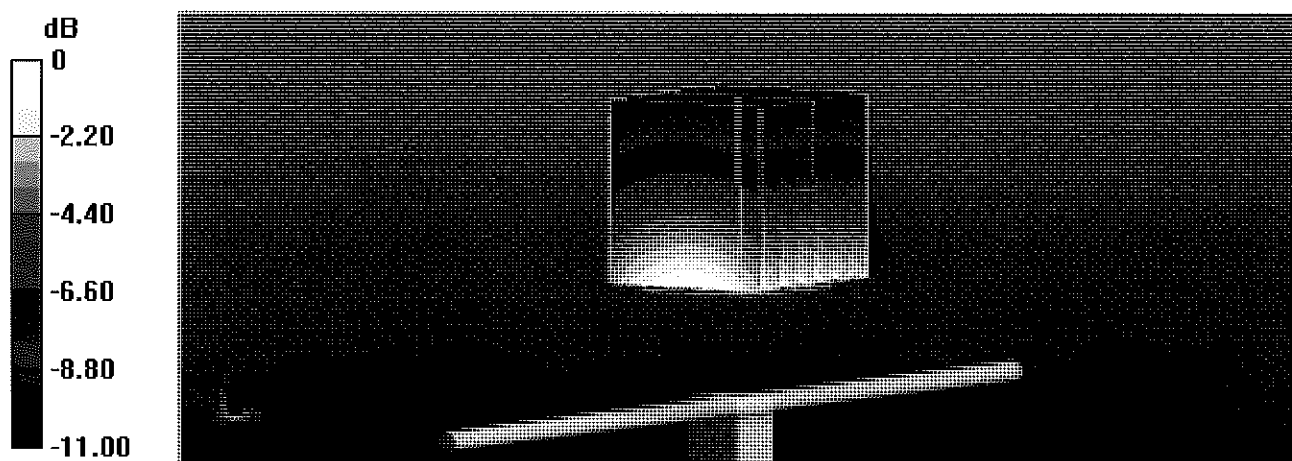
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 34.24 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.73 W/kg

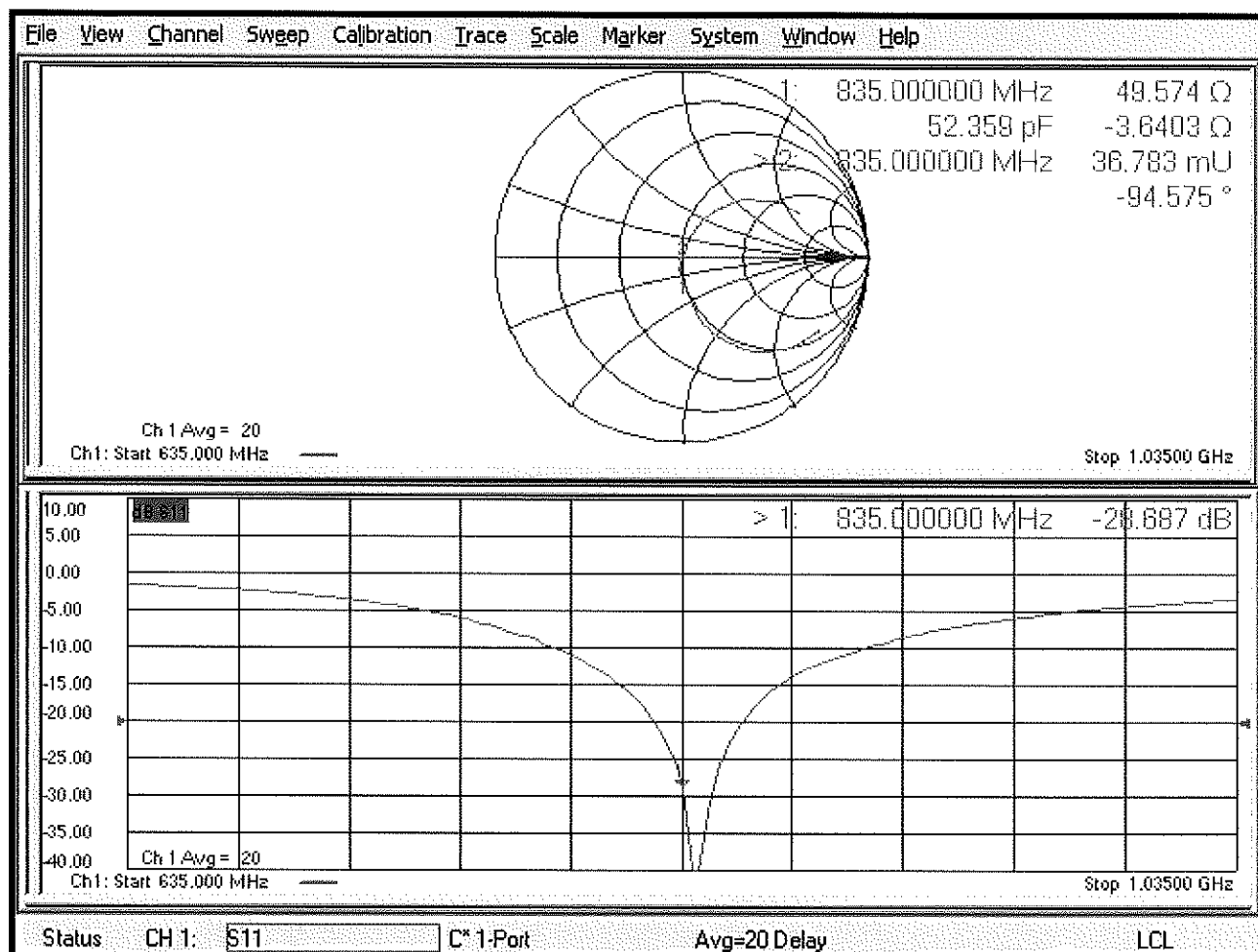
**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.58 W/kg**

Maximum value of SAR (measured) = 3.28 W/kg



0 dB = 3.28 W/kg = 5.16 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 17.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.99 \text{ S/m}$ ;  $\epsilon_r = 54.6$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.15, 10.15, 10.15) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

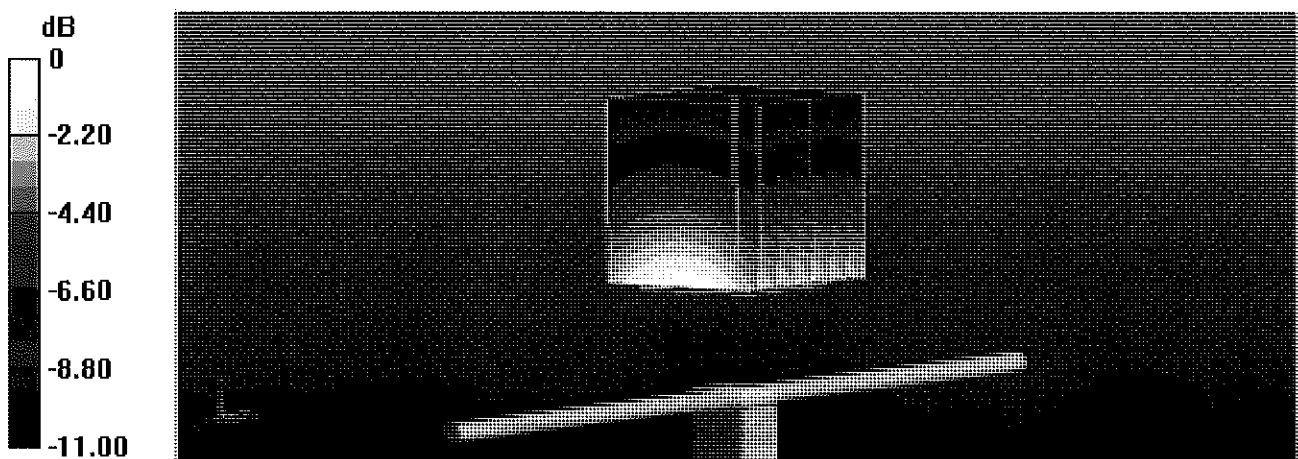
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 63.32 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.64 W/kg

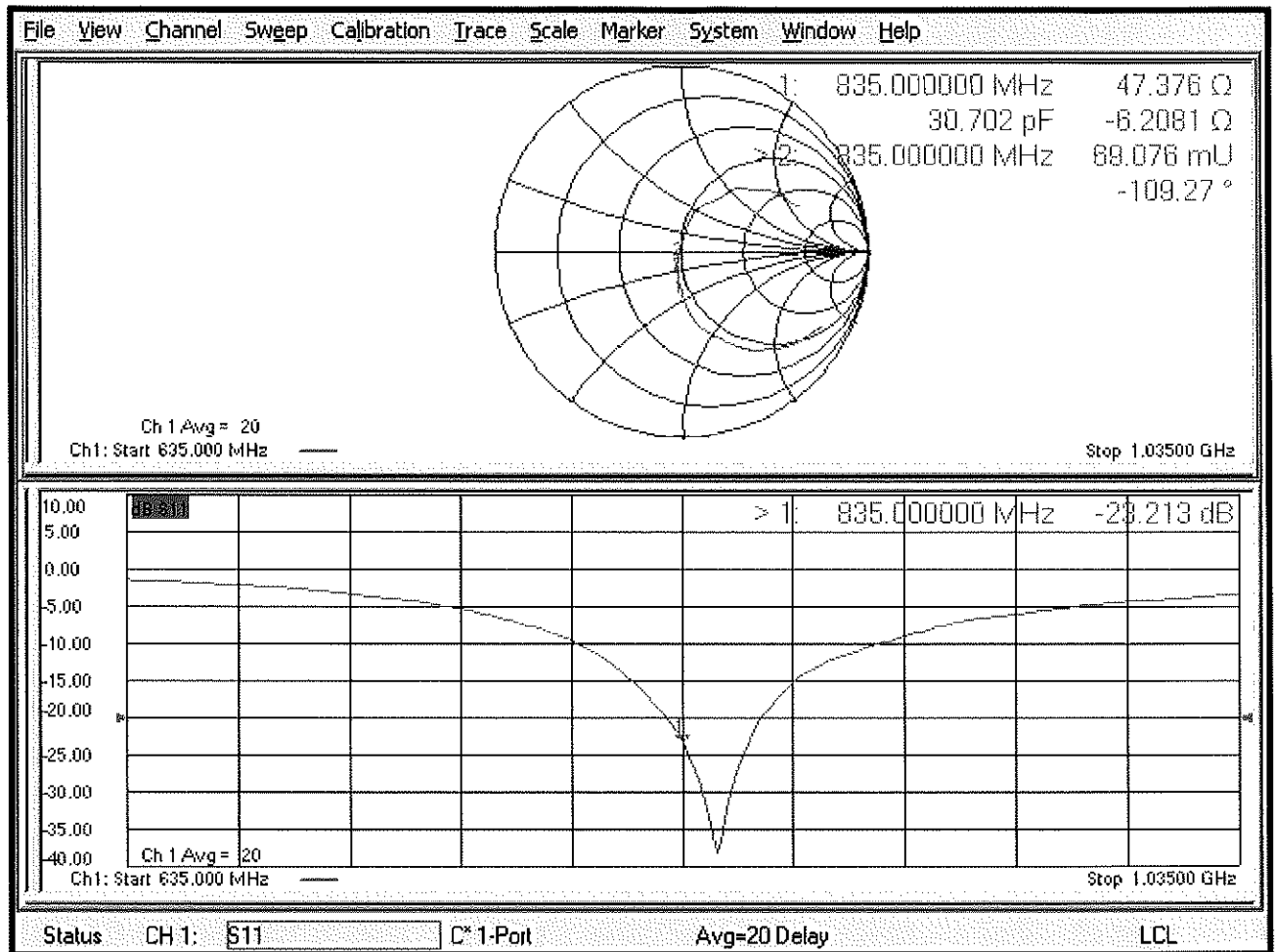
**SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg**

Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 22.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 44.4$ ;  $\rho = 1000 \text{ kg/m}^3$

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: SAM Head
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**SAM/Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 61.32 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.51 W/kg

**SAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.57 W/kg**

Maximum value of SAR (measured) = 3.12 W/kg

**SAM/Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 62.25 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.67 W/kg

**SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.65 W/kg**

Maximum value of SAR (measured) = 3.24 W/kg

**SAM/Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 60.69 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 3.43 W/kg

**SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.6 W/kg**

Maximum value of SAR (measured) = 3.08 W/kg

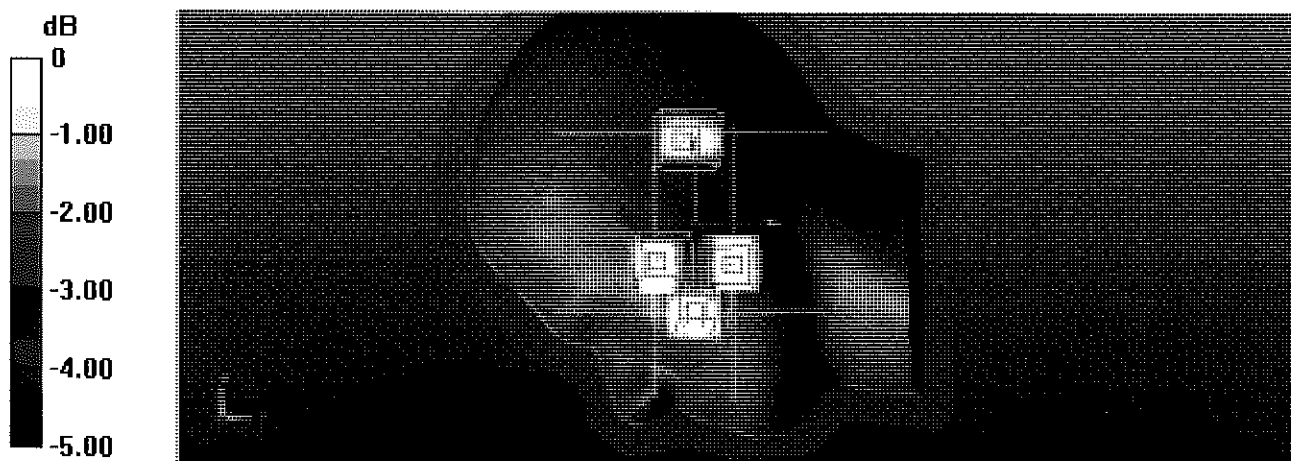
**SAM/Head/Ear/Zoom Scan (8x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 55.79 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 2.94 W/kg

**SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.36 W/kg**

Maximum value of SAR (measured) = 2.62 W/kg





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1765V2-1008\_May18**

## CALIBRATION CERTIFICATE

Object **D1765V2 - SN:1008**

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

Calibration date: **May 23, 2018**

BN ✓  
 7/16/2018  
 BN ✓  
 05/20/2019

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&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: US37390586 | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |

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

Issued: May 23, 2018

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



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Accreditation No.: **SCS 0108**

### Glossary:

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

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

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 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 | 39.0 $\pm$ 6 % | 1.34 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 | 8.94 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 36.2 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 | 4.71 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 19.0 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 53.2 $\pm$ 6 % | 1.46 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 9.21 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 37.4 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 4.92 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 19.9 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 | 47.7 $\Omega$ - 6.5 j $\Omega$ |
| Return Loss                          | - 23.0 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 43.3 $\Omega$ - 6.0 j $\Omega$ |
| Return Loss                          | - 20.3 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.210 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 | October 06, 2005 |

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.26 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.4 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 4.95 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>19.9 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.47 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>38.2 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.06 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.4 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.26 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.4 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.02 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.2 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 7.12 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>28.7 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 4.01 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>16.1 W/kg ± 16.9 % (k=2)</b> |

## DASY5 Validation Report for Head TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.34$  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(8.5, 8.5, 8.5) @ 1750 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:**

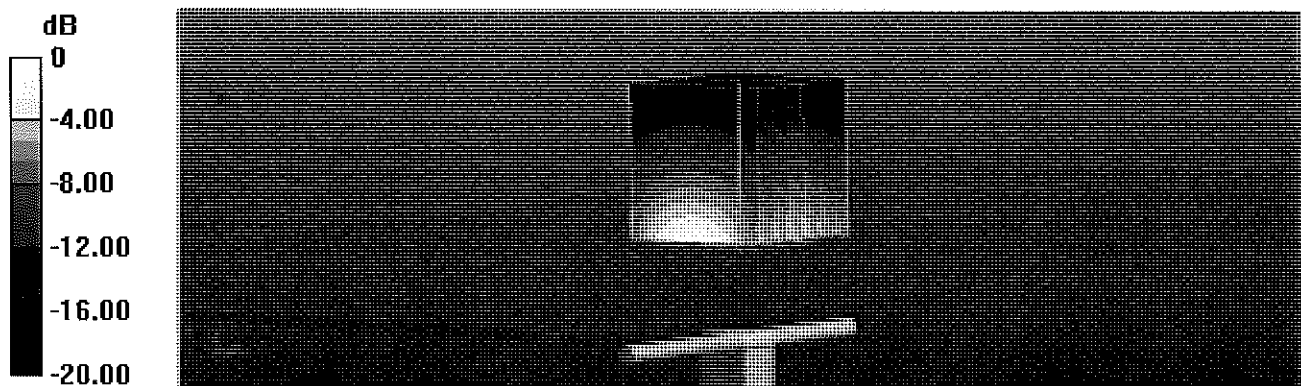
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.6 V/m; Power Drift = -0.02 dB

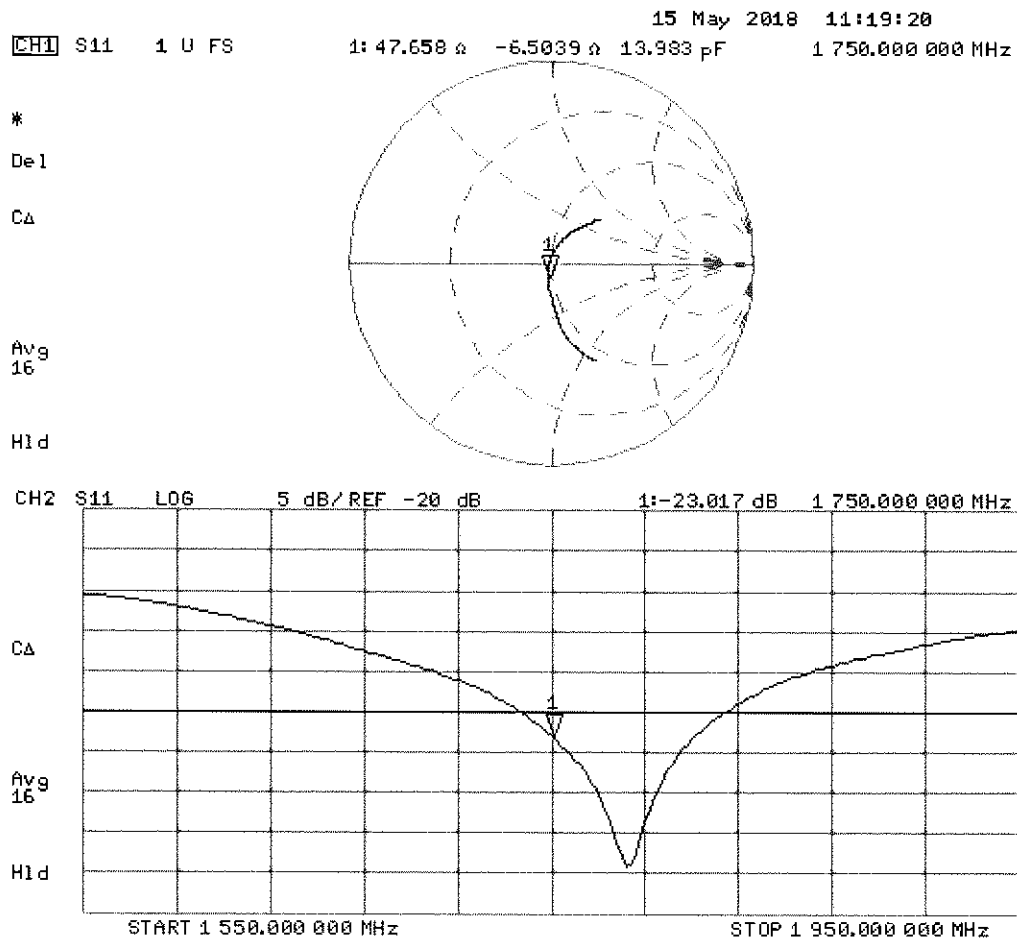
Peak SAR (extrapolated) = 16.4 W/kg

**SAR(1 g) = 8.94 W/kg; SAR(10 g) = 4.71 W/kg**

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



Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 53.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 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:**

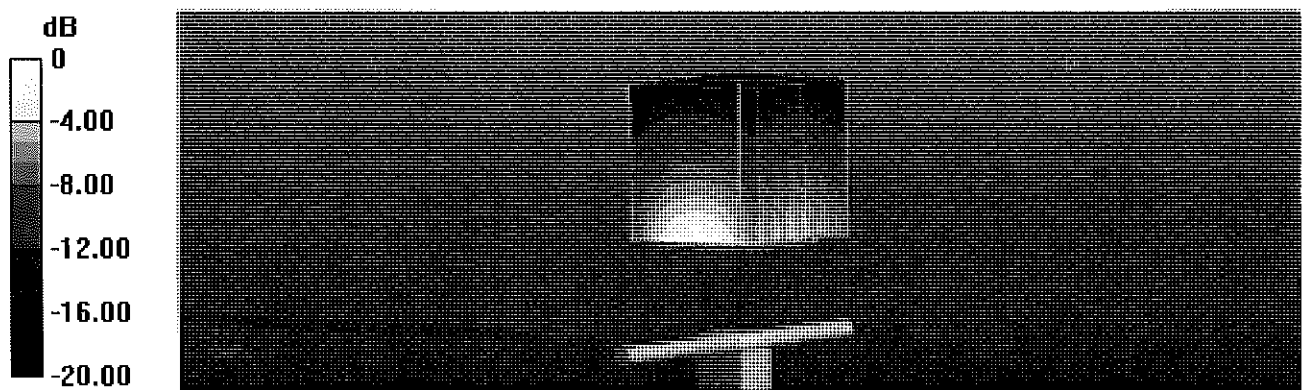
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.4 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 16.1 W/kg

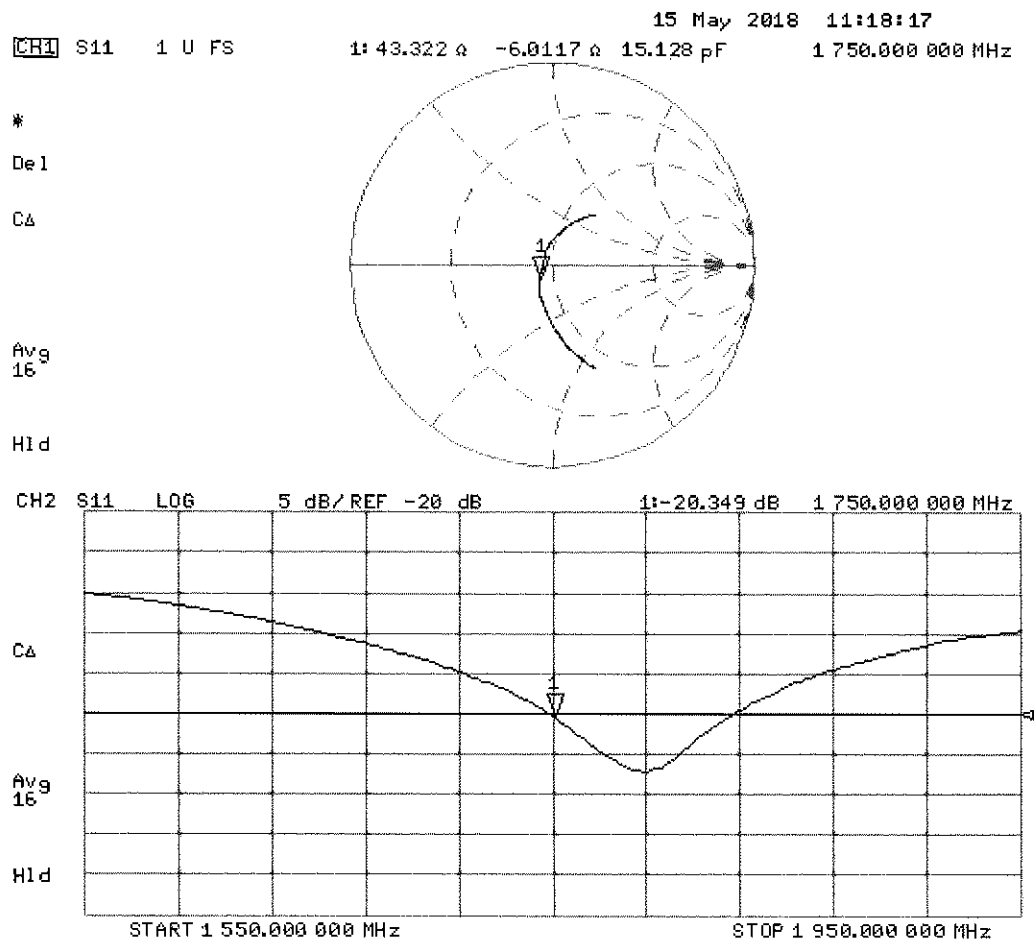
**SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.92 W/kg**

Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.37 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 23.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 41.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: SAM Head
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

**SAM/Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.4 W/kg

**SAR(1 g) = 9.26 W/kg; SAR(10 g) = 4.95 W/kg**

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

**SAM/Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.2 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.6 W/kg

**SAR(1 g) = 9.47 W/kg; SAR(10 g) = 5.06 W/kg**

Maximum value of SAR (measured) = 13.7 W/kg

**SAM/Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.7 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 15.8 W/kg

**SAR(1 g) = 9.26 W/kg; SAR(10 g) = 5.02 W/kg**

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

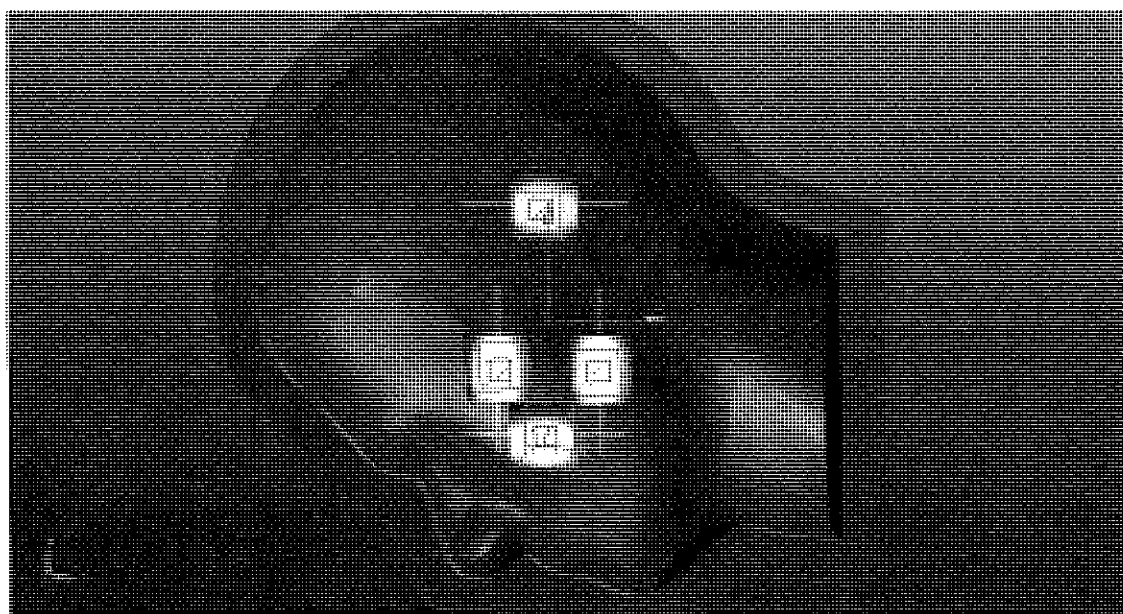
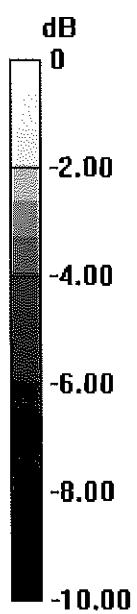
**SAM/Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.46 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 11.8 W/kg

**SAR(1 g) = 7.12 W/kg; SAR(10 g) = 4.01 W/kg**

Maximum value of SAR (measured) = 10.3 W/kg



0 dB = 10.3 W/kg = 10.13 dBW/kg

# Certification of Calibration

Object D1765V2 – SN: 1008

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

Extension Calibration date: 5/17/2019

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                            | 3/11/2019  | Annual       | 3/11/2020  | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 11/28/2018 | Annual       | 11/28/2019 | MY47420603    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/20/2018 | Annual       | 11/20/2019 | 1027293       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 10/30/2018 | Annual       | 10/30/2019 | 1126066       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./ Clock/ Humidity Monitor                         | 10/9/2018  | Biennial     | 10/9/2020  | 181647811     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 6/6/2018   | Biennial     | 6/6/2020   | 181334678     |
| 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    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | 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           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 6/25/2018  | Annual       | 6/25/2019  | 7409          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

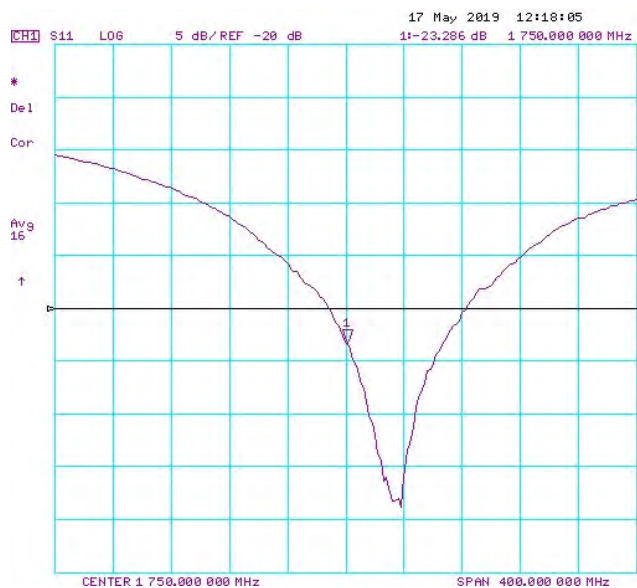
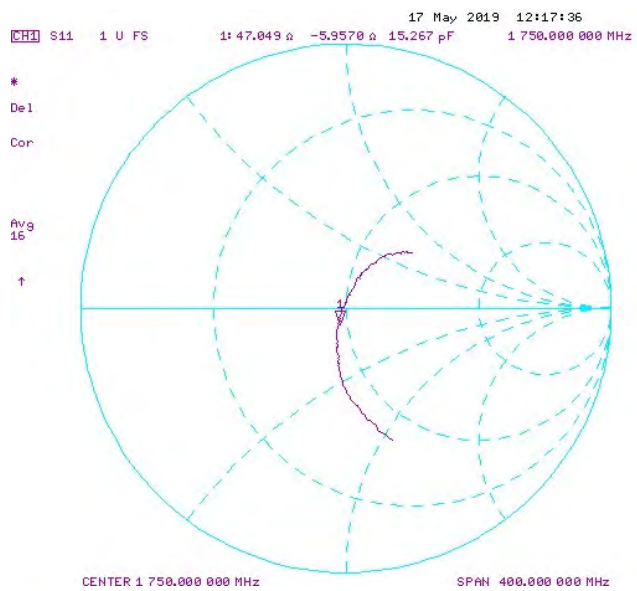
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

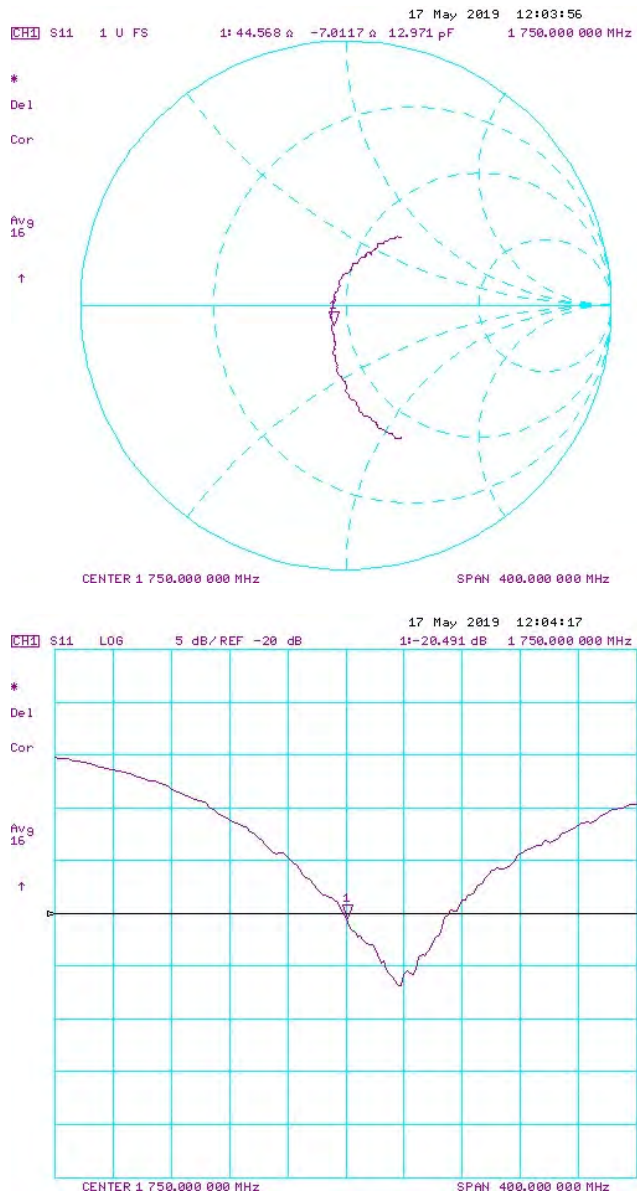
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 5/23/2019        | 5/17/2019      | 1.21                              | 3.62                                             | 3.63                                   | 0.28%            | 1.9                                               | 1.92                                    | 1.05%             | 47.7                                  | 47                                 | 0.7                   | -6.5                                       | -6                                      | 0.5                        | -23                               | -23.3                          | -1.20%        | 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 |
| 5/23/2019        | 5/17/2019      | 1.21                              | 3.74                                             | 3.95                                   | 5.61%            | 1.99                                              | 2.08                                    | 4.52%             | 43.3                                  | 44.6                               | 1.3                   | -6                                         | -7                                      | 1                          | -20.3                             | -20.5                          | -0.90%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL





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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1148\_May19**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1148**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **May 15, 2019**

*BNV*  
*05-23-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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         | 03-Apr-19 (No. 217-02892/02893) | Apr-20                |
| Power sensor NRP-Z91        | SN: 103244         | 03-Apr-19 (No. 217-02892)       | Apr-20                |
| Power sensor NRP-Z91        | SN: 103245         | 03-Apr-19 (No. 217-02893)       | Apr-20                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-19 (No. 217-02894)       | Apr-20                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895)       | Apr-20                |
| Reference Probe EX3DV4      | SN: 7349           | 31-Dec-18 (No. EX3-7349_Dec18)  | Dec-19                |
| DAE4                        | SN: 601            | 30-Apr-19 (No. DAE4-601_Apr19)  | Apr-20                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

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

Issued: May 15, 2019

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                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 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 | 40.0 $\pm$ 6 % | 1.34 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 | 9.13 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 37.0 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 4.83 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 19.5 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             | 53.4           | 1.49 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 53.5 $\pm$ 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 | 9.35 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 37.7 W/kg $\pm$ 17.0 % (k=2) |

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

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.4 $\Omega$ - 0.2 j $\Omega$ |
| Return Loss                          | - 37.0 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.4 $\Omega$ - 0.5 j $\Omega$ |
| Return Loss                          | - 31.4 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.222 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 |
|-----------------|-------|

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.38 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.9 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.04 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.3 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.34 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>37.8 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 5.04 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.3 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 9.06 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>36.6 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 4.95 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>19.9 W/kg ± 16.9 % (k=2)</b> |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|-------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                          | 250 mW input power | 7.11 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>28.7 W/kg ± 17.5 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                 |
|---------------------------------------------------------|--------------------|---------------------------------|
| SAR measured                                            | 250 mW input power | 3.98 W/kg                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>16.0 W/kg ± 16.9 % (k=2)</b> |

## DASY5 Validation Report for Head TSL

Date: 08.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.34$  S/m;  $\epsilon_r = 40$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.59, 8.59, 8.59) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

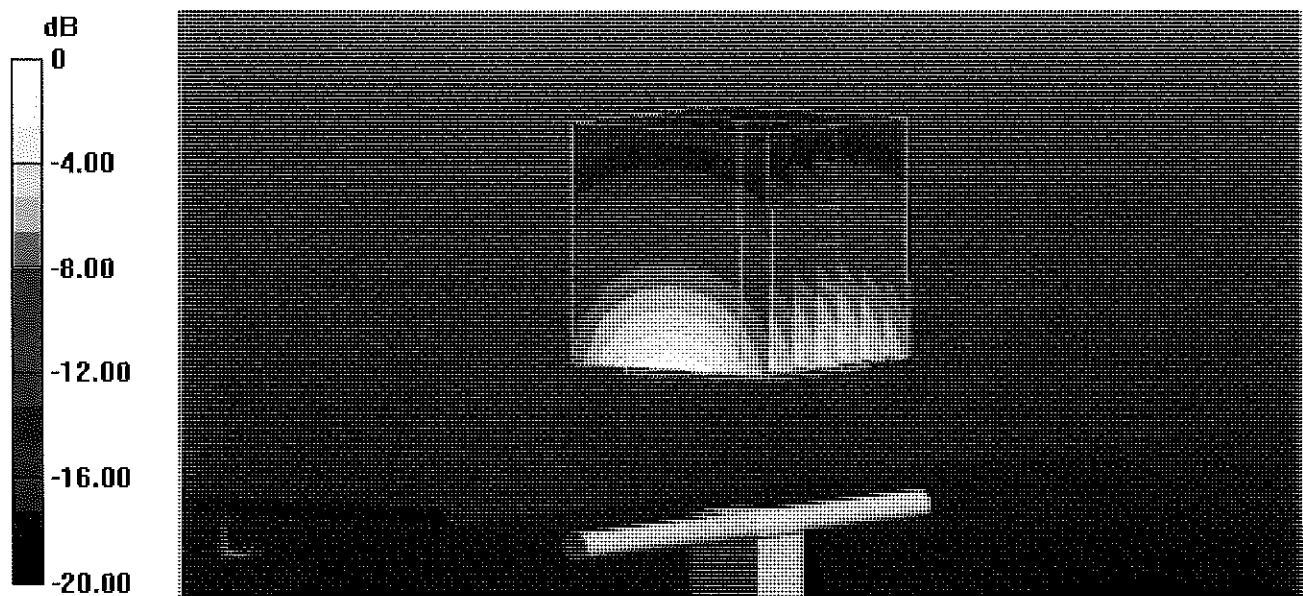
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.8 V/m; Power Drift = -0.01 dB

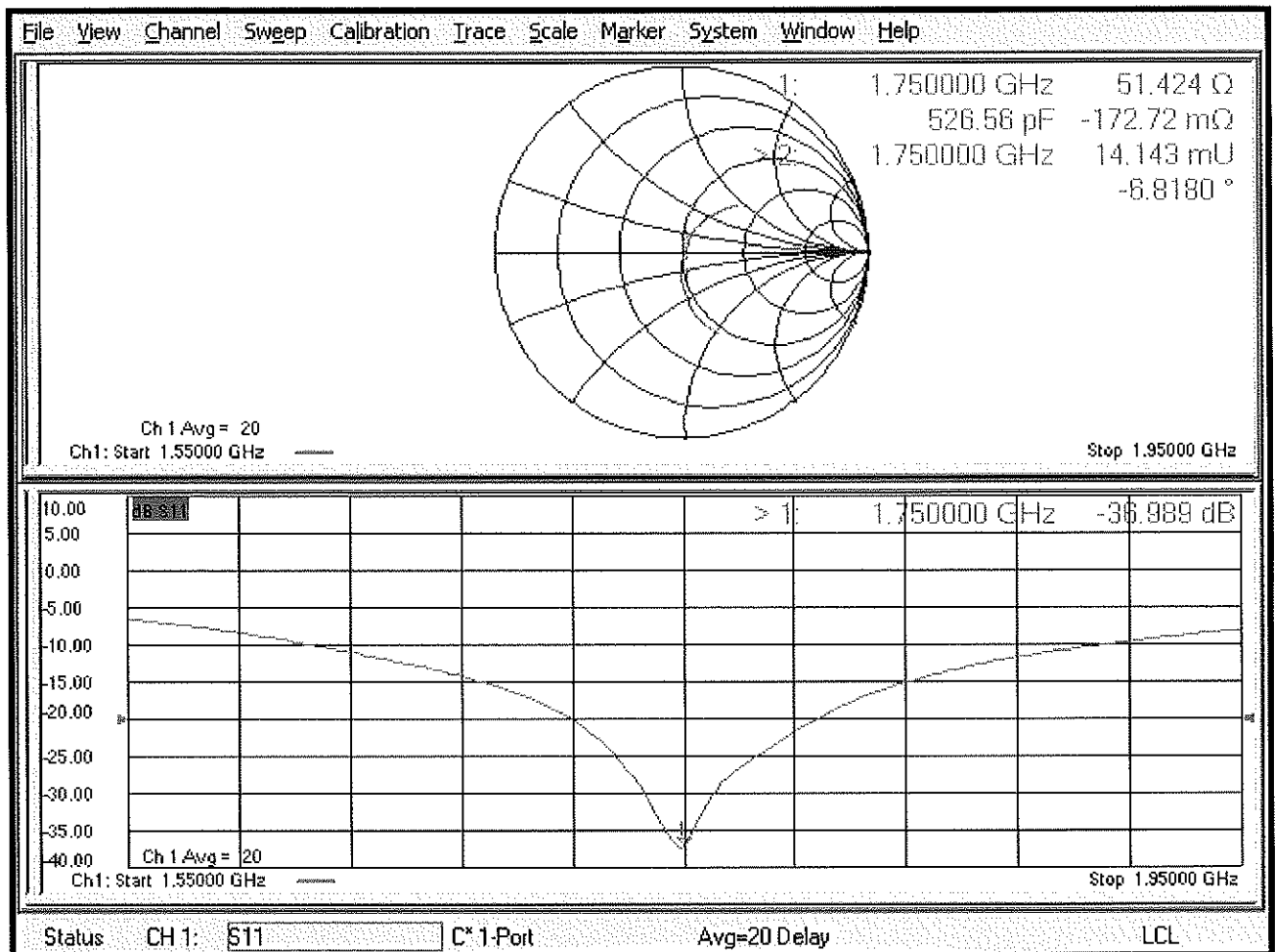
Peak SAR (extrapolated) = 16.7 W/kg

**SAR(1 g) = 9.13 W/kg; SAR(10 g) = 4.83 W/kg**

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



## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 08.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 53.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

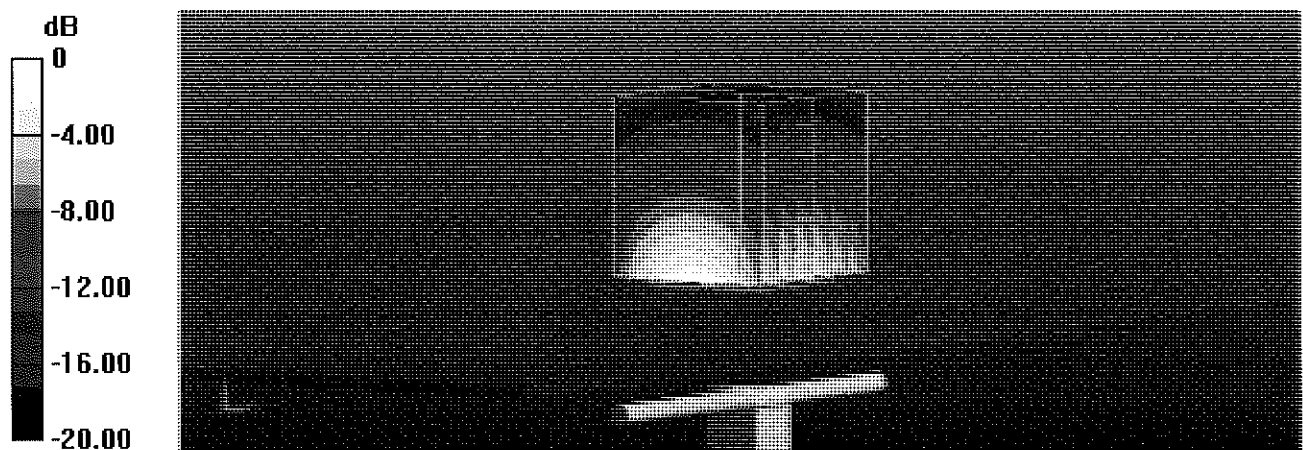
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.2 W/kg

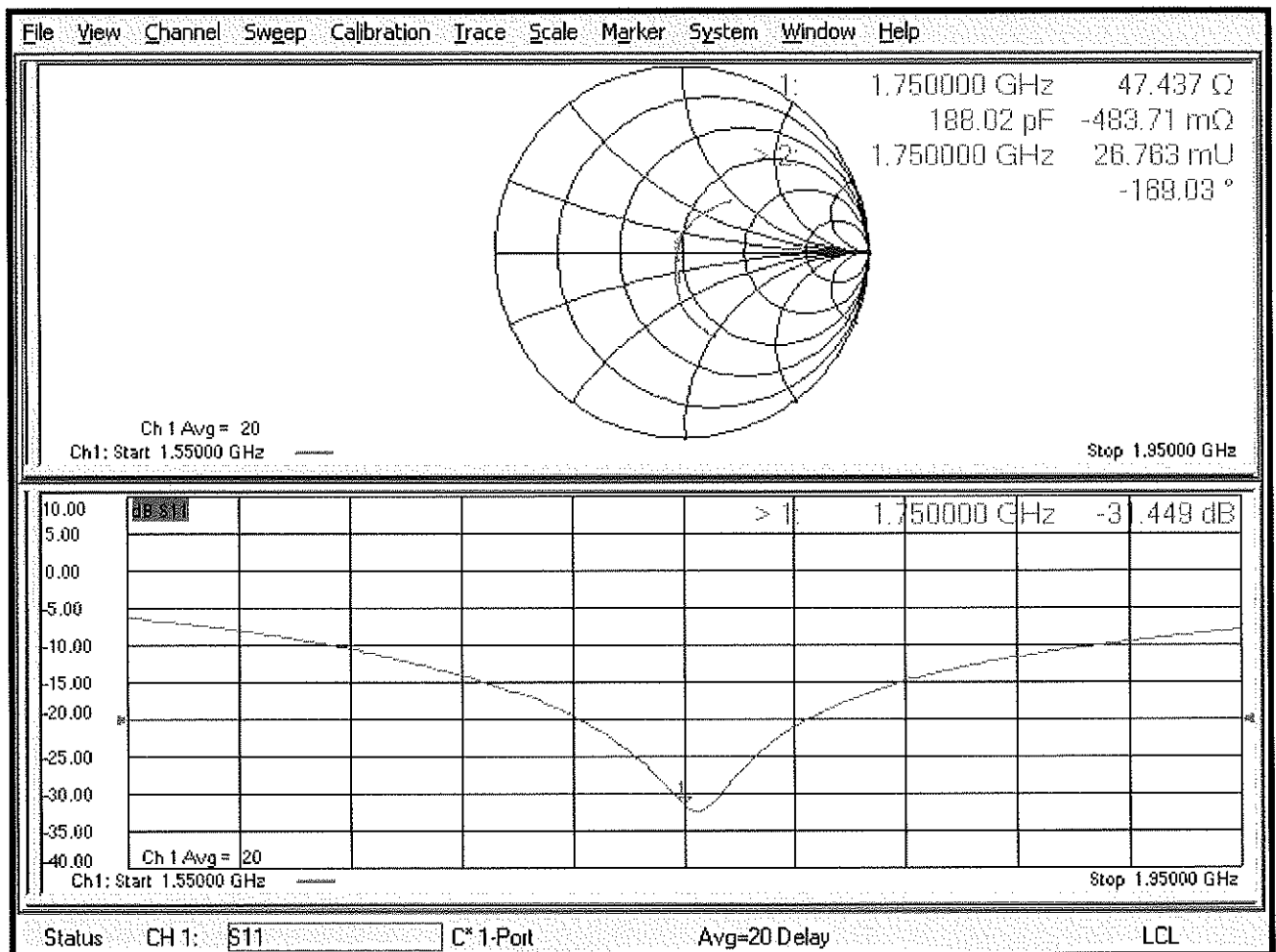
**SAR(1 g) = 9.35 W/kg; SAR(10 g) = 4.93 W/kg**

Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

## Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 15.05.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1148**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 42.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.59, 8.59, 8.59) @ 1750 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: SAM Head
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

**SAM Head/Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.2 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.6 W/kg

**SAR(1 g) = 9.38 W/kg; SAR(10 g) = 5.04 W/kg**

Maximum value of SAR (measured) = 14.2 W/kg

**SAM Head/Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.7 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.5 W/kg

**SAR(1 g) = 9.34 W/kg; SAR(10 g) = 5.04 W/kg**

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

**SAM Head/Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.3 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 15.5 W/kg

**SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.95 W/kg**

Maximum value of SAR (measured) = 13.1 W/kg

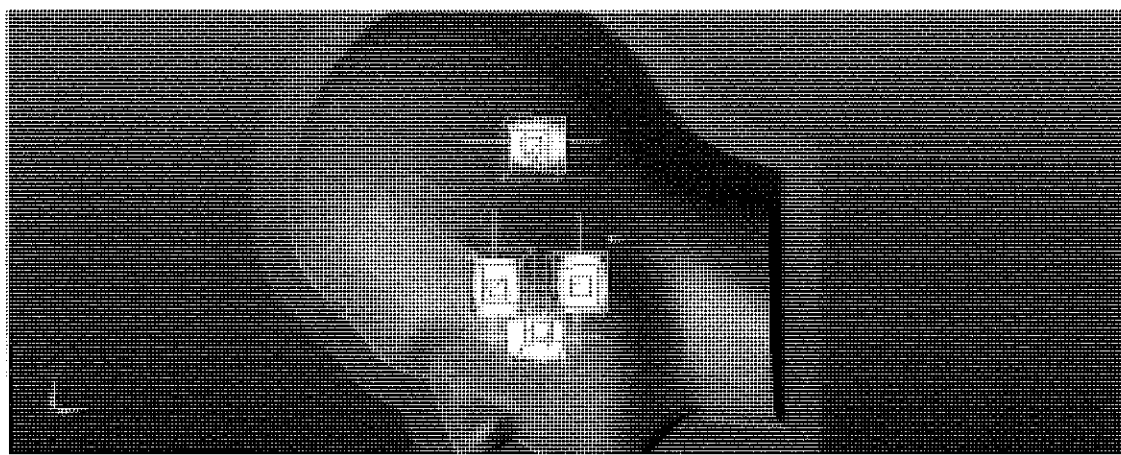
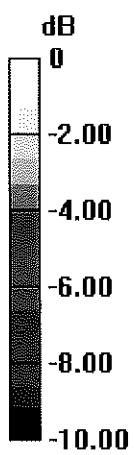
**SAM Head/Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.82 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 12.0 W/kg

**SAR(1 g) = 7.11 W/kg; SAR(10 g) = 3.98 W/kg**

Maximum value of SAR (measured) = 10.2 W/kg



0 dB = 10.2 W/kg = 10.09 dBW/kg



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1150\_Oct18**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1150**

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

Calibration date: **October 22, 2018**

*BNV*  
*10/30/2018*  
*BNV*  
*10-20-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (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            | 04-Oct-18 (No. DAE4-601_Oct18)    | Oct-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |                       |                                   |                              |
|----------------|-----------------------|-----------------------------------|------------------------------|
| Calibrated by: | Name<br>Michael Weber | Function<br>Laboratory Technician | Signature<br><i>M. Weber</i> |
| Approved by:   | Katja Pokovic         | Technical Manager                 | <i>K. Pokovic</i>            |

Issued: October 22, 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.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.2    |
| <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>                    | 1750 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             | 40.1           | 1.37 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 38.8 $\pm$ 6 % | 1.33 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 | 9.02 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>36.5 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 | 4.76 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         |
|------------------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Body TSL parameters</b>             | 22.0 °C             | 53.4           | 1.49 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 53.5 $\pm$ 6 % | 1.46 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 | 9.04 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 | 4.82 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>19.4 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 | 50.9 $\Omega$ - 0.4 j $\Omega$ |
| Return Loss                          | - 40.1 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.6 $\Omega$ - 0.1 j $\Omega$ |
| Return Loss                          | - 29.2 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 | April 10, 2015 |

## DASY5 Validation Report for Head TSL

Date: 22.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1150**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.33$  S/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

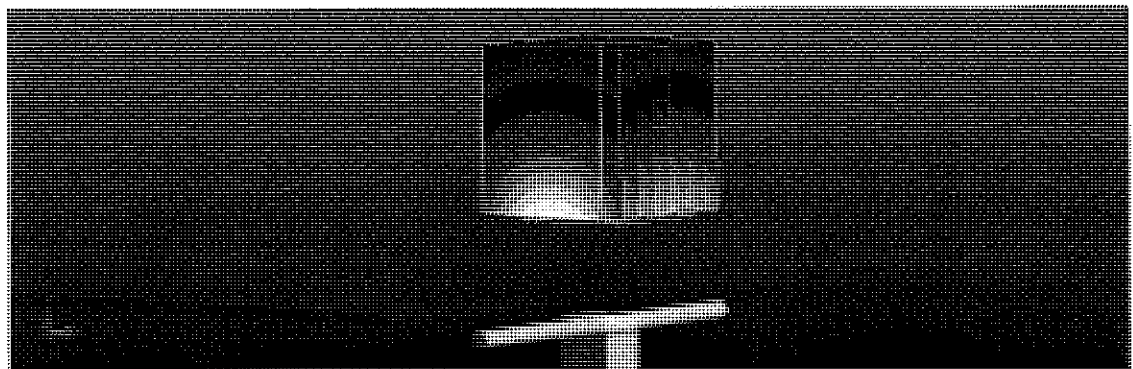
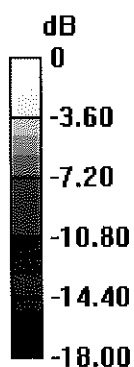
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.1 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.7 W/kg

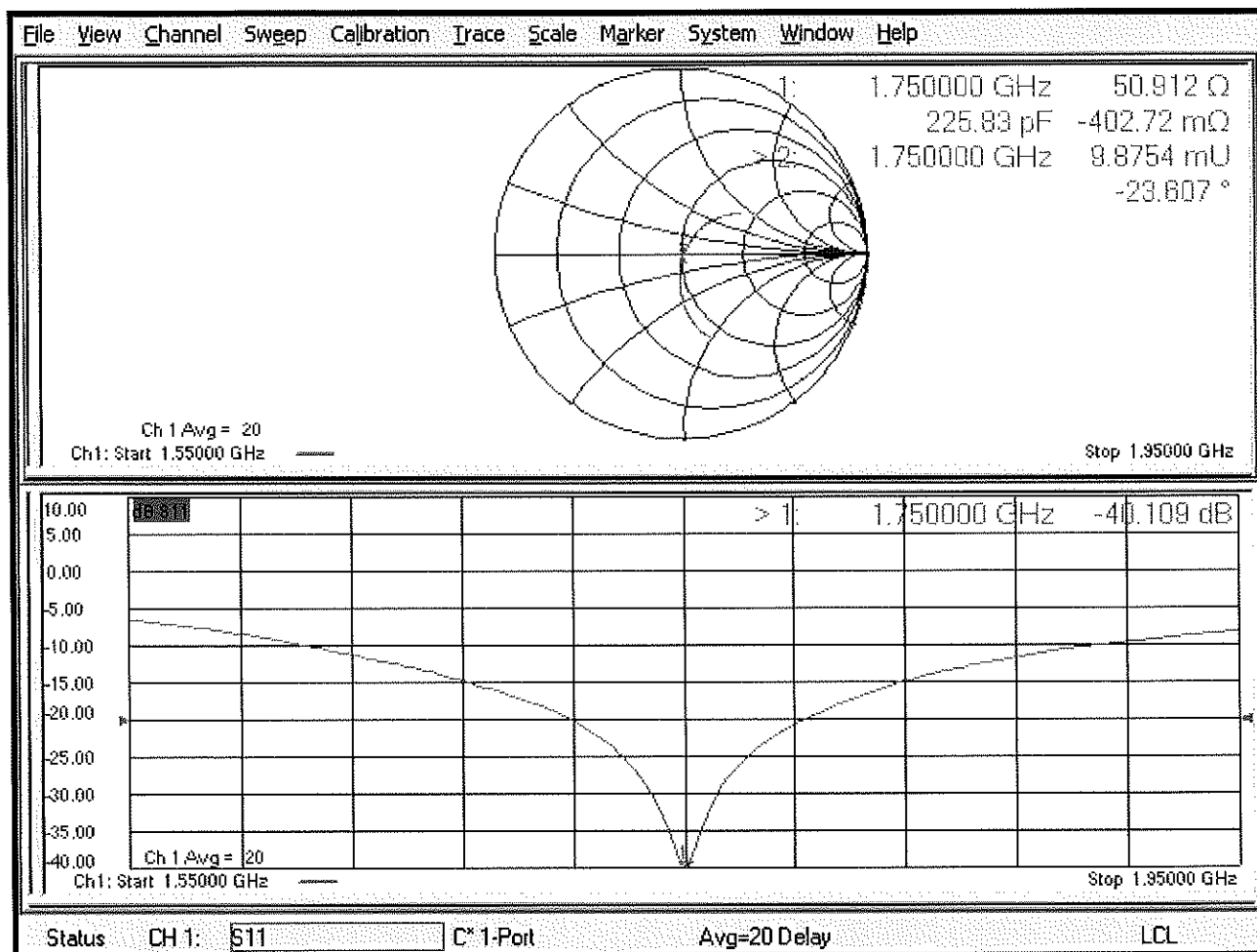
**SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.76 W/kg**

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



0 dB = 14.0 W/kg = 11.46 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 22.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1150**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 53.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

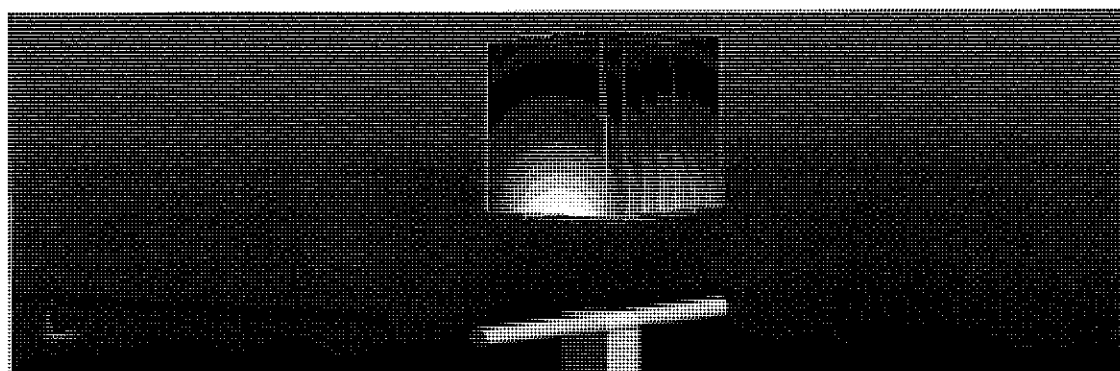
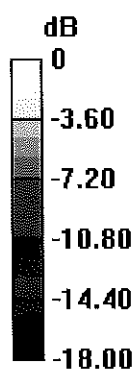
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.1 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.0 W/kg

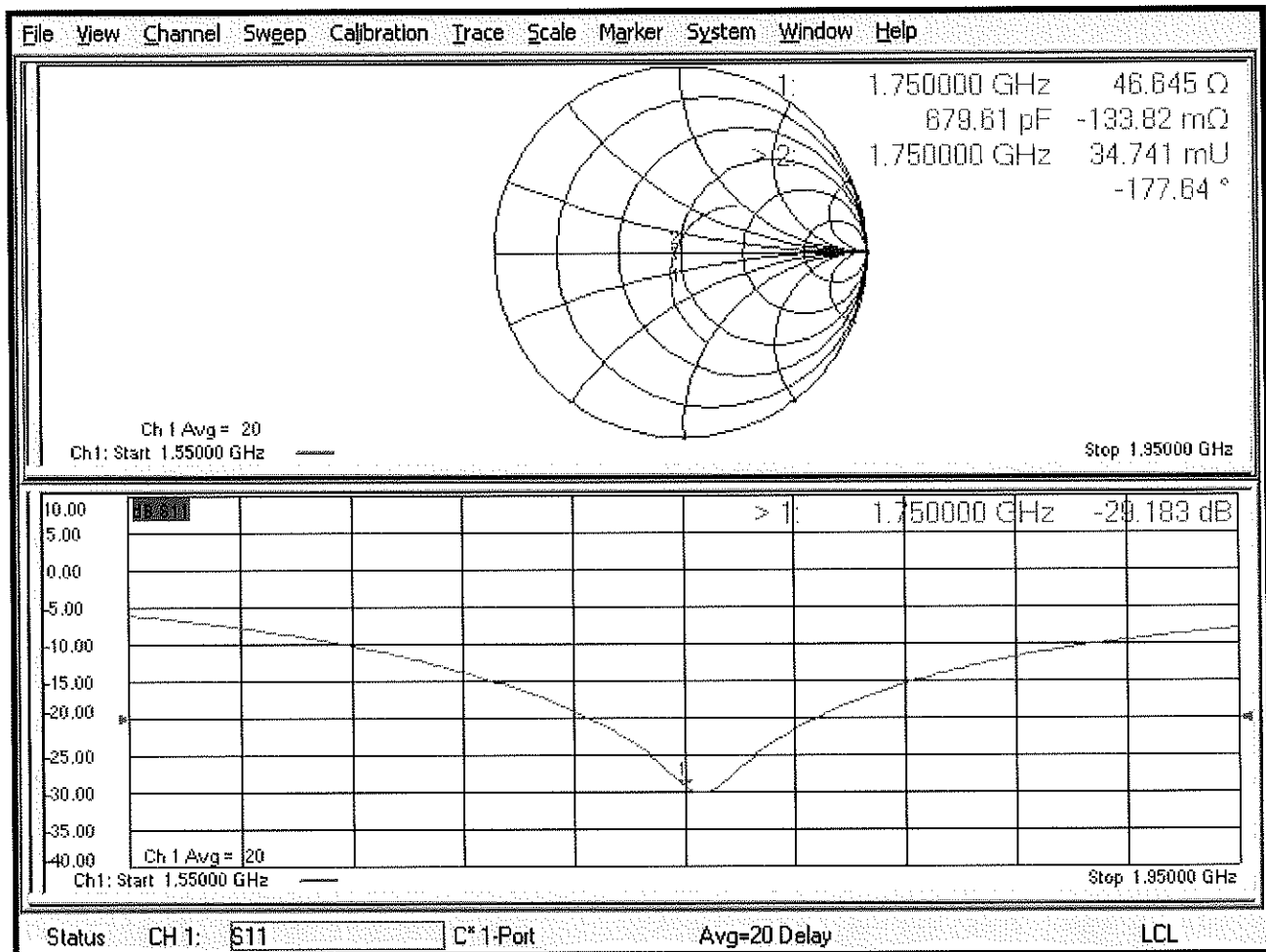
**SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.82 W/kg**

Maximum value of SAR (measured) = 13.6 W/kg



0 dB = 13.6 W/kg = 11.34 dBW/kg

## Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D1750V2 – SN:1150

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 1750 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 8/16/2019  | Annual       | 8/16/2020  | 7308          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 4/24/2019  | Annual       | 4/24/2020  | 7357          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 4/18/2019  | Annual       | 4/18/2020  | 1407          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 8/14/2019  | Annual       | 8/14/2020  | 1450          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

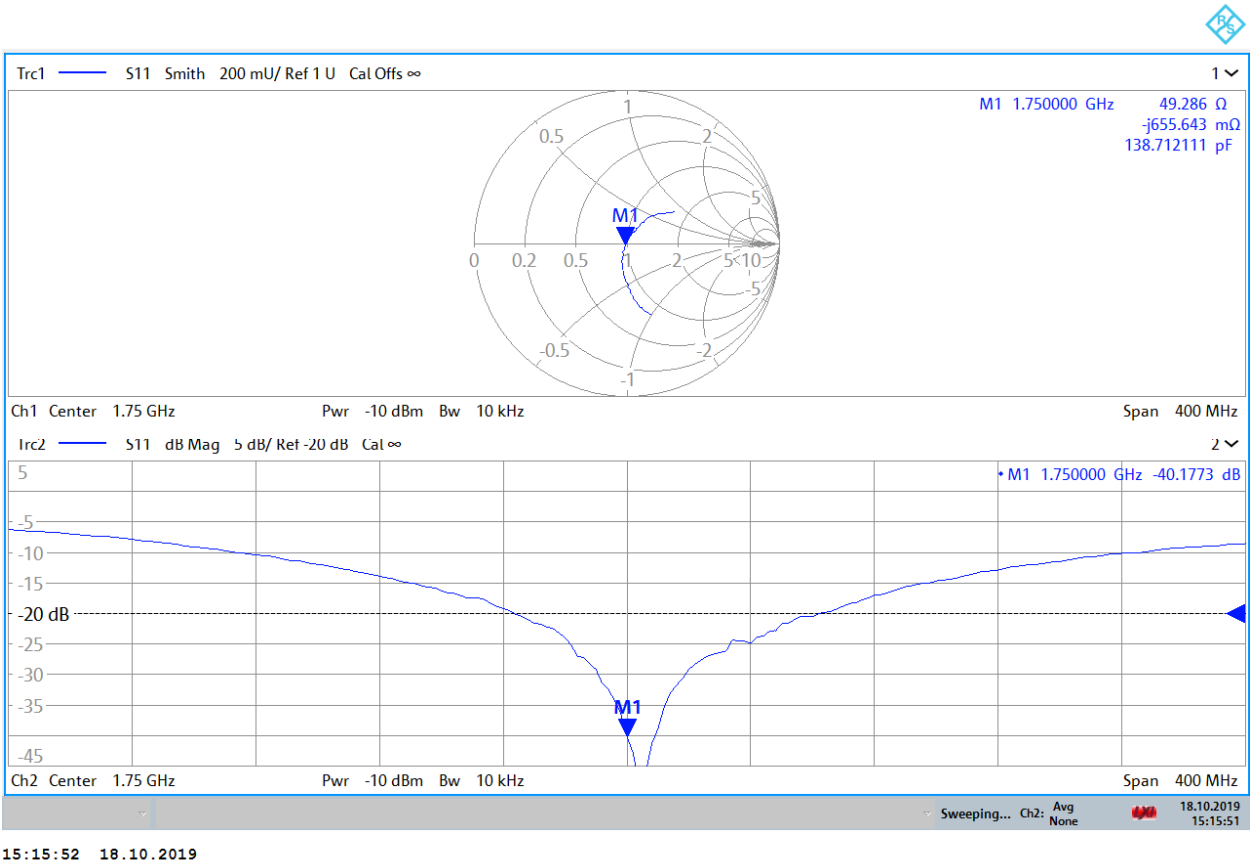
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

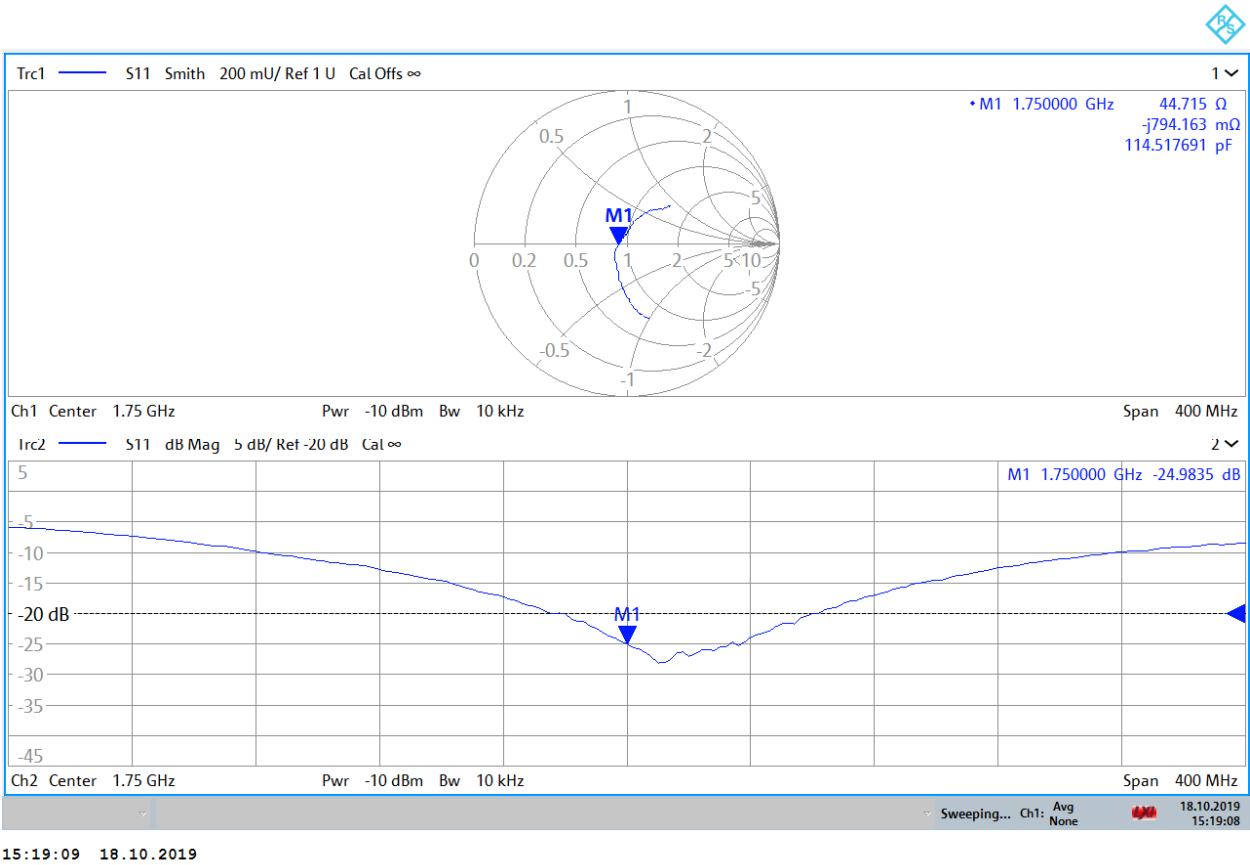
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/22/2018       | 10/18/2019     | 1.217                             | 3.65                                             | 3.8                                    | 4.11%            | 1.92                                              | 2                                       | 4.17%             | 50.9                                  | 49.3                               | 1.6                   | 0.4                                        | -0.7                                    | 1.1                        | -40.1                             | -40.2                          | -0.20%        | 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 |
| 10/22/2018       | 10/18/2019     | 1.217                             | 3.66                                             | 3.82                                   | 4.37%            | 1.94                                              | 2.02                                    | 4.12%             | 46.6                                  | 44.7                               | 1.9                   | -0.1                                       | -0.8                                    | 0.7                        | -29.2                             | -25                            | 14.40%        | 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: **D1900V2-5d080\_Oct18**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d080**

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

Calibration date: **October 23, 2018**

*BN ✓*  
*10-30-2018*  
*BN ✓*  
*10-20-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&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            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A            | SN: GB37480704 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |                |                       |           |
|----------------|----------------|-----------------------|-----------|
|                | Name           | Function              | Signature |
| Calibrated by: | Jeton Kastrati | Laboratory Technician |           |
| Approved by:   | Katja Pokovic  | Technical Manager     |           |

Issued: October 23, 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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| 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 | 40.3 $\pm$ 6 % | 1.40 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 | 9.93 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>39.8 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 | 5.18 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>20.7 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 | 52.9 $\pm$ 6 % | 1.47 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 | 9.62 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>39.2 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 | 5.09 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>20.6 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 | 52.5 $\Omega$ + 7.9 j $\Omega$ |
| Return Loss                          | - 21.8 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.1 $\Omega$ + 8.1 j $\Omega$ |
| Return Loss                          | - 21.5 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.193 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 28, 2006 |

## DASY5 Validation Report for Head TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.4$  S/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.18, 8.18, 8.18) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

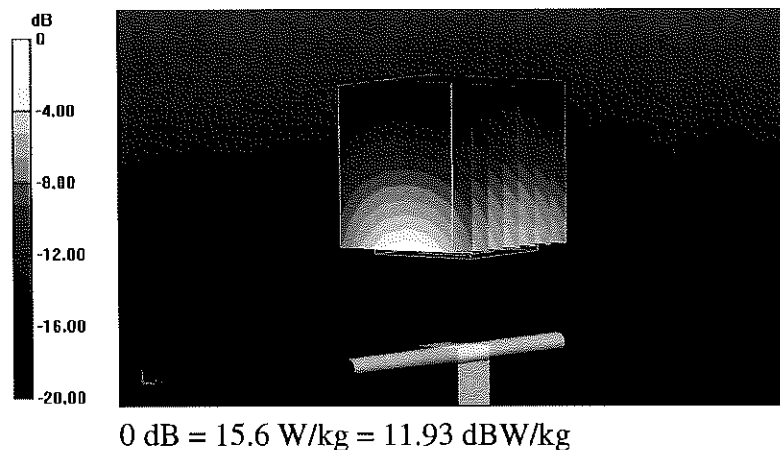
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.0 V/m; Power Drift = -0.05 dB

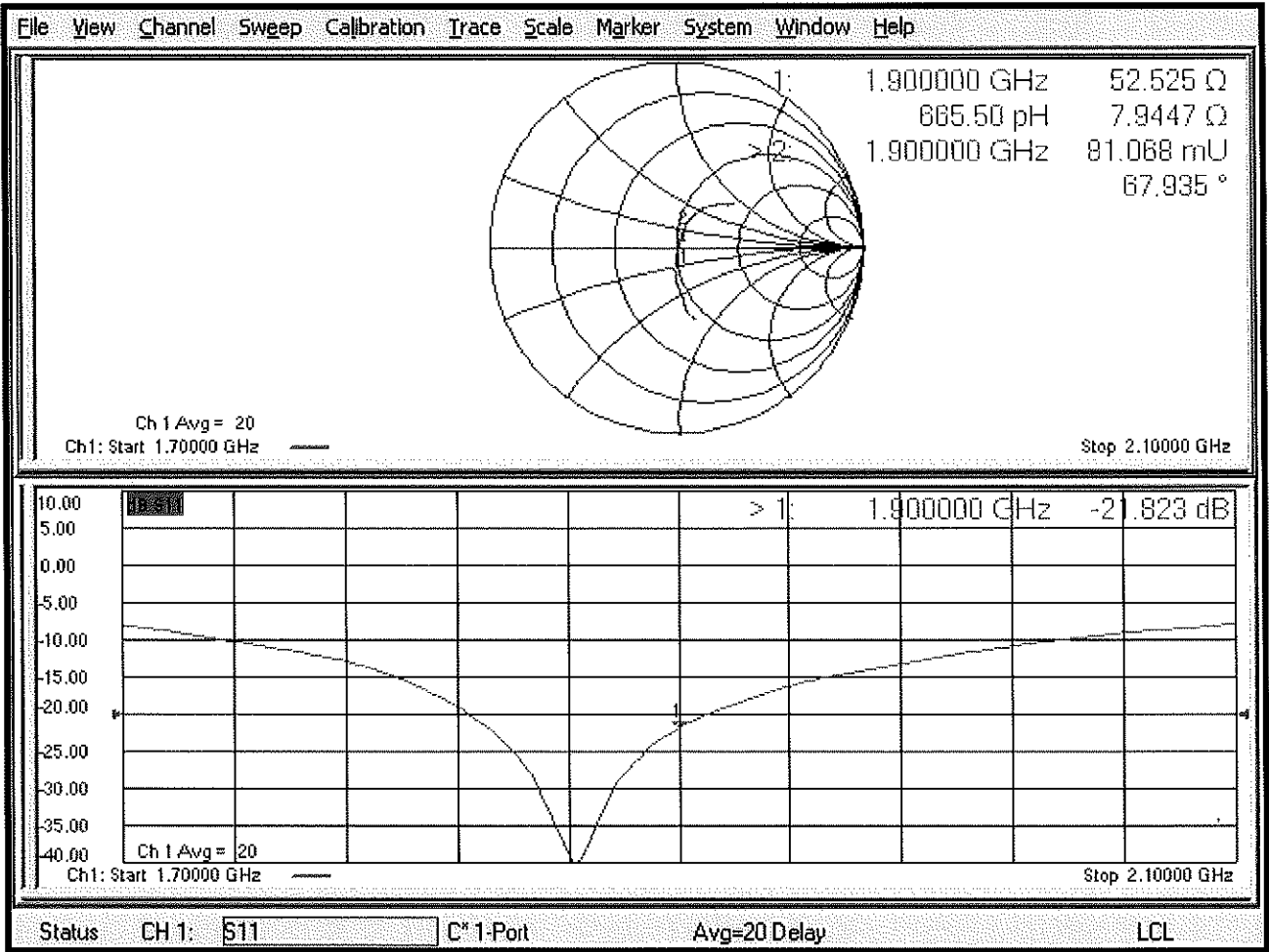
Peak SAR (extrapolated) = 18.7 W/kg

**SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.18 W/kg**

Maximum value of SAR (measured) = 15.6 W/kg



Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 52.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.15, 8.15, 8.15) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

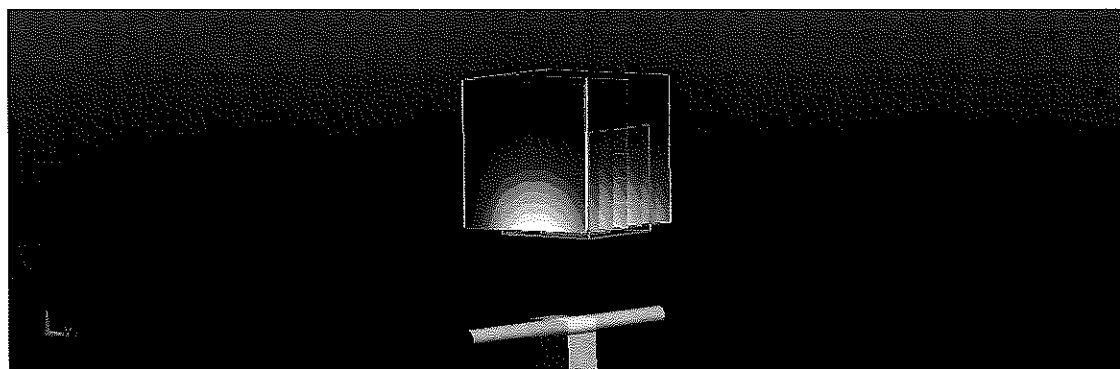
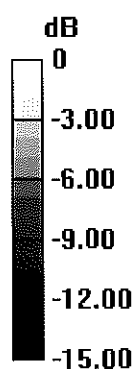
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.86 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 17.3 W/kg

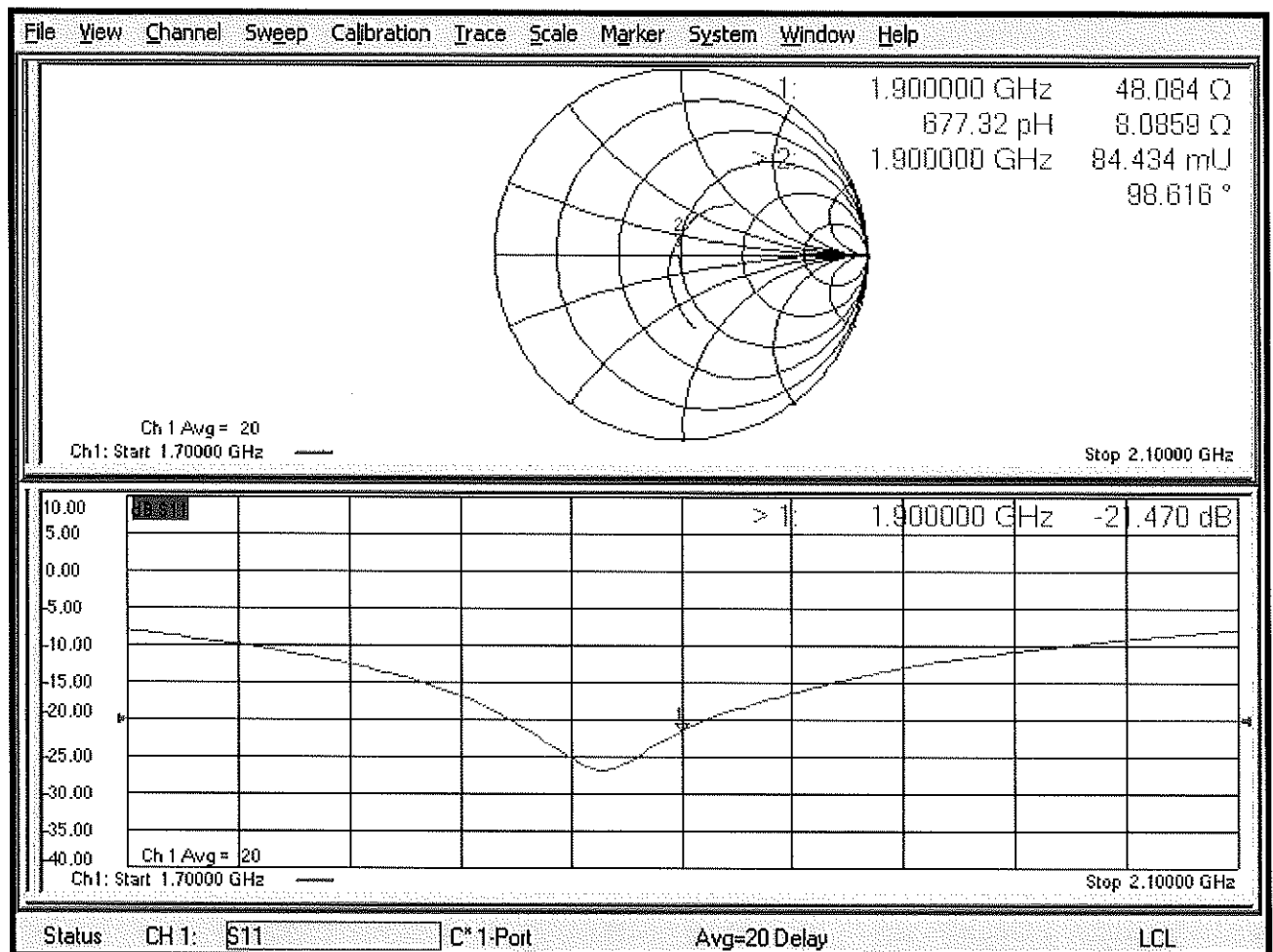
**SAR(1 g) = 9.62 W/kg; SAR(10 g) = 5.09 W/kg**

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



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

# Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D1900V2 – SN:5d080

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 1900 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 5/16/2019  | Annual       | 5/16/2020  | 7406          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 5/8/2019   | Annual       | 5/8/2020   | 859           |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

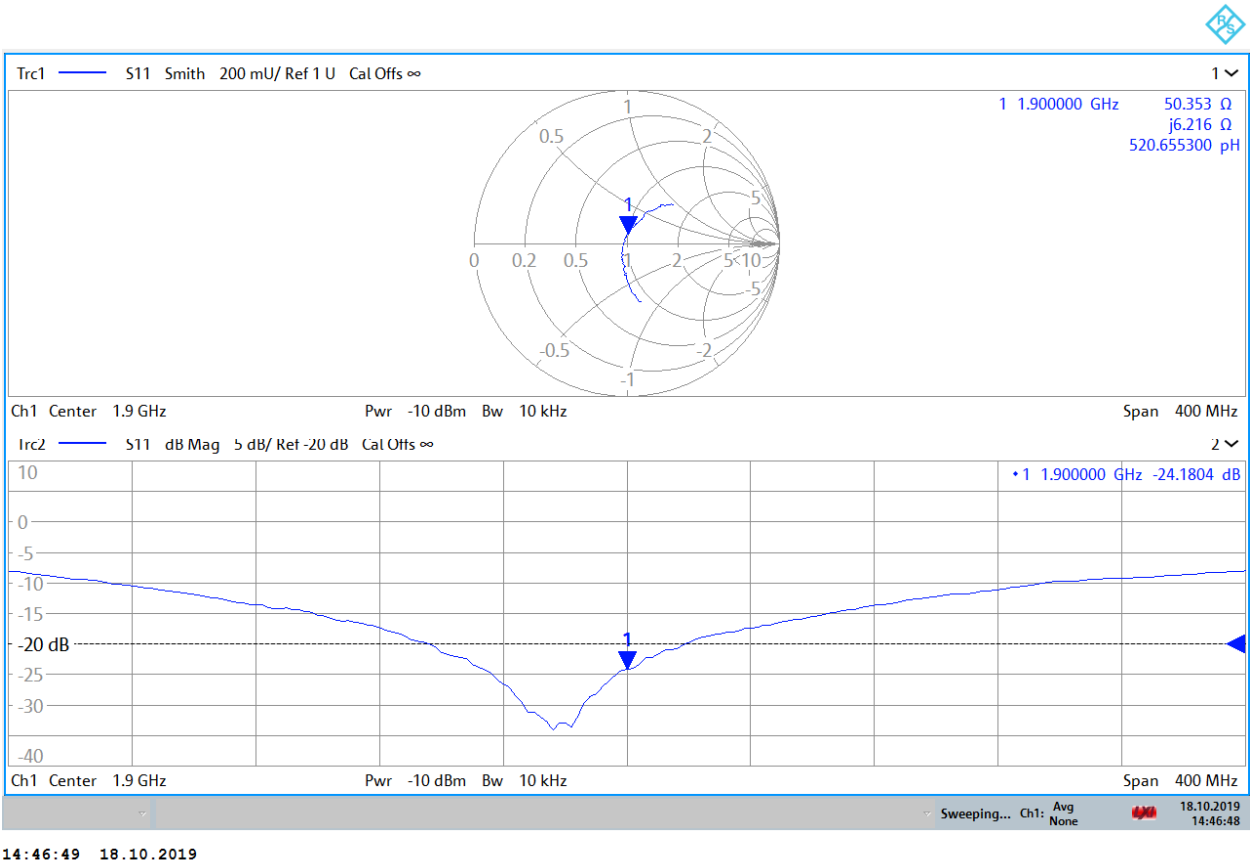
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

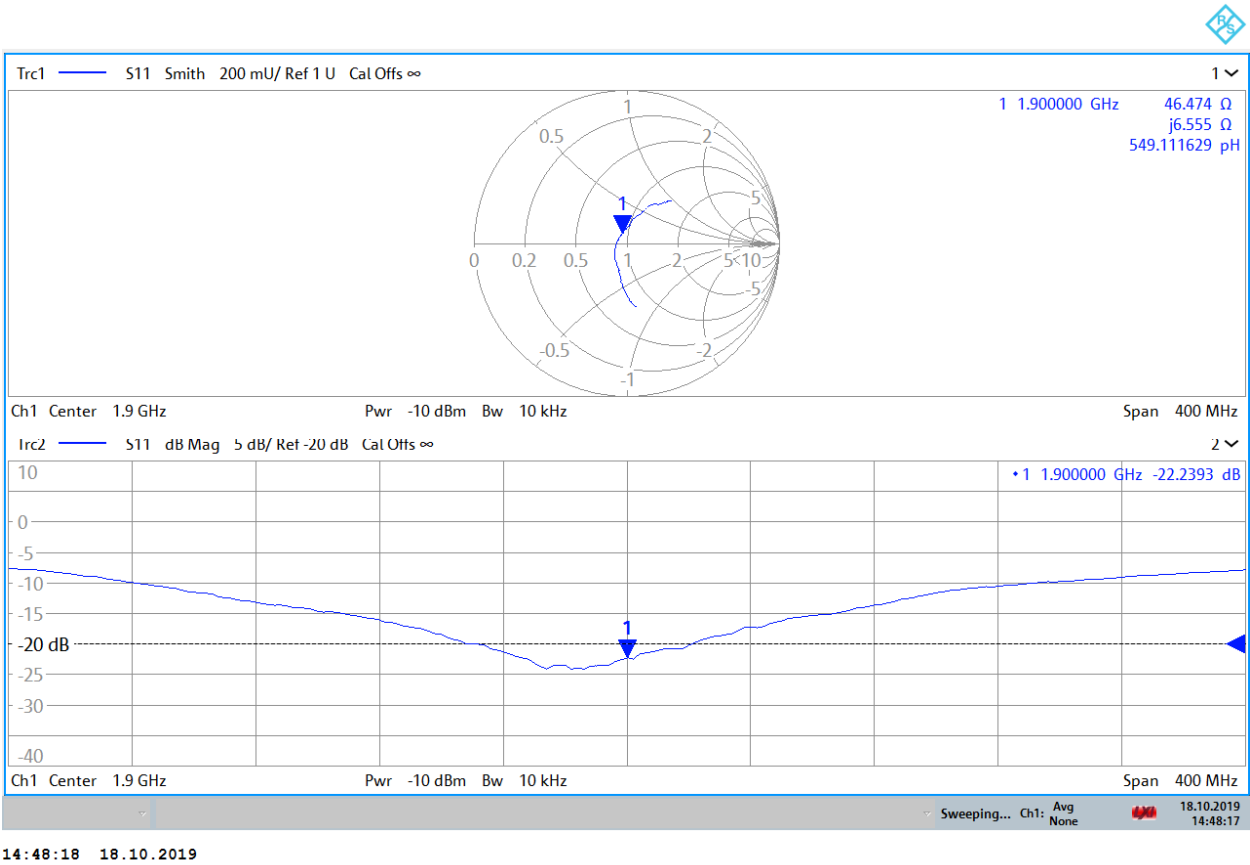
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/23/2018       | 10/18/2019     | 1.193                             | 3.98                                             | 4.16                                   | 4.52%            | 2.07                                              | 2.13                                    | 2.90%             | 52.5                                  | 50.4                               | 2.1                   | 7.9                                        | 6.2                                     | 1.7                        | -21.8                             | -24.2                          | -10.90%       | 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 |
| 10/23/2018       | 10/18/2019     | 1.193                             | 3.92                                             | 4.21                                   | 7.40%            | 2.06                                              | 2.16                                    | 4.85%             | 48.1                                  | 46.5                               | 1.6                   | 8.1                                        | 6.6                                     | 1.5                        | -21.5                             | -22.2                          | -3.40%        | 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: **D1900V2-5d148\_Feb19**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d148**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **February 21, 2019**

*BNV  
05-01-19*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 04-Apr-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 31-Dec-18 (No. EX3-7349_Dec18)    | Dec-19                 |
| DAE4                            | SN: 601            | 04-Oct-18 (No. DAE4-601_Oct18)    | Oct-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 07-Oct-15 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

Calibrated by: **Manu Seitz**      Name: **Manu Seitz**      Function: **Laboratory Technician**

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

*[Signatures]*

Issued: February 21, 2019

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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| 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 | 40.9 $\pm$ 6 % | 1.38 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 | 9.65 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>39.1 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 | 5.05 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>20.4 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 | 53.6 $\pm$ 6 % | 1.47 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 | 9.56 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>39.1 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 | 5.05 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>20.5 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 | $51.8 \Omega + 6.8 j\Omega$ |
| Return Loss                          | - 23.2 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $48.4 \Omega + 7.8 j\Omega$ |
| Return Loss                          | - 21.9 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 |
|-----------------|-------|

## DASY5 Validation Report for Head TSL

Date: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.38$  S/m;  $\epsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

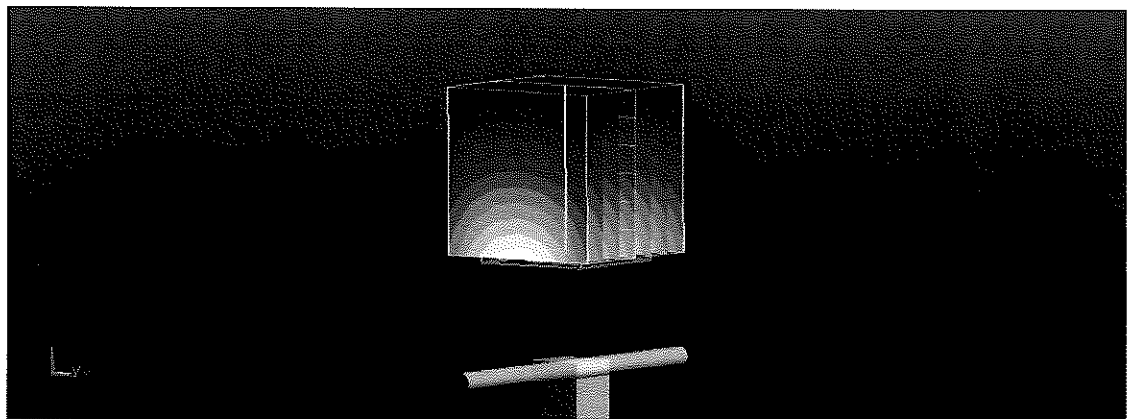
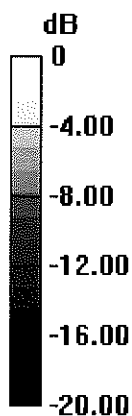
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.4 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.8 W/kg

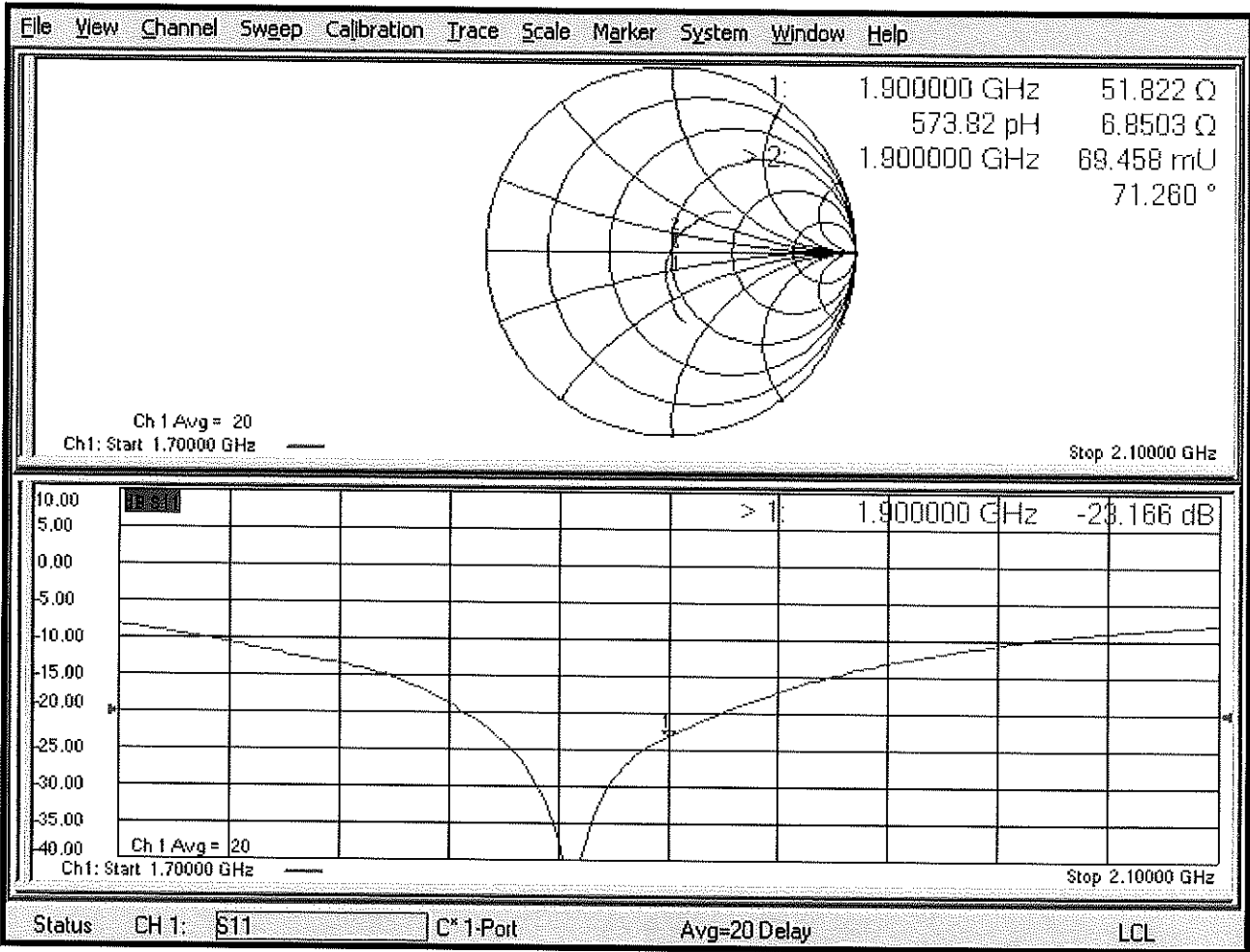
**SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.05 W/kg**

Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.23, 8.23, 8.23) @ 1900 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

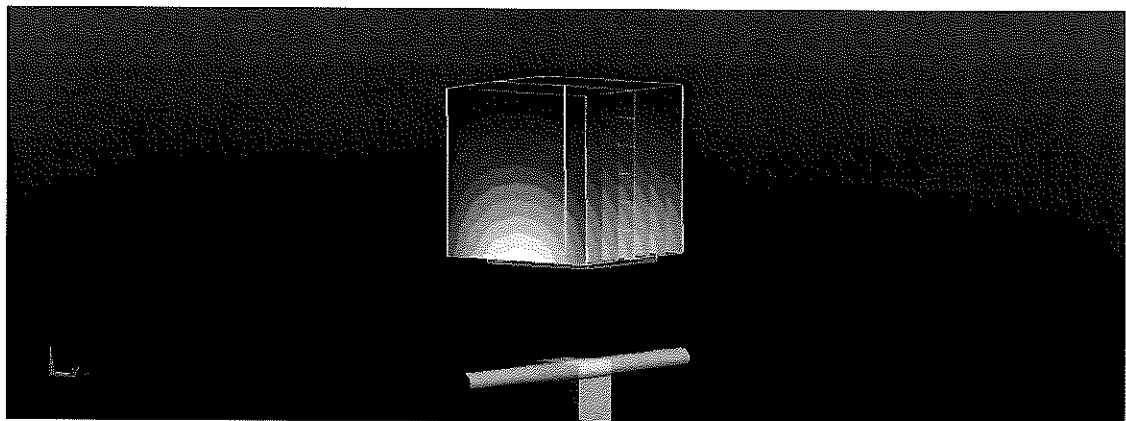
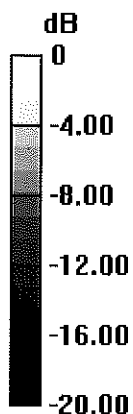
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.7 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.0 W/kg

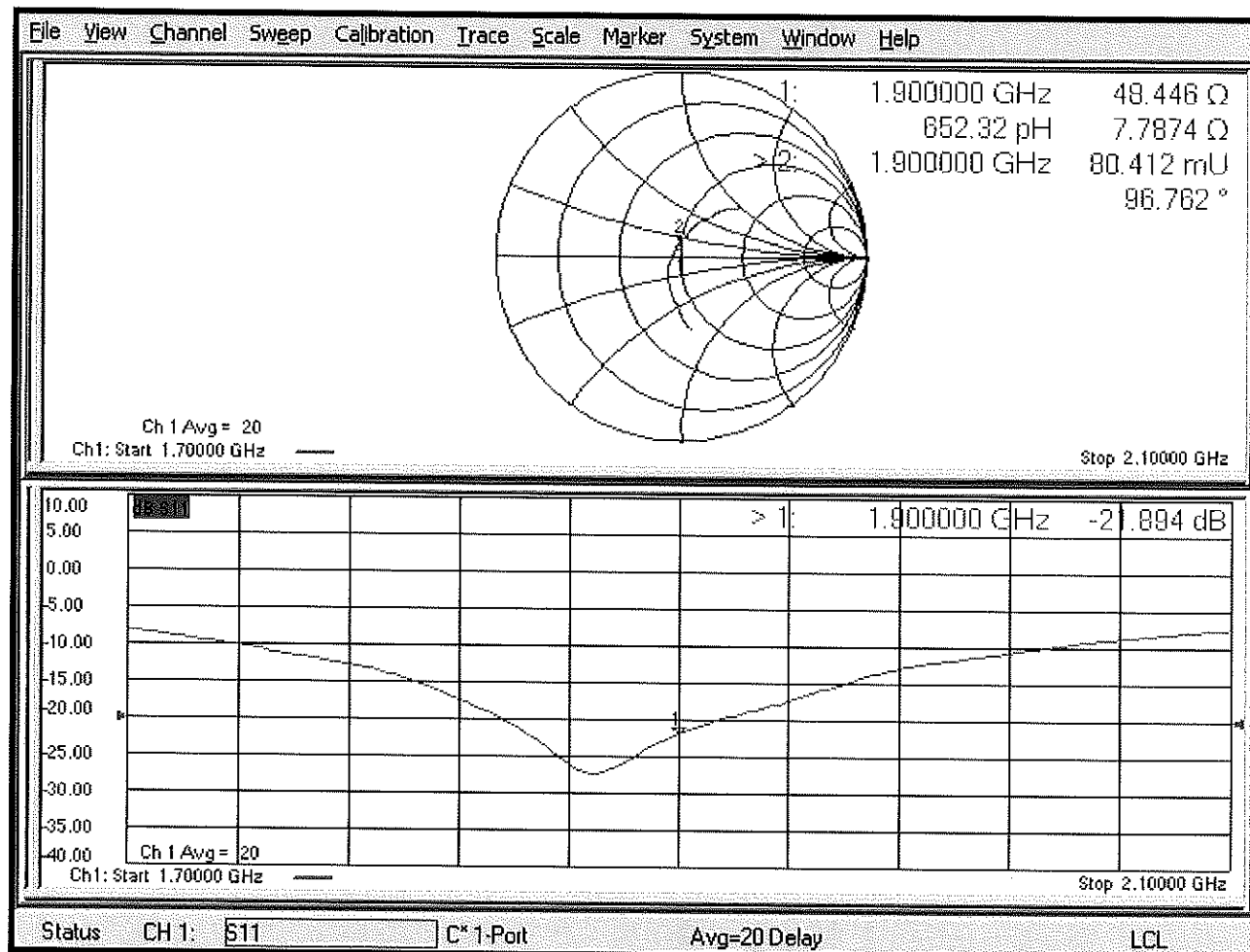
**SAR(1 g) = 9.56 W/kg; SAR(10 g) = 5.05 W/kg**

Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

## Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d149\_Oct18**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d149**

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

Calibration date: **October 23, 2018**

*BNV*  
*10-30-2018*  
*BNV*  
*10-20-2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (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            | 04-Oct-18 (No. DAE4-601_Oct18)  | Oct-19                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A            | SN: GB37480704 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                |                |                       |           |
|----------------|----------------|-----------------------|-----------|
|                | Name           | Function              | Signature |
| Calibrated by: | Jeton Kastrati | Laboratory Technician |           |
| Approved by:   | Katja Pokovic  | Technical Manager     |           |

Issued: October 23, 2018

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

### Glossary:

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

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

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| 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 | 40.3 $\pm$ 6 % | 1.40 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 | 9.80 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>39.3 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 | 5.11 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.5 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 | 52.9 $\pm$ 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 | 9.68 W/kg                                      |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>39.4 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 | 5.11 W/kg                                      |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>20.7 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 | $52.9\ \Omega + 6.3\ j\Omega$ |
| Return Loss                          | - 23.4 dB                     |

### Antenna Parameters with Body TSL

|                                      |                               |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | $48.5\ \Omega + 8.2\ j\Omega$ |
| Return Loss                          | - 21.5 dB                     |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.193 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 11, 2011 |

## DASY5 Validation Report for Head TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d149**

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

Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.4 \text{ S/m}$ ;  $\epsilon_r = 40.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.18, 8.18, 8.18) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

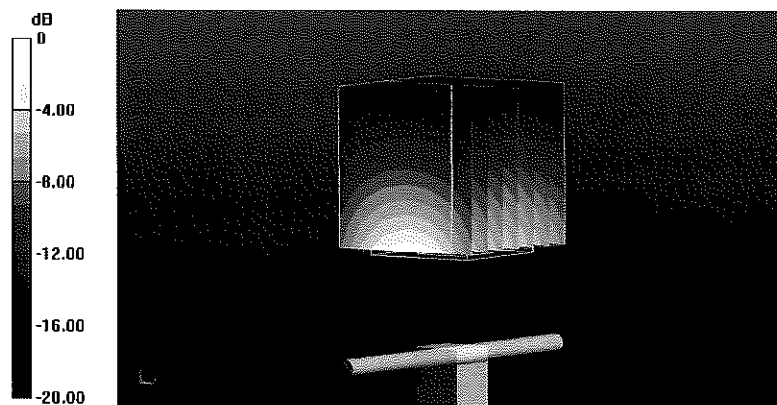
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 110.0 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 18.5 W/kg

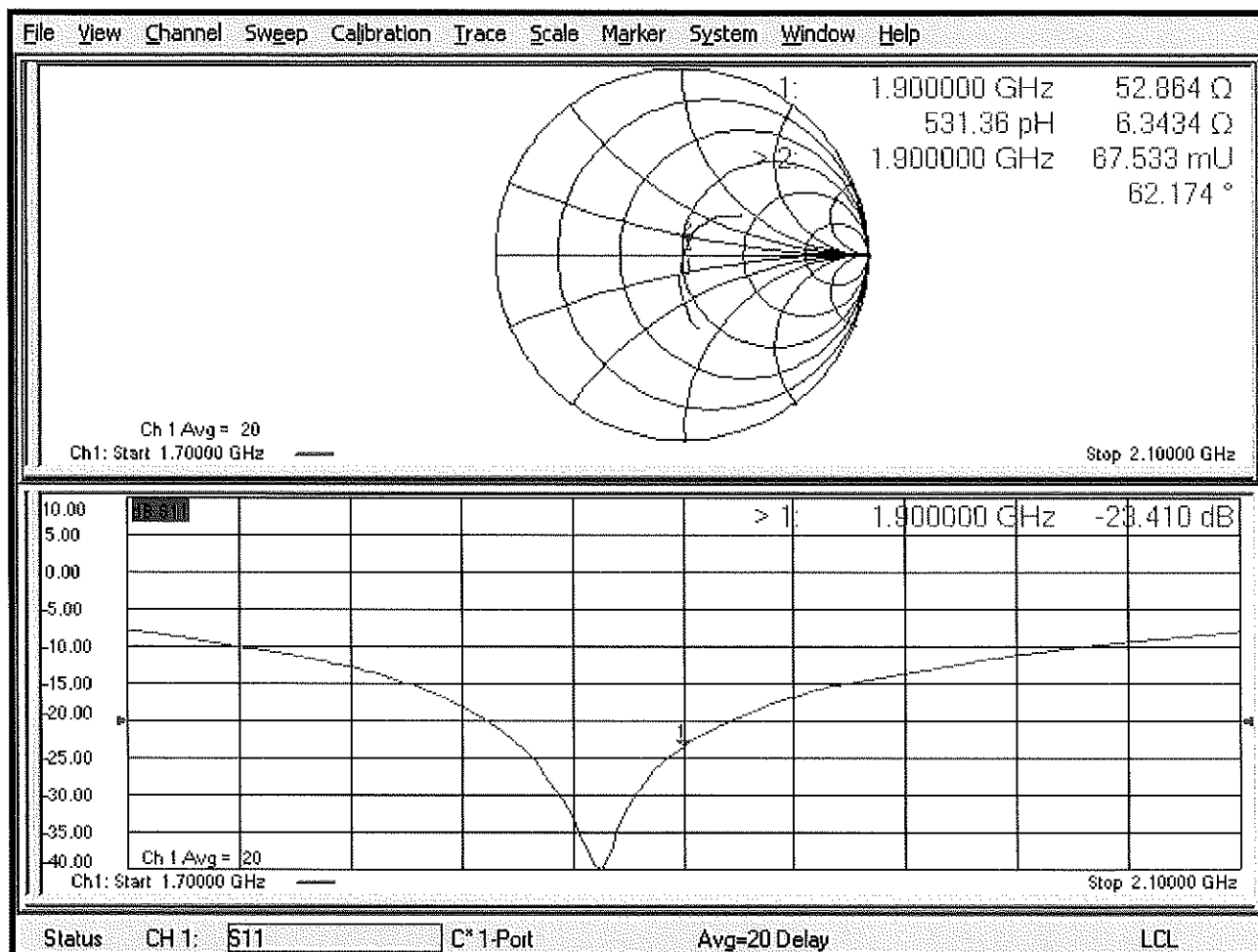
**SAR(1 g) = 9.8 W/kg; SAR(10 g) = 5.11 W/kg**

Maximum value of SAR (measured) = 15.4 W/kg



0 dB = 15.4 W/kg = 11.88 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d149**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  S/m;  $\epsilon_r = 52.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.15, 8.15, 8.15) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

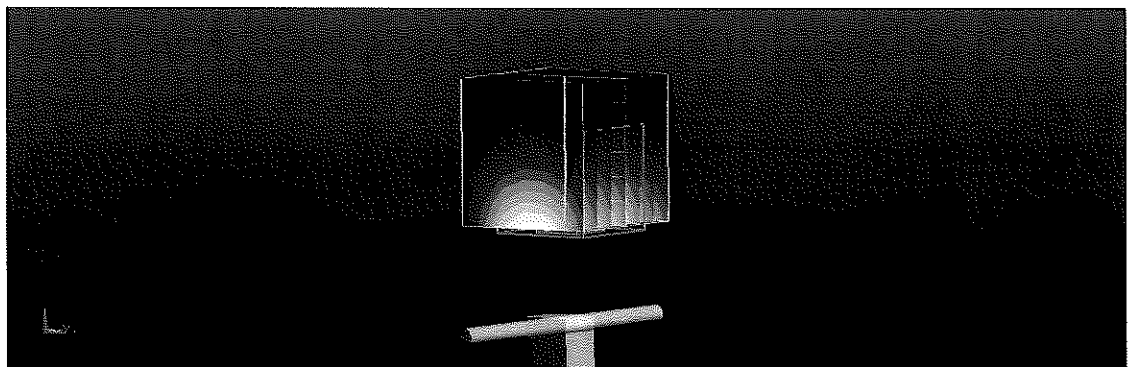
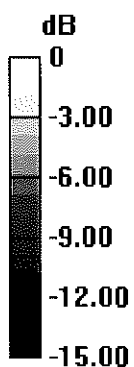
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.5 W/kg

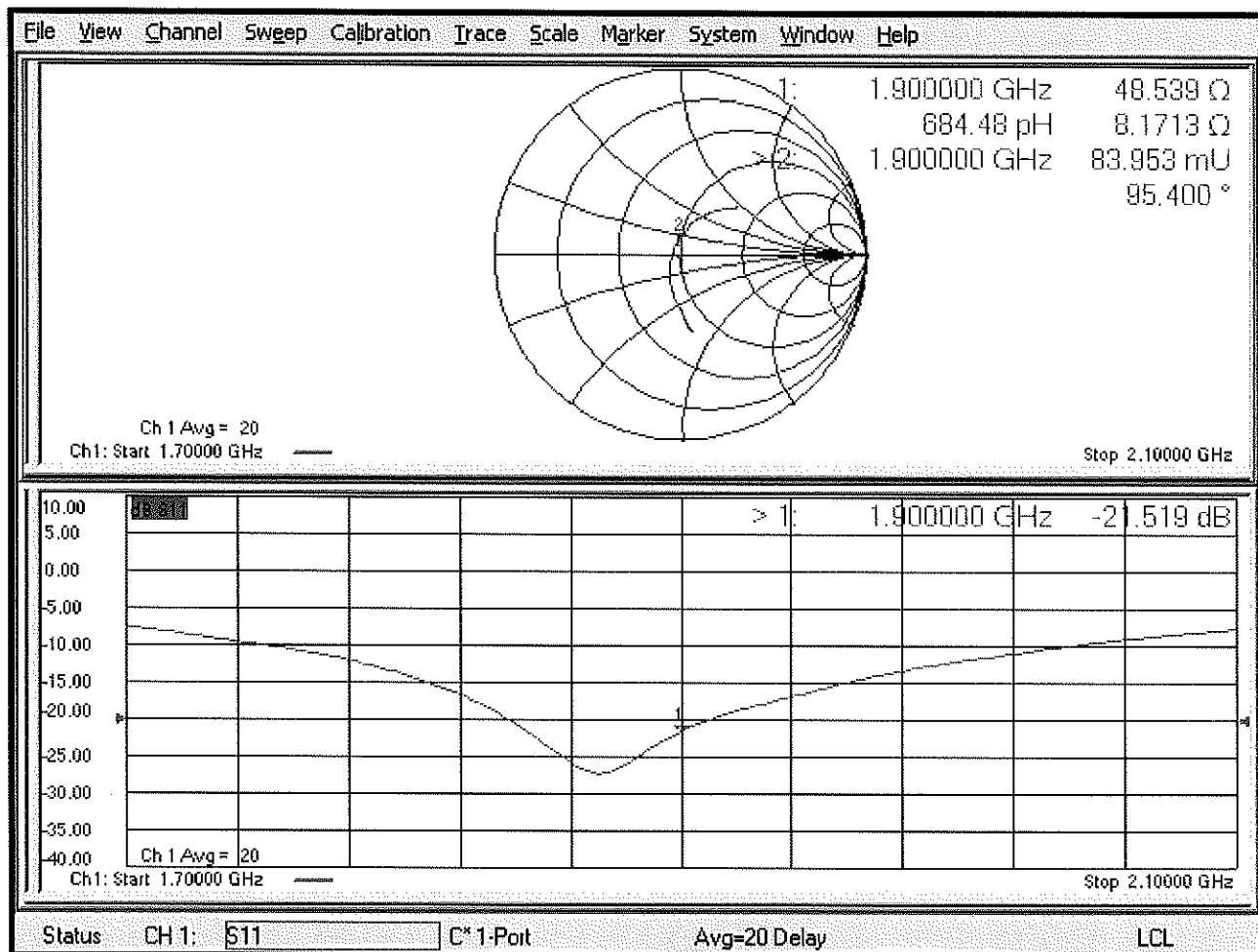
**SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.11 W/kg**

Maximum value of SAR (measured) = 14.2 W/kg



0 dB = 14.2 W/kg = 11.52 dBW/kg

## Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D1900V2 – SN:5d149

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

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 1900 MHz.

## Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable Dielectric Assessment Kit                      | 8/13/2019  | Annual       | 8/13/2020  | 1041          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Anritsu               | ML2495A       | Power Meter                                             | 11/20/2018 | Annual       | 11/20/2019 | 1039008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| Mini-Circuits         | NLP-2950+     | Low Pass Filter DC to 2700 MHz                          | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 5/16/2019  | Annual       | 5/16/2020  | 7406          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 5/8/2019   | Annual       | 5/8/2020   | 859           |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Team Lead Engineer       | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

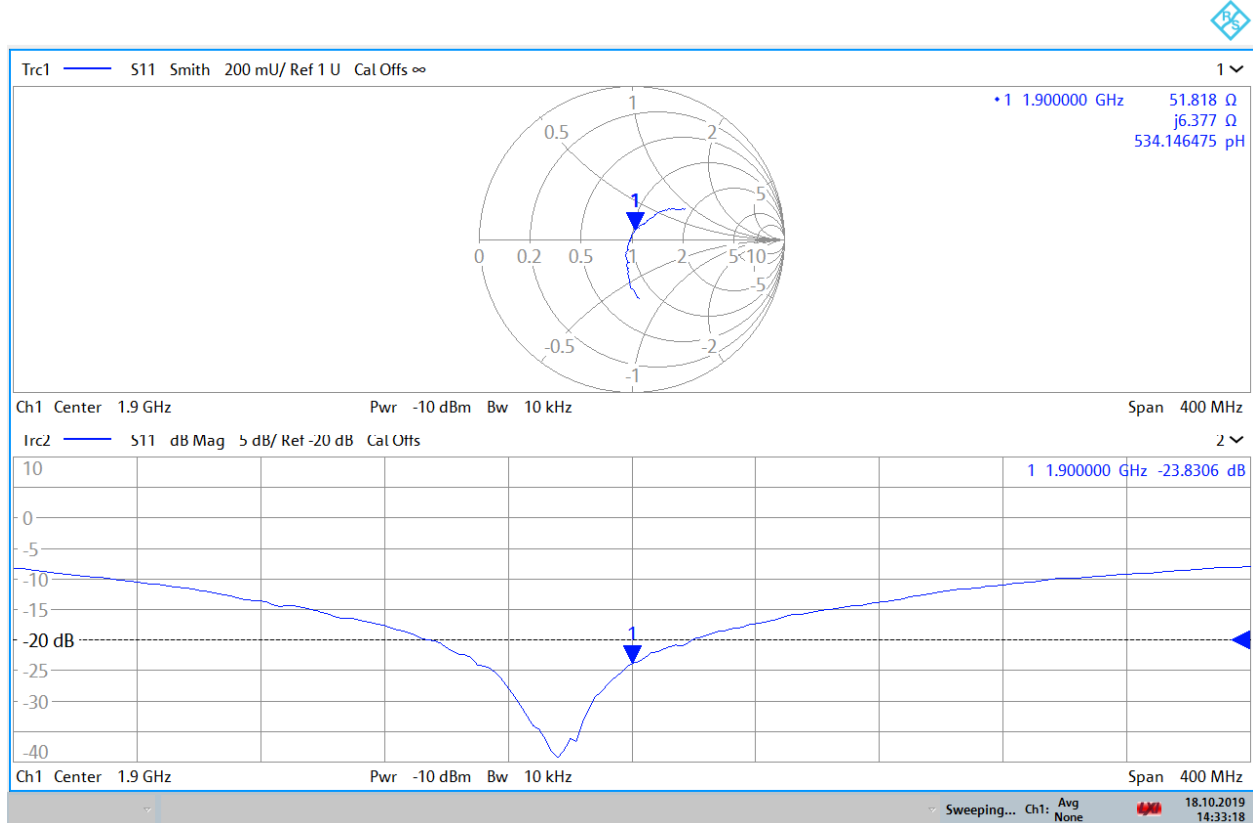
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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:

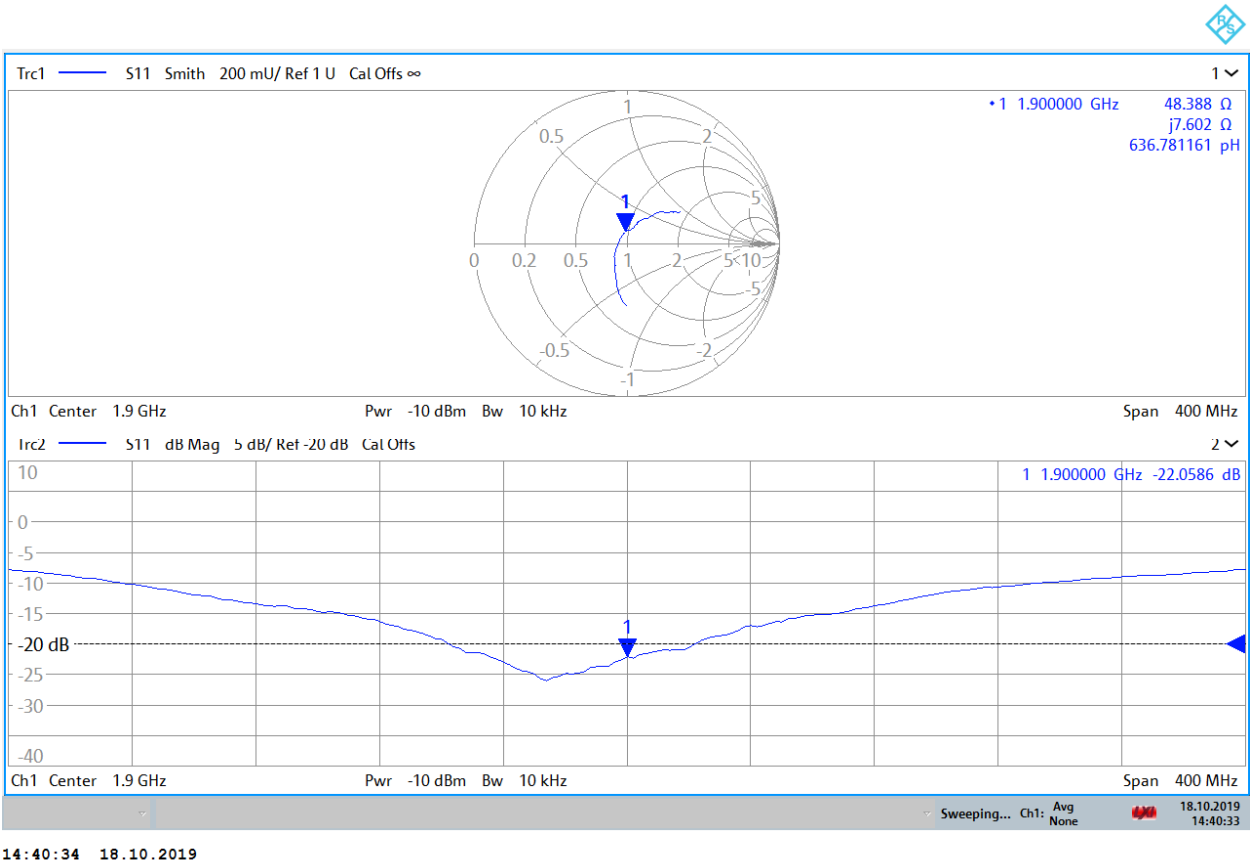
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | Deviation 1g (%) | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | Measured Head SAR (10g) W/kg @ 20.0 dBm | Deviation 10g (%) | Certificate 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 10/23/2018       | 10/18/2019     | 1.193                             | 3.99                                             | 4.24                                   | 7.89%            | 2.05                                              | 2.18                                    | 6.34%             | 52.9                                  | 51.8                               | 1.1                   | 6.3                                        | 6.4                                     | 0.1                        | -23.4                             | -23.8                          | -1.80%        | 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 |
| 10/23/2018       | 10/18/2019     | 1.193                             | 3.98                                             | 4.2                                    | 6.60%            | 2.07                                              | 2.15                                    | 3.96%             | 48.5                                  | 48.4                               | 0.1                   | 8.2                                        | 7.6                                     | 0.6                        | -21.5                             | -22.1                          | -2.60%        | PASS      |

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



14:33:19 18.10.2019

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: **D2300V2-1073\_Aug18**

## CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1073**

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

Calibration date: **August 13, 2018**

*BNV*  
*09-06-2018*  
*BNV*  
*08/10/2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (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 Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

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

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

Signature

*M. Weber*

*K. Pokovic*

Issued: August 13, 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.

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 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 | 38.2 $\pm$ 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   | 49.2 W/kg $\pm$ 17.0 % (k=2) |

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

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.9           | 1.81 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.2 $\pm$ 6 % | 1.85 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 12.1 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 47.7 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 | 5.86 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 23.2 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 | 50.1 $\Omega$ - 5.2 j $\Omega$ |
| Return Loss                          | - 25.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 45.5 $\Omega$ - 4.1 j $\Omega$ |
| Return Loss                          | - 23.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.171 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 | November 16, 2015 |

## DASY5 Validation Report for Head TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073**

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

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.7$  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(8.08, 8.08, 8.08) @ 2300 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

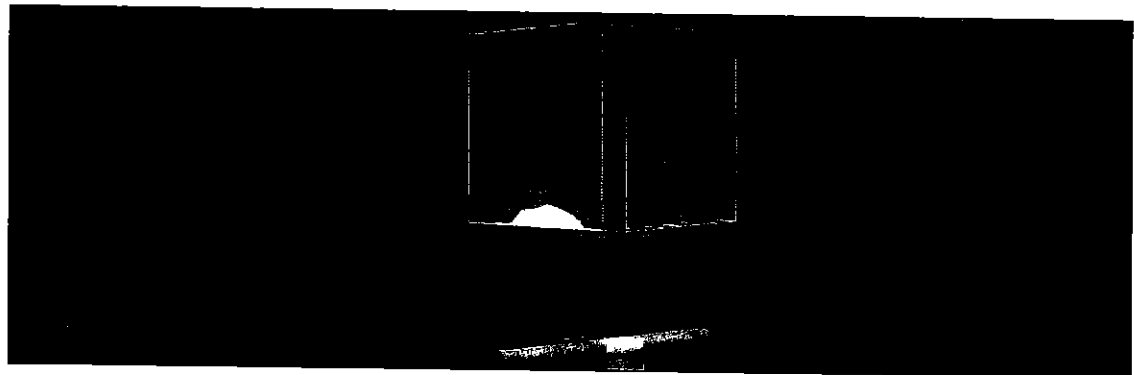
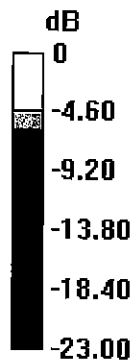
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.9 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 24.1 W/kg

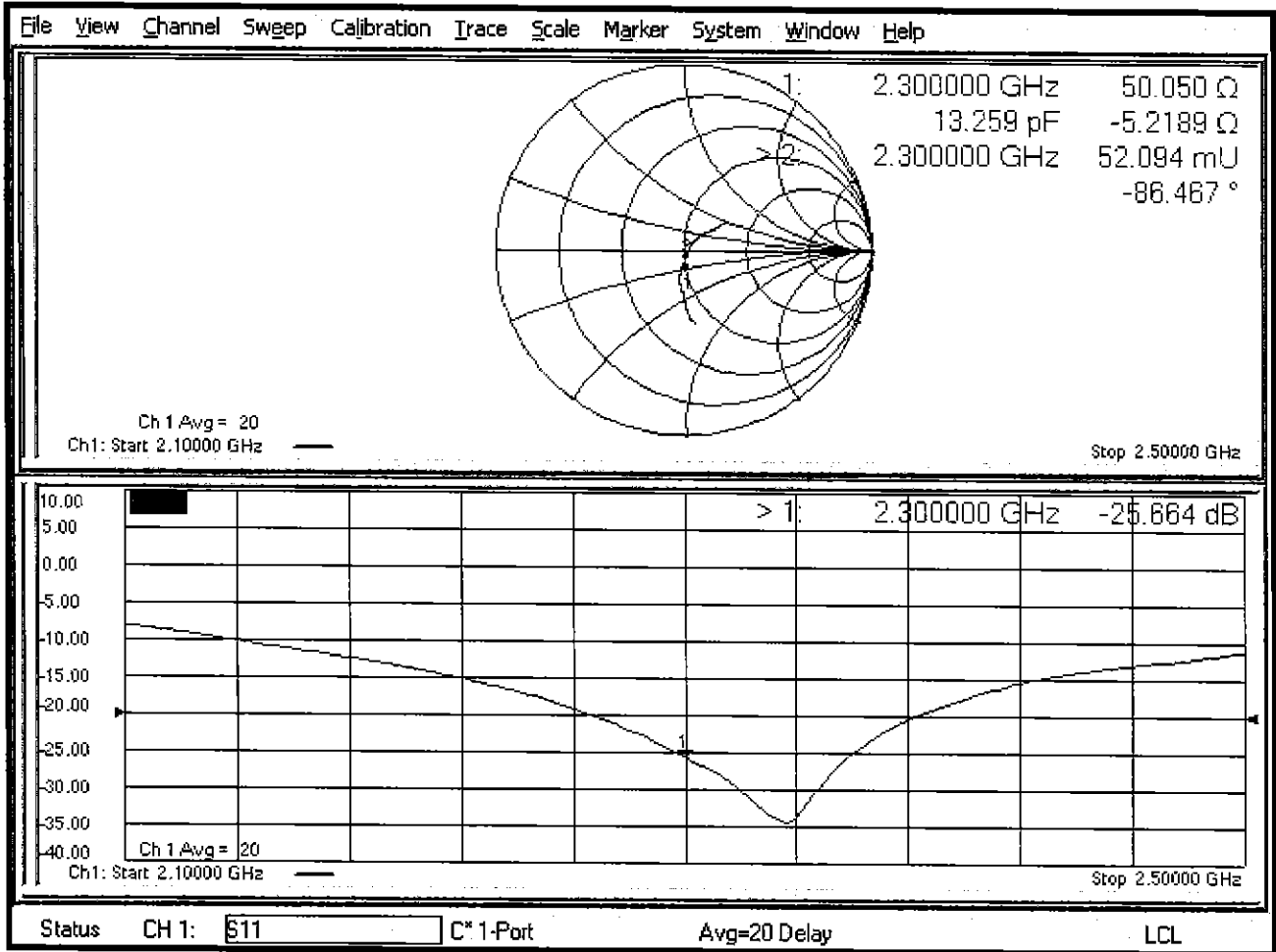
**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 6.02 W/kg**

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



0 dB = 20.2 W/kg = 13.05 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073**

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

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 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:**

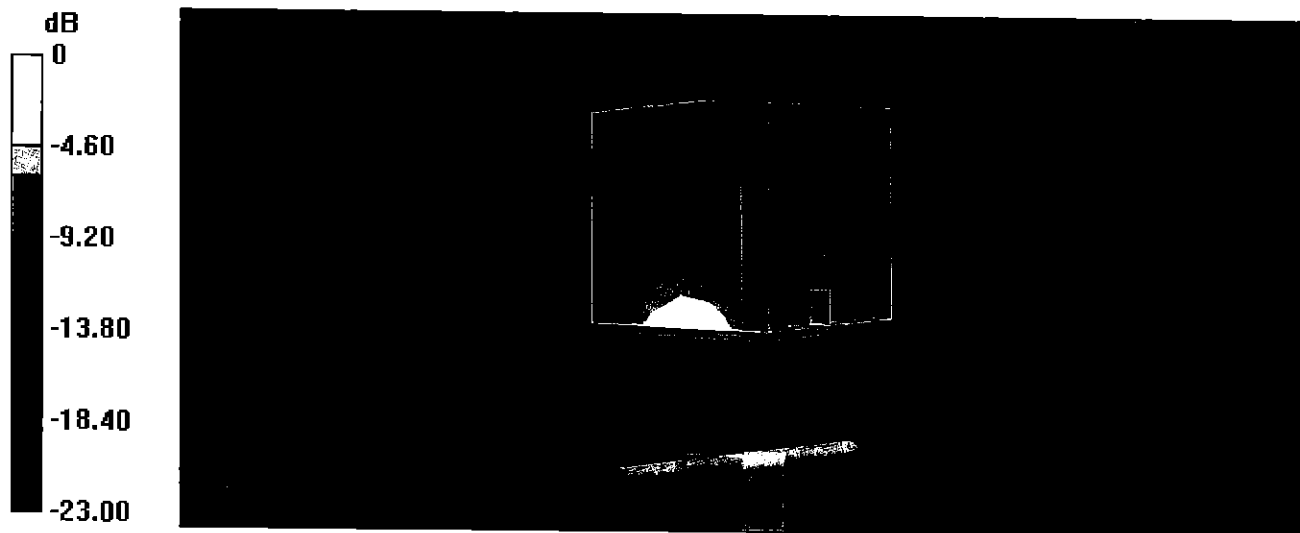
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = -0.08 dB

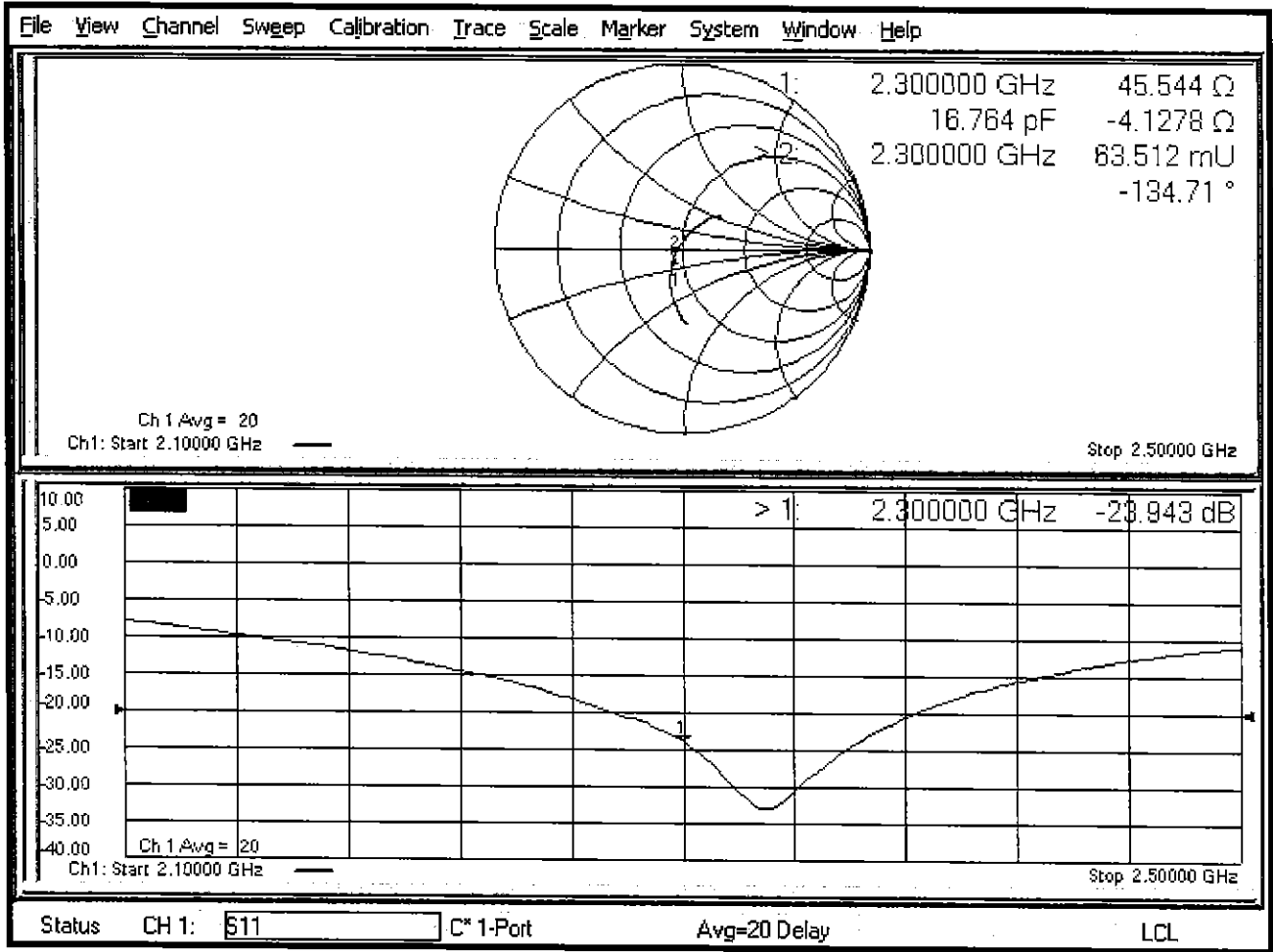
Peak SAR (extrapolated) = 22.9 W/kg

**SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.86 W/kg**

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



Impedance Measurement Plot for Body TSL



# Certification of Calibration

Object D2300V2 – SN: 1073

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

Calibration date: 08/09/2019

Description: SAR Validation Dipole at 2300 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 10/2/2018  | Annual       | 10/2/2019  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 6/27/2019  | Annual       | 6/27/2020  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 10/30/2018 | Annual       | 10/30/2019 | 1207470       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/20/2018 | Annual       | 11/20/2019 | 1339007       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/28/2018  | Biennial     | 2/28/2020  | 170330160     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | 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            | NC-100    | Torque Wrench                                           | 5/23/2018  | Biennial     | 5/23/2020  | N/A           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 7417          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/13/2019  | Annual       | 2/13/2020  | 665           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 7/15/2019  | Annual       | 7/15/2020  | 7547          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 7/11/2019  | Annual       | 7/11/2020  | 1323          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

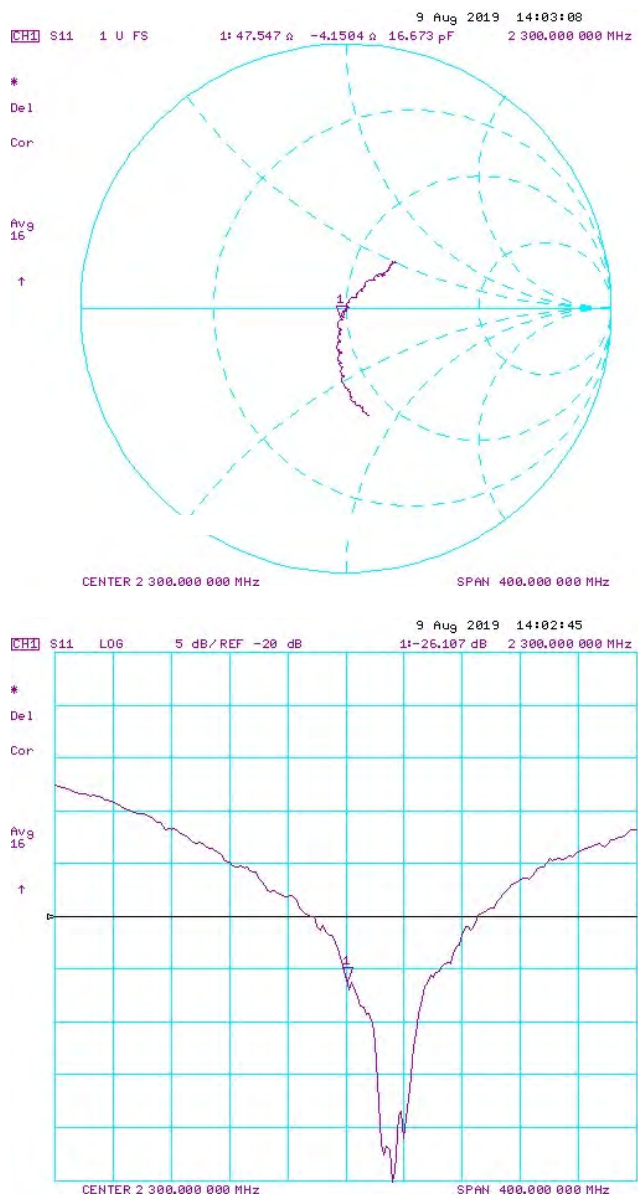
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

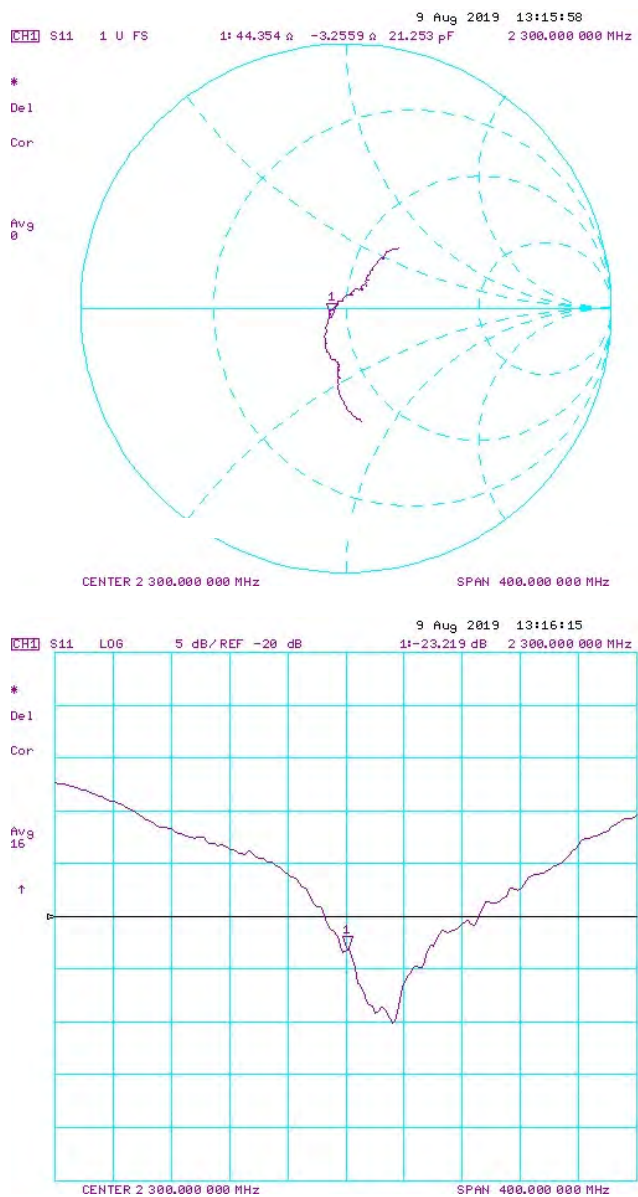
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 8/13/2018        | 8/9/2019       | 1.171                             | 4.92                                             | 5.21                                   | 5.89%            | 2.38                                              | 2.49                                    | 4.62%             | 50.1                                  | 47.5                               | 2.6                   | -5.2                                       | -4.2                                    | 1                          | -25.7                             | -26.1                          | -1.60%        | 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 |
| 8/13/2018        | 8/9/2019       | 1.171                             | 4.77                                             | 5.05                                   | 5.87%            | 2.32                                              | 2.4                                     | 3.45%             | 45.5                                  | 44.4                               | 1.1                   | -4.1                                       | -3.3                                    | 0.8                        | -23.9                             | -23.2                          | 2.80%         | 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: **D2450V2-719\_Aug19**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:719**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **August 14, 2019**

*BNW  
08/30/2019*

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 03-Apr-19 (No. 217-02892/02893) | Apr-20                |
| Power sensor NRP-Z91        | SN: 103244         | 03-Apr-19 (No. 217-02892)       | Apr-20                |
| Power sensor NRP-Z91        | SN: 103245         | 03-Apr-19 (No. 217-02893)       | Apr-20                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-19 (No. 217-02894)       | Apr-20                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895)       | Apr-20                |
| Reference Probe EX3DV4      | SN: 7349           | 29-May-19 (No. EX3-7349_May19)  | May-20                |
| DAE4                        | SN: 601            | 30-Apr-19 (No. DAE4-601_Apr19)  | Apr-20                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

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

Signature

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

Issued: August 15, 2019

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

### Glossary:

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

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

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.2    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.8 $\pm$ 6 % | 1.83 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 13.5 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 53.1 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 | 6.25 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.7 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 50.8 $\pm$ 6 % | 2.01 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 | 13.0 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 50.8 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 | 6.09 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.0 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 | $54.6 \Omega + 5.6 j\Omega$ |
| Return Loss                          | - 23.2 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $51.0 \Omega + 8.4 j\Omega$ |
| Return Loss                          | - 21.6 dB                   |

### General Antenna Parameters and Design

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

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

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

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

### Additional EUT Data

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

## DASY5 Validation Report for Head TSL

Date: 14.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.9, 7.9, 7.9) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

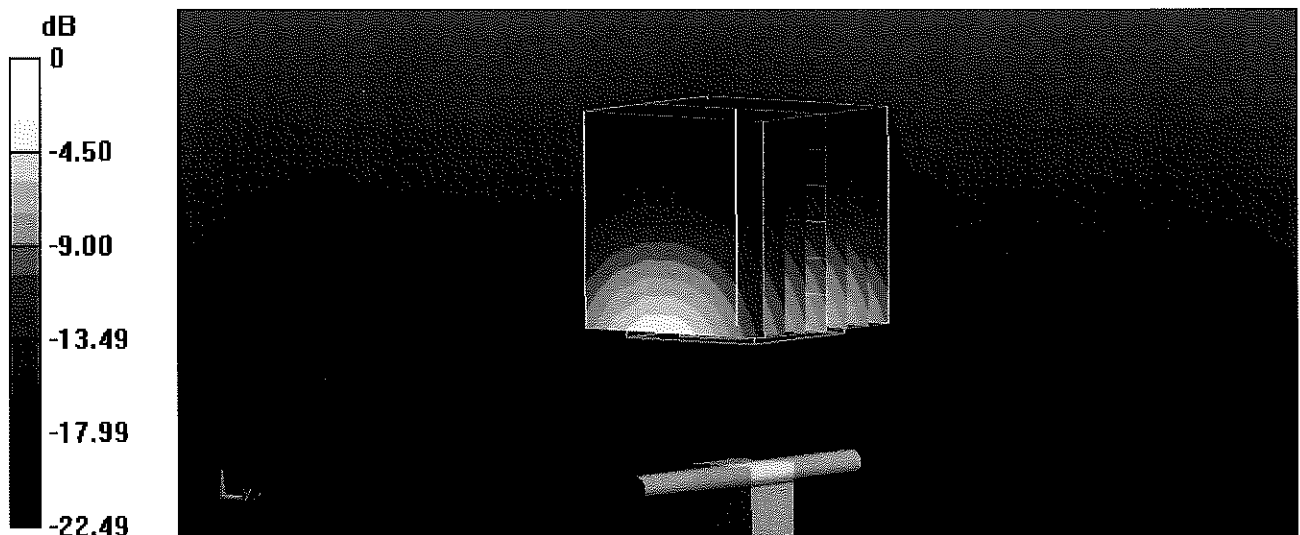
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 117.1 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 26.6 W/kg

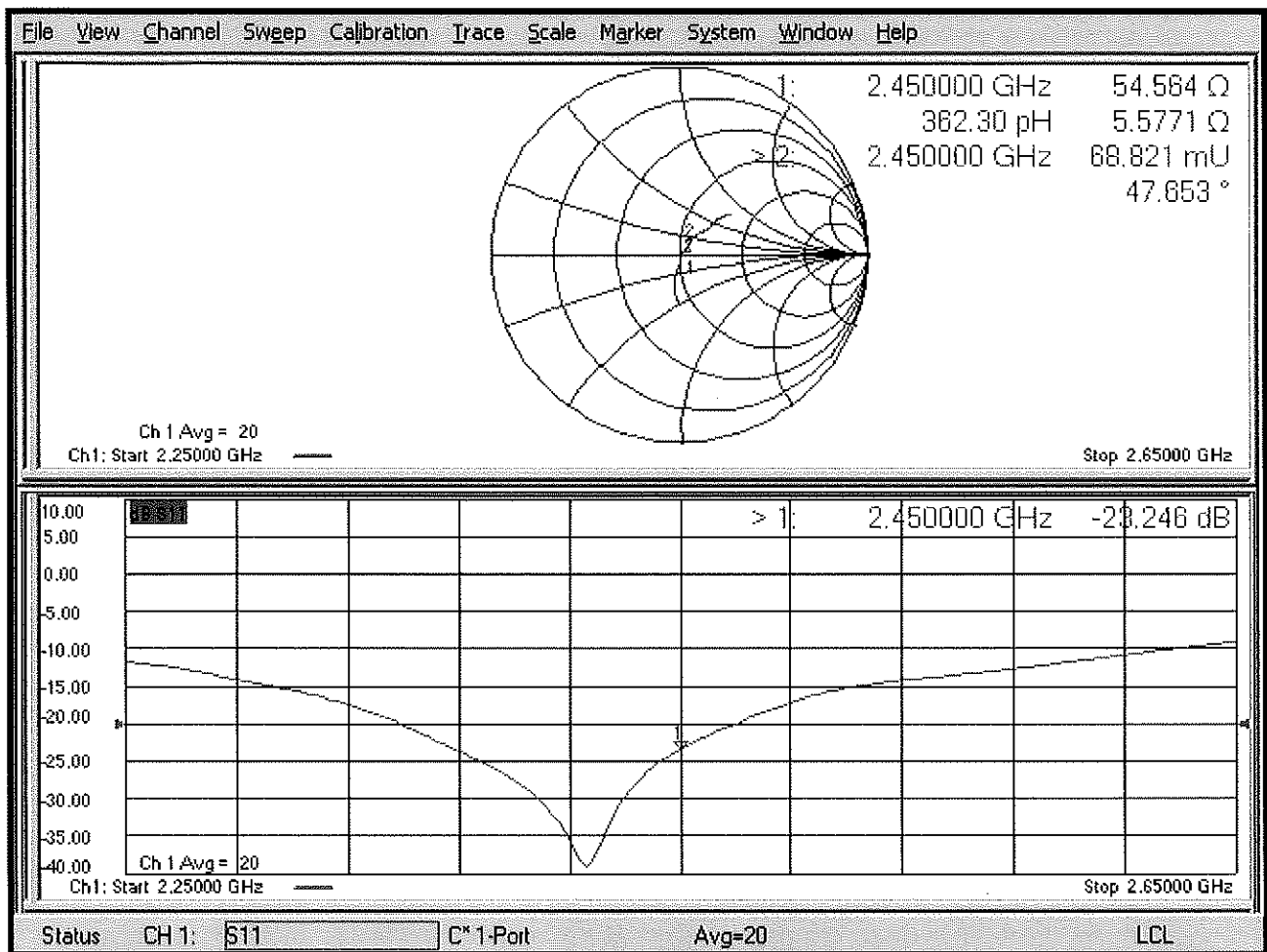
**SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.25 W/kg**

Maximum value of SAR (measured) = 21.8 W/kg



0 dB = 21.8 W/kg = 13.38 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 14.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  S/m;  $\epsilon_r = 50.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

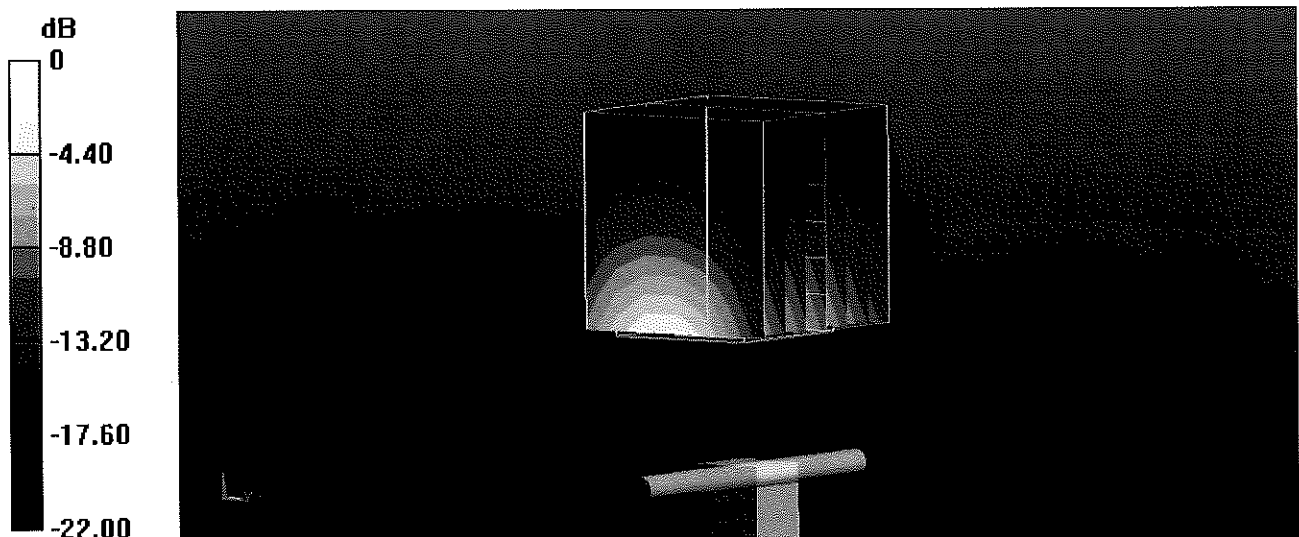
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.2 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 25.6 W/kg

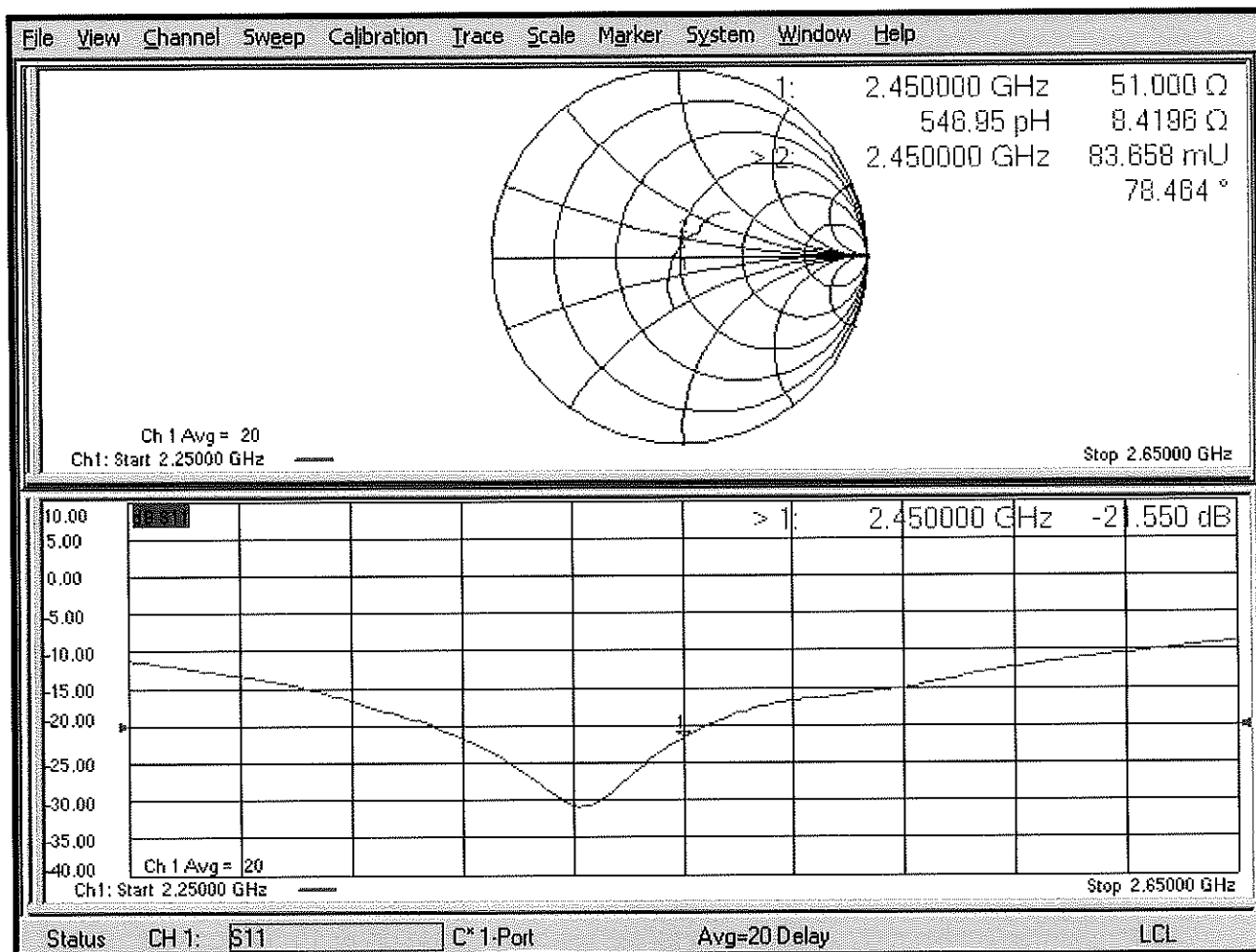
**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.09 W/kg**

Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 20.0 W/kg = 13.01 dBW/kg

## Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2450V2-981\_Aug18**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:981**

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

Calibration date: **August 16, 2018**

BNV  
 09-26/2018  
 BNV  
 08/10/2019

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&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 Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

Calibrated by: **Leif Klysner** Name: **Leif Klysner** Function: **Laboratory Technician**

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

Signature

*Leif Klysner*

*Katja Pokovic*

Issued: August 23, 2018

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Accreditation No.: **SCS 0108**

**Glossary:**

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

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

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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

## Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5.0 mm    |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.7 $\pm$ 6 % | 1.86 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 13.4 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 52.3 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.20 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.4 W/kg $\pm$ 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.8 $\pm$ 6 % | 2.02 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

## SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 13.0 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 50.9 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.11 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.2 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 | 55.0 $\Omega$ + 2.3 j $\Omega$ |
| Return Loss                          | - 25.6 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.2 $\Omega$ + 4.7 j $\Omega$ |
| Return Loss                          | - 26.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.162 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | December 30, 2014 |

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

### Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

|         |                  |                             |
|---------|------------------|-----------------------------|
| Phantom | SAM Head Phantom | For usage with cSAR3DV2-R/L |
|---------|------------------|-----------------------------|

### SAR result with SAM Head (Top)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                          | 250 mW input power | 13.6 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 54.0 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 6.33 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 25.2 W/kg $\pm$ 16.9 % (k=2) |

### SAR result with SAM Head (Mouth)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                          | 250 mW input power | 13.6 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 54.0 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 6.35 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 25.3 W/kg $\pm$ 16.9 % (k=2) |

### SAR result with SAM Head (Neck)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                          | 250 mW input power | 12.9 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 51.2 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 6.11 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.4 W/kg $\pm$ 16.9 % (k=2) |

### SAR result with SAM Head (Ear)

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                          | 250 mW input power | 8.74 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 34.7 W/kg $\pm$ 17.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 250 mW input power | 4.40 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 17.5 W/kg $\pm$ 16.9 % (k=2) |

## DASY5 Validation Report for Head TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:981**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.86$  S/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

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

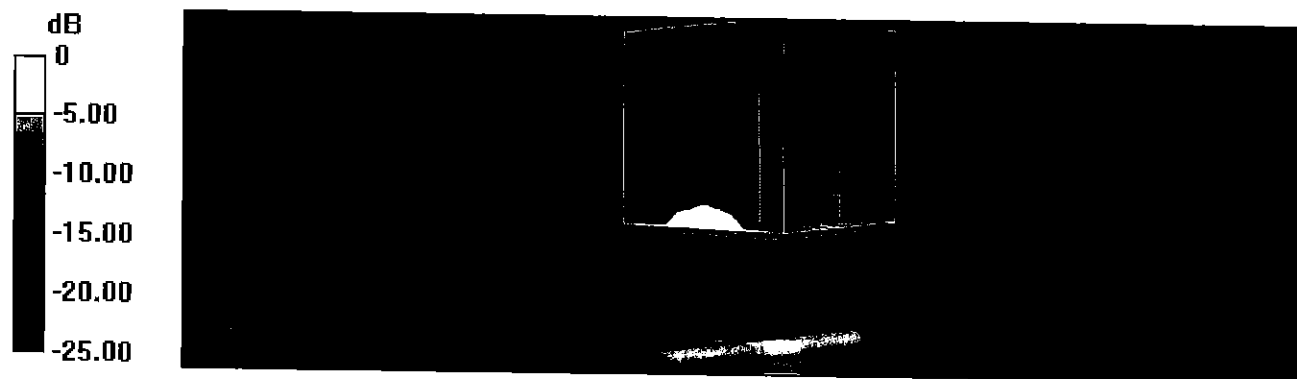
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.6 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.7 W/kg

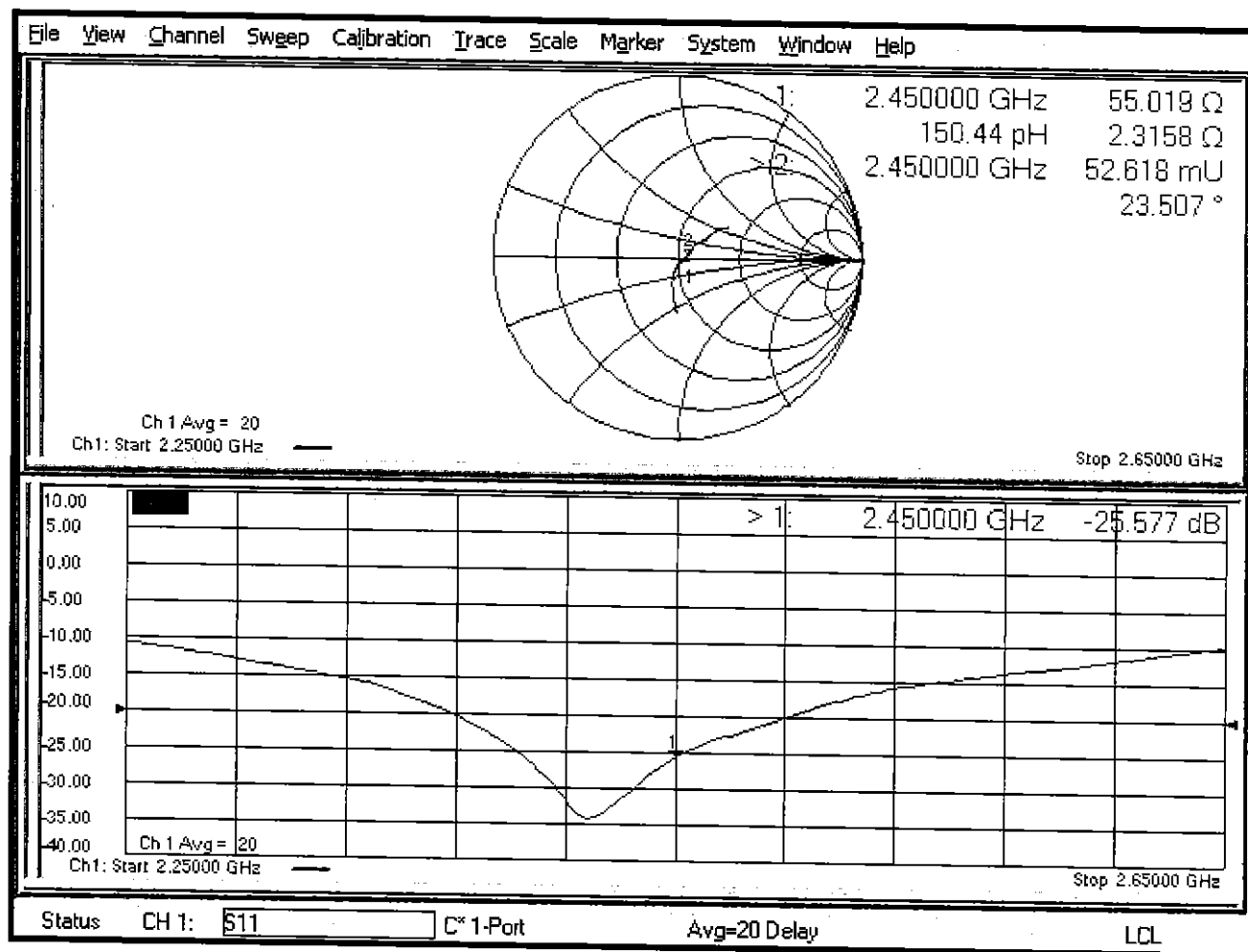
**SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.2 W/kg**

Maximum value of SAR (measured) = 22.1 W/kg



0 dB = 22.1 W/kg = 13.44 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:981**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 51.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

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

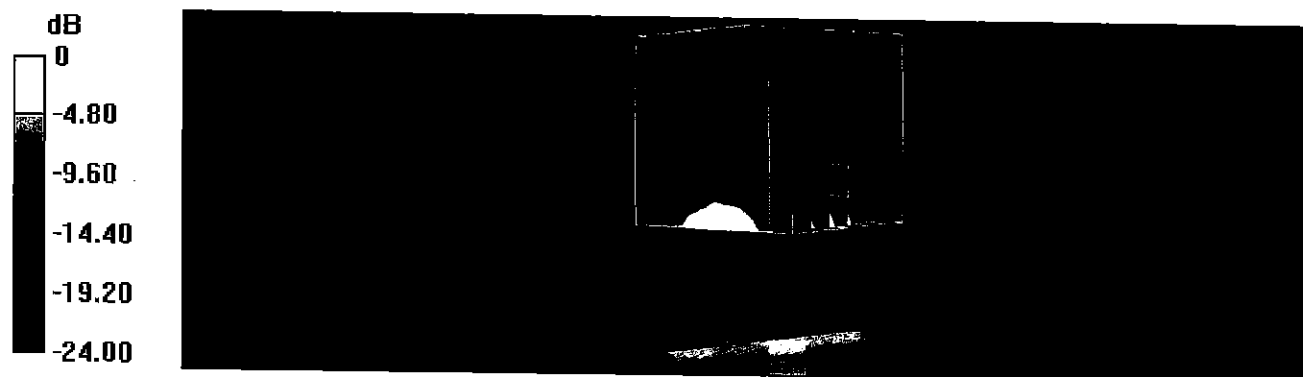
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.0 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 25.3 W/kg

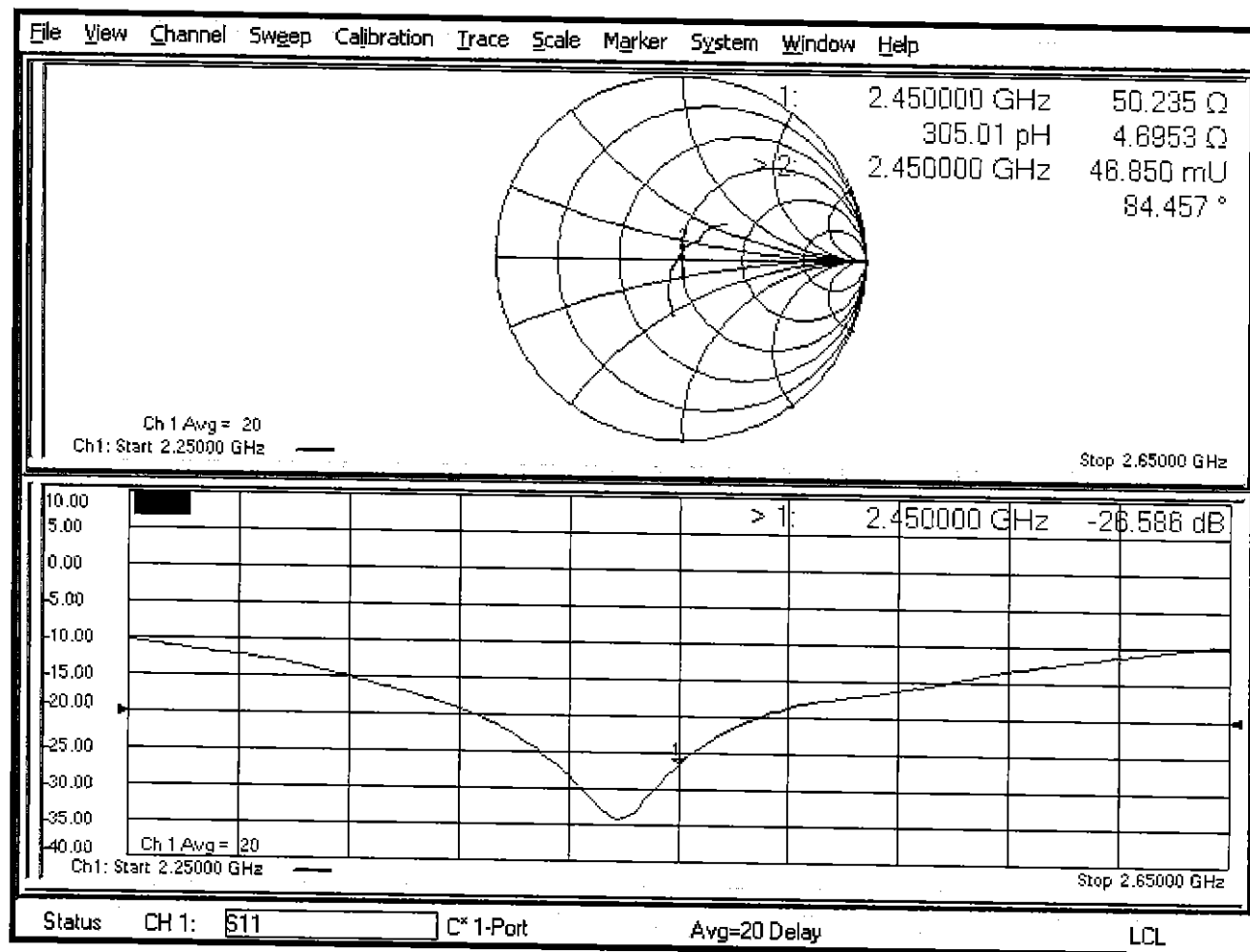
**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.11 W/kg**

Maximum value of SAR (measured) = 20.7 W/kg



0 dB = 20.7 W/kg = 13.16 dBW/kg

# Impedance Measurement Plot for Body TSL



## DASY5 Validation Report for SAM Head

Date: 16.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:981**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: SAM Head
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

**SAM Head Top/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 26.4 W/kg

**SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.33 W/kg**

Maximum value of SAR (measured) = 22.0 W/kg

**SAM Head Mouth/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.9 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.3 W/kg

**SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.35 W/kg**

Maximum value of SAR (measured) = 21.7 W/kg

**SAM Head Neck/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 112.0 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 24.1 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.11 W/kg**

Maximum value of SAR (measured) = 20.5 W/kg

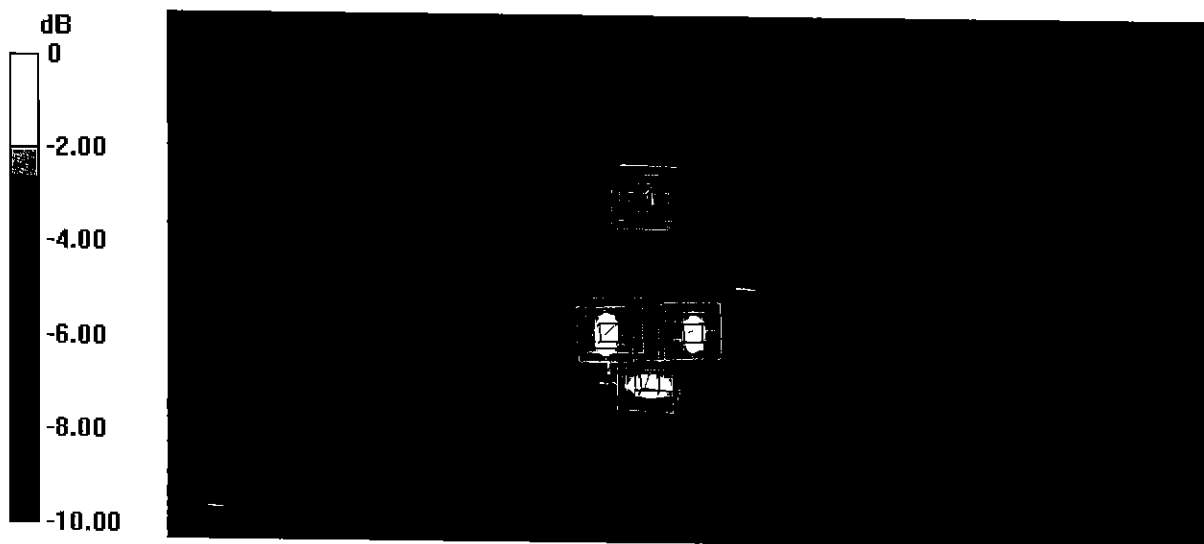
**SAM Head Ear/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.03 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 15.8 W/kg

**SAR(1 g) = 8.74 W/kg; SAR(10 g) = 4.4 W/kg**

Maximum value of SAR (measured) = 13.5 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

# Certification of Calibration

Object D2450V2 – SN: 981

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

Calibration date: 08/09/2019

Description: SAR Validation Dipole at 2450 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 10/2/2018  | Annual       | 10/2/2019  | US39170118    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 6/27/2019  | Annual       | 6/27/2020  | US46240505    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 343972        |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 10/30/2018 | Annual       | 10/30/2019 | 1207470       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/20/2018 | Annual       | 11/20/2019 | 1339007       |
| Control Company       | 4040      | Temperature / Humidity Monitor                          | 2/28/2018  | Biennial     | 2/28/2020  | 150761911     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 2/28/2018  | Biennial     | 2/28/2020  | 170330160     |
| Keysight              | 772D      | Dual Directional Coupler                                | CBT        | N/A          | CBT        | MY52180215    |
| Keysight Technologies | 85033E    | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | 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            | NC-100    | Torque Wrench                                           | 5/23/2018  | Biennial     | 5/23/2020  | N/A           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 7417          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/13/2019  | Annual       | 2/13/2020  | 665           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 7/15/2019  | Annual       | 7/15/2020  | 7547          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 7/11/2019  | Annual       | 7/11/2020  | 1323          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

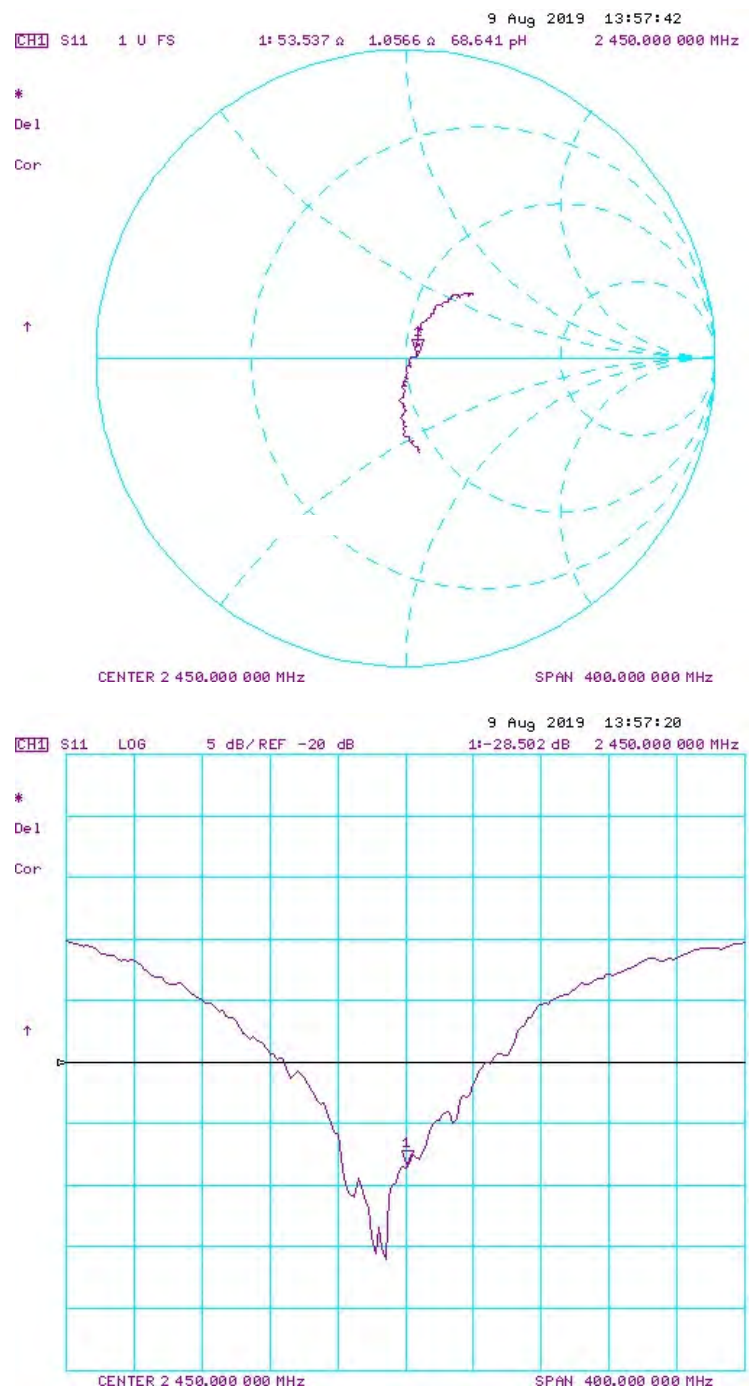
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

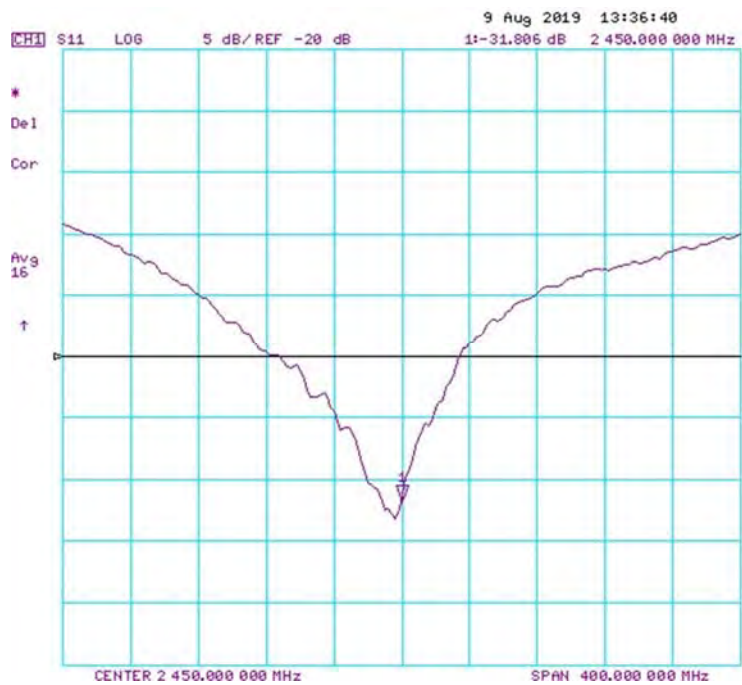
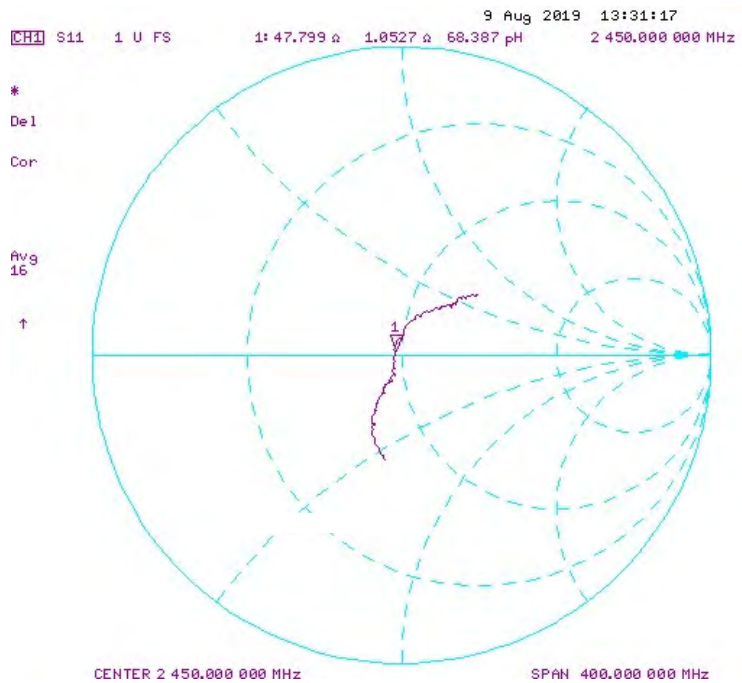
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 8/16/2018        | 8/9/2019       | 1.162                             | 5.23                                             | 5.53                                   | 5.74%            | 2.44                                              | 2.56                                    | 4.92%             | 55                                    | 53.5                               | 1.5                   | 2.3                                        | 1.1                                     | 1.2                        | -25.6                             | -28.5                          | -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 |
| 8/16/2018        | 8/9/2019       | 1.162                             | 5.09                                             | 4.98                                   | -2.16%           | 2.42                                              | 2.28                                    | -5.79%            | 50.2                                  | 47.8                               | 2.4                   | 4.7                                        | 1.1                                     | 3.6                        | -26.6                             | -31.8                          | -19.60%       | 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: **D2600V2-1004\_Apr18**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1004**

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

Calibration date: **April 11, 2018**

BN ✓  
 05-01-2018  
 BN ✓ Extended  
 04-20-2019

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&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: | Name<br>Michael Weber | Function<br>Laboratory Technician | Signature<br> |
| Approved by:   | Name<br>Katja Pokovic | Technical Manager                 |               |

Issued: April 12, 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.

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <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.

|                                                | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|------------------------------------------------|---------------------|---------------------|----------------------|
| <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 | 37.8 $\pm$ 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 | 14.3 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>55.9 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 | 6.35 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>25.1 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                                | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|------------------------------------------------|---------------------|---------------------|----------------------|
| <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 | 52.1 $\pm$ 6 %      | 2.19 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 | 13.8 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>54.8 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 | 6.20 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>24.7 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 | 47.7 $\Omega$ - 5.7 j $\Omega$ |
| Return Loss                          | - 24.1 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.0 $\Omega$ - 3.8 j $\Omega$ |
| Return Loss                          | - 24.9 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 | December 23, 2006 |

## DASY5 Validation Report for Head TSL

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.7, 7.7, 7.7); 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:**

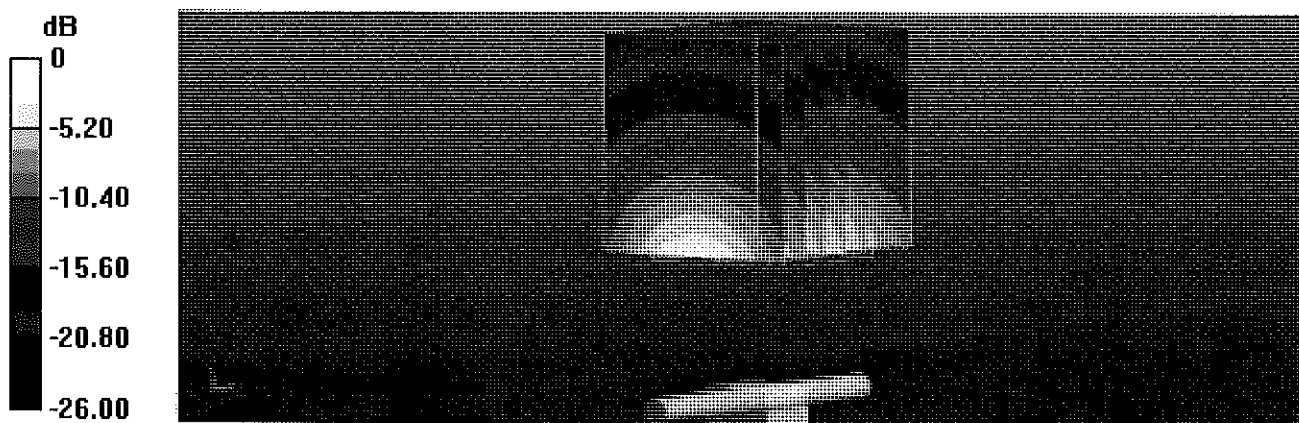
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 118.5 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.6 W/kg

**SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.35 W/kg**

Maximum value of SAR (measured) = 23.9 W/kg



0 dB = 23.9 W/kg = 13.78 dBW/kg

# Impedance Measurement Plot for Head TSL

11 Apr 2018 11:25:16  
 [CH1] S11 1 U FS 1: 47.721  $\Omega$  -5.6836  $\Omega$  10.770 pF 2 500.000 000 MHz

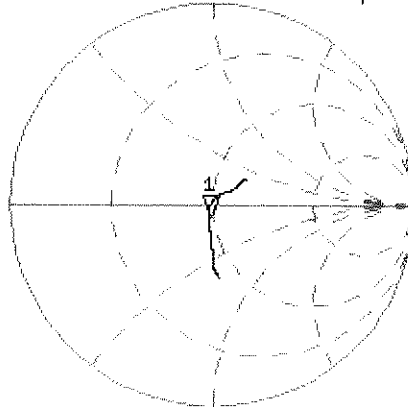
\*

De1

CA

Avg  
16

H1d

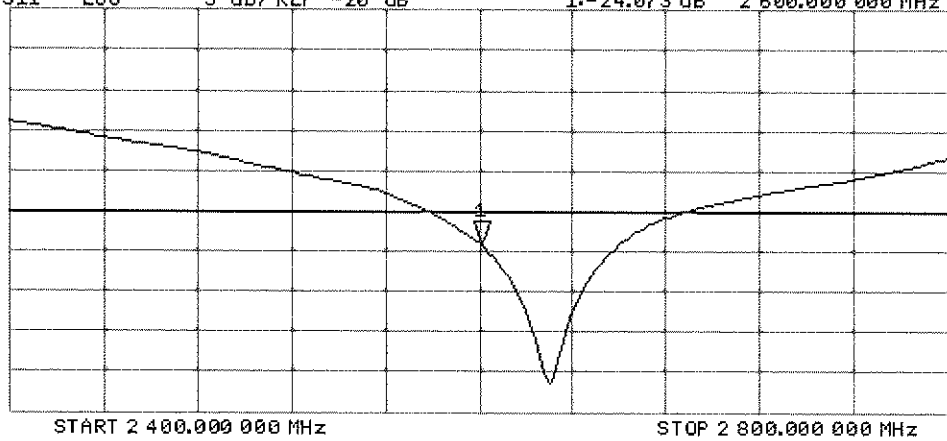


CH2 S11 LOG 5 dB/REF -20 dB 1:-24.073 dB 2 500.000 000 MHz

CA

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.19$  S/m;  $\epsilon_r = 52.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.81, 7.81, 7.81); 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:**

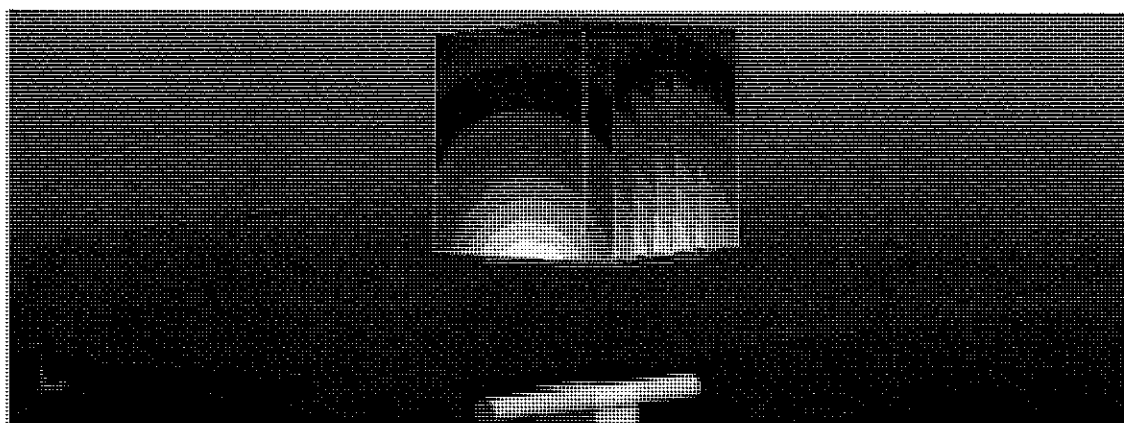
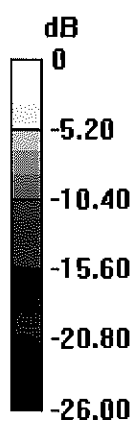
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.5 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.3 W/kg

**SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.2 W/kg**

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

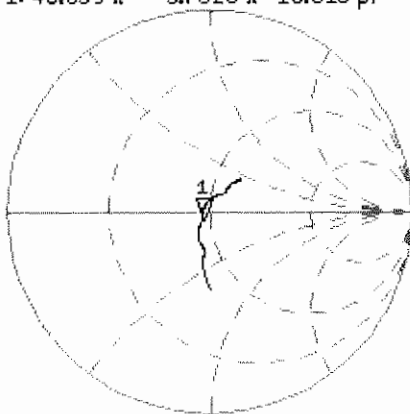


0 dB = 22.9 W/kg = 13.60 dBW/kg

# Impedance Measurement Plot for Body TSL

11 Apr 2018 11:24:36  
 [CH1] S11 1 U FS 1: 46.039  $\Omega$  -3.7520  $\Omega$  16.315 pF 2 600.000 000 MHz

\*  
 Del  
 CA



Avg  
 16

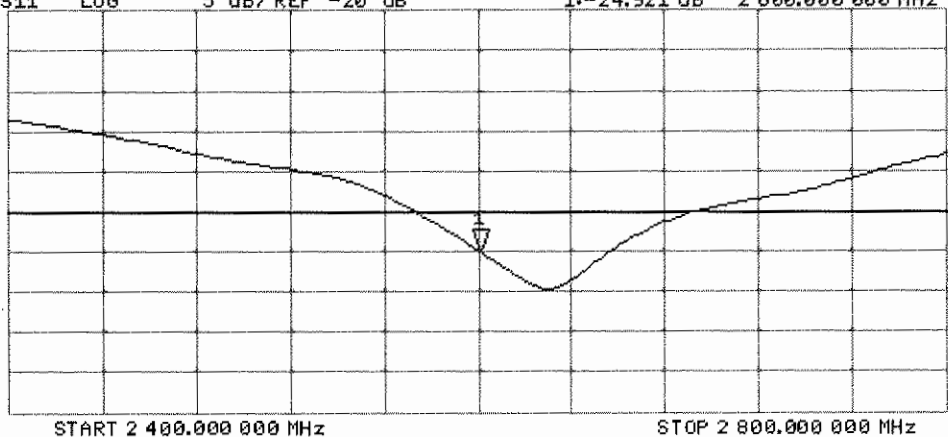
H1 d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.921 dB 2 600.000 000 MHz

CA

Avg  
 16

H1 d



# Certification of Calibration

Object D2600V2 – SN: 1004

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

Extension Calibration date: 4/11/2019

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                            | 3/11/2019  | Annual       | 3/11/2020  | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 11/20/2018 | Annual       | 11/20/2019 | 1027293       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 10/30/2018 | Annual       | 10/30/2019 | 1126066       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./ Clock/ Humidity Monitor                         | 10/9/2018  | Biennial     | 10/9/2020  | 181647811     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 5/2/2017   | Biennial     | 5/2/2019   | 170330156     |
| 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    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | 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           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 6/25/2018  | Annual       | 6/25/2019  | 7409          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 2/13/2019  | Annual       | 2/13/2020  | 665           |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 7417          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

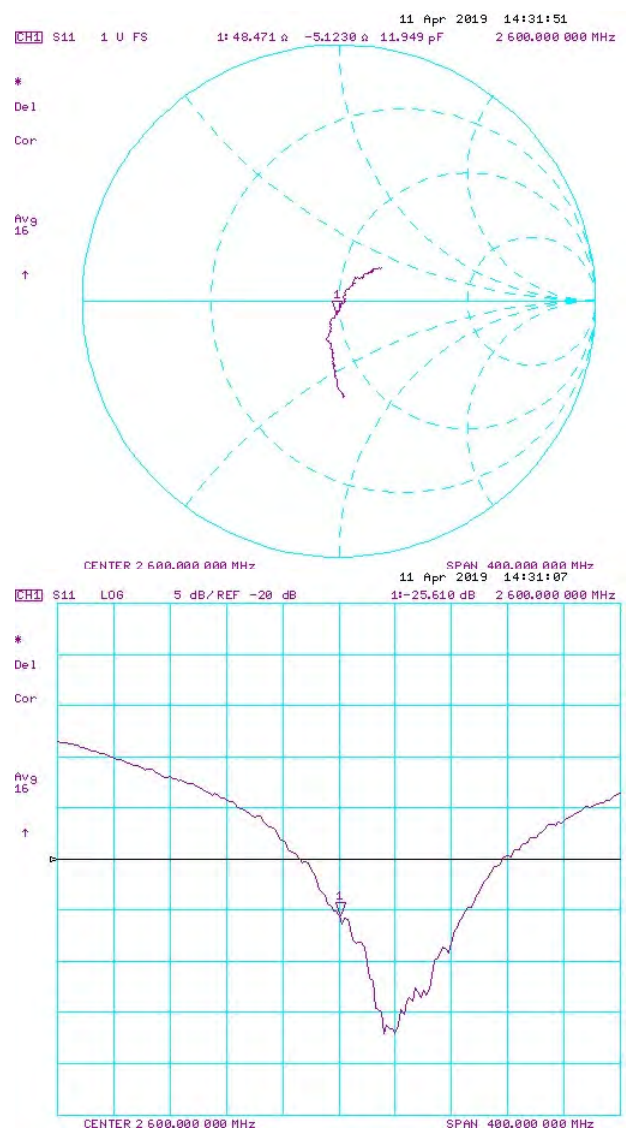
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

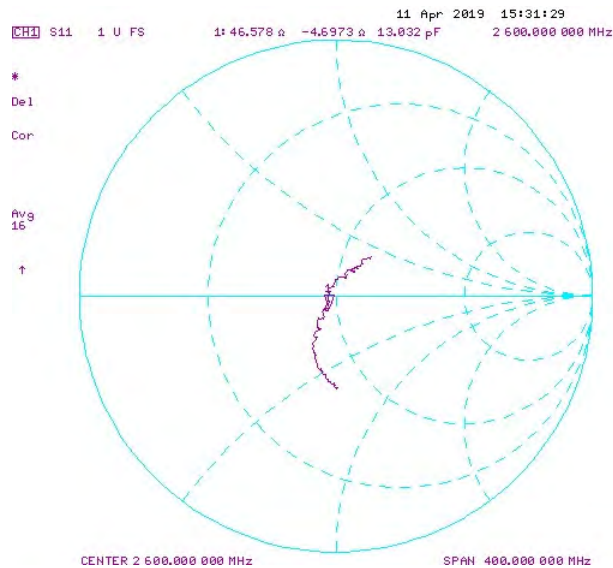
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 4/11/2018        | 4/11/2019      | 1.140                             | 5.59                                             | 5.51                                   | -1.43%           | 2.51                                              | 2.47                                    | -1.59%            | 47.7                                  | 48.5                               | 0.8                   | -5.7                                       | -5.1                                    | 0.6                        | -24.1                             | -25.6                          | -6.30%        | 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 |
| 4/11/2018        | 4/11/2019      | 1.140                             | 5.48                                             | 5.65                                   | 3.10%            | 2.47                                              | 2.48                                    | 0.40%             | 46                                    | 46.6                               | 0.6                   | -3.8                                       | -4.7                                    | 0.9                        | -24.9                             | -24.5                          | 1.60%         | 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: **D2600V2-1064\_Jun19**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1064**

Calibration procedure(s) **QA CAL-05.v11**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

*BNV*  
*07/01/2019*

Calibration date: **June 14, 2019**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 03-Apr-19 (No. 217-02892/02893)   | Apr-20                 |
| Power sensor NRP-Z91            | SN: 103244         | 03-Apr-19 (No. 217-02892)         | Apr-20                 |
| Power sensor NRP-Z91            | SN: 103245         | 03-Apr-19 (No. 217-02893)         | Apr-20                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-19 (No. 217-02894)         | Apr-20                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895)         | Apr-20                 |
| Reference Probe EX3DV4          | SN: 7349           | 29-May-19 (No. EX3-7349_May19)    | May-20                 |
| DAE4                            | SN: 601            | 30-Apr-19 (No. DAE4-601_Apr19)    | Apr-20                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

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

Signature

*M. Weber*

Approved by: **Katja Pokovic**      Technical Manager

*Katja Pokovic*

Issued: June 20, 2019

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                  | V52.10.2    |
| 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 % | 2.03 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 | 14.9 W/kg                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>58.1 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 | 6.59 W/kg                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>26.0 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             | 52.5           | 2.16 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 50.5 $\pm$ 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 | 14.2 W/kg                                      |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>55.6 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 | 6.33 W/kg                                      |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>25.0 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 | 49.8 $\Omega$ - 6.9 j $\Omega$ |
| Return Loss                          | - 23.2 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 46.6 $\Omega$ - 4.4 j $\Omega$ |
| Return Loss                          | - 24.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.151 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

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

## DASY5 Validation Report for Head TSL

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1064**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.03$  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(7.69, 7.69, 7.69) @ 2600 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

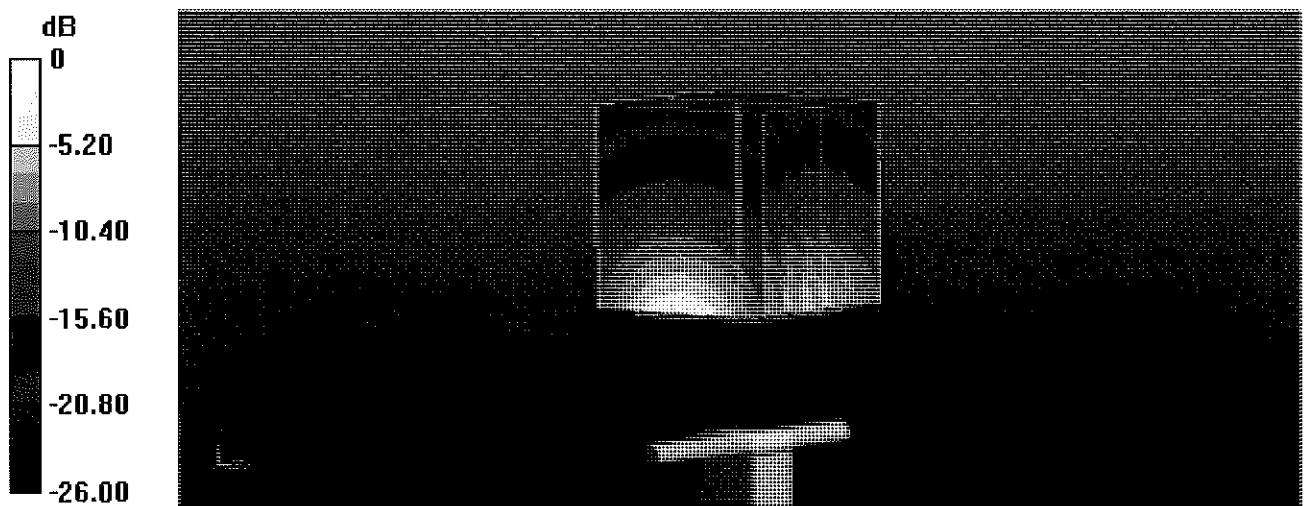
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 120.9 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 30.2 W/kg

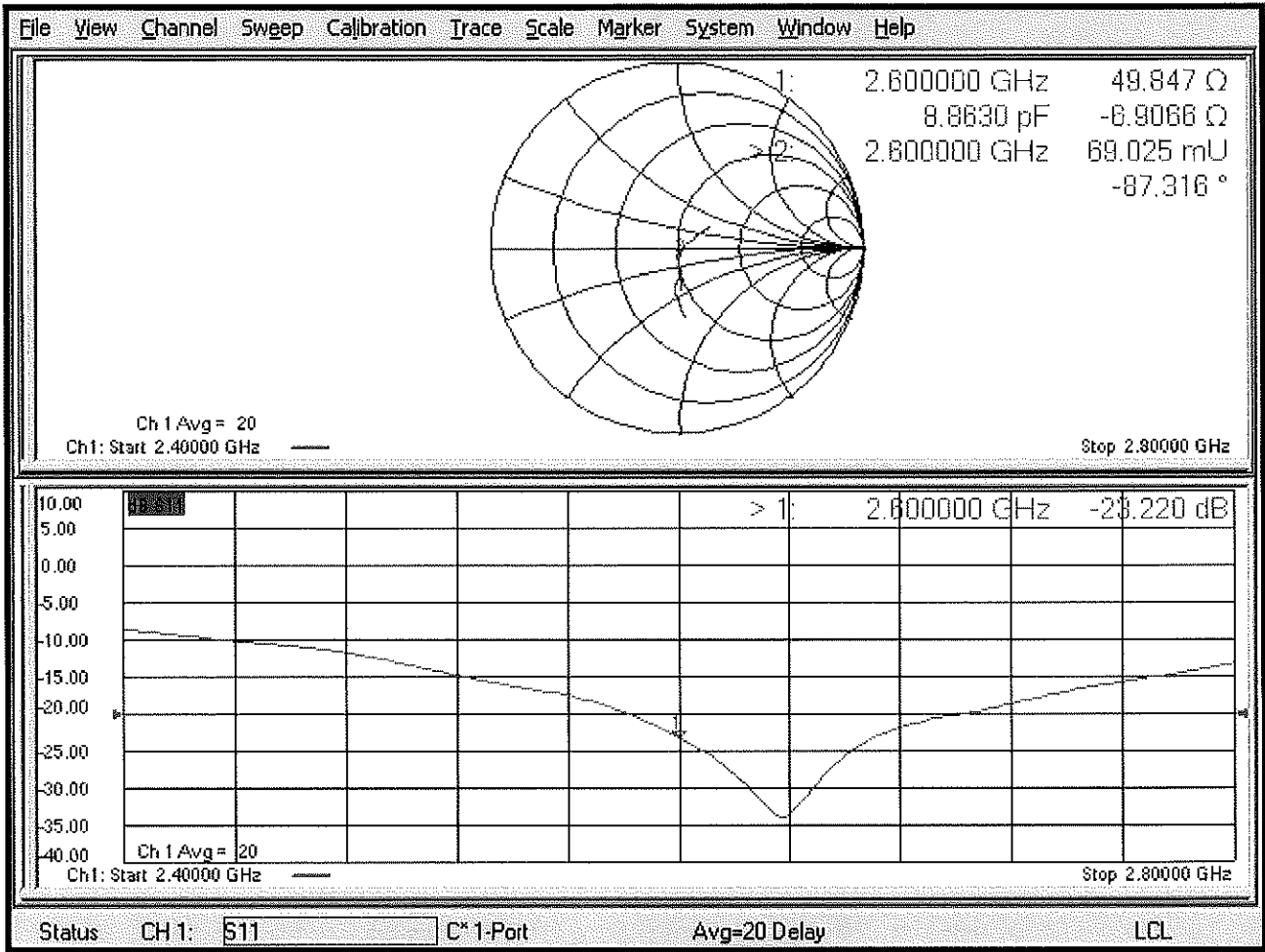
**SAR(1 g) = 14.9 W/kg; SAR(10 g) = 6.59 W/kg**

Maximum value of SAR (measured) = 25.1 W/kg



0 dB = 25.1 W/kg = 14.00 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1064**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.22$  S/m;  $\epsilon_r = 50.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.8, 7.8, 7.8) @ 2600 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

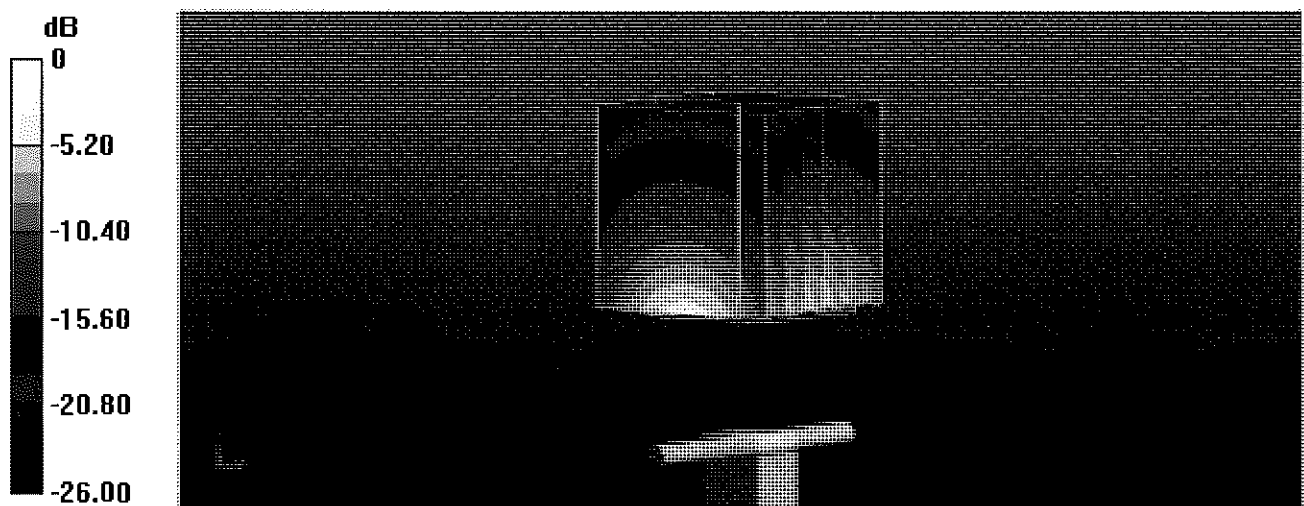
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.6 V/m; Power Drift = -0.05 dB

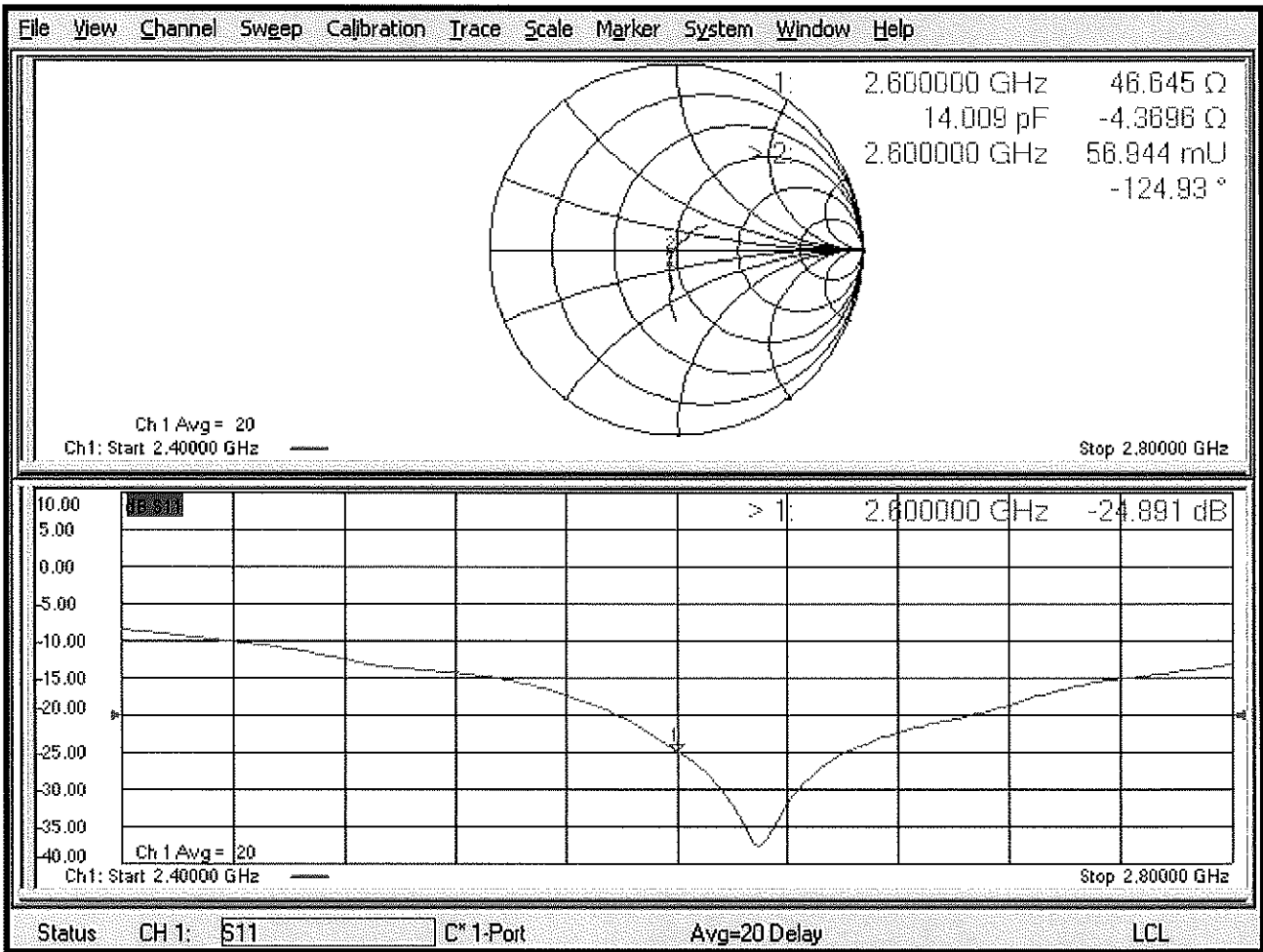
Peak SAR (extrapolated) = 28.9 W/kg

**SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.33 W/kg**

Maximum value of SAR (measured) = 23.6 W/kg



Impedance 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: **D3500V2-1059\_Jan18**

## CALIBRATION CERTIFICATE

Object: **D3500V2 - SN:1059**

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

Calibration date: **January 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 ± 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           | 30-Dec-17 (No. EX3-3503_Dec17)  | Dec-18                |
| DAE4                        | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)  | Oct-18                |

| Secondary Standards       | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------|----------------|-----------------------------------|------------------------|
| Power meter EPM-442A      | SN: GB37480704 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A     | SN: US37292783 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A     | SN: MY41092317 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-08   | SN: 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: **Michael Weber**      Name: **Michael Weber**      Function: **Laboratory Technician**

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

Signature

*M. Weber*

*K. Pokovic*

Issued: January 16, 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.

|                              |                            |                                  |
|------------------------------|----------------------------|----------------------------------|
| 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 = 4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 3500 MHz $\pm$ 1 MHz       |                                  |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 37.9           | 2.91 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 38.5 $\pm$ 6 % | 2.91 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                                          | 100 mW input power | 6.44 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 64.6 W/kg $\pm$ 19.9 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 100 mW input power | 2.43 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.4 W/kg $\pm$ 19.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 51.3           | 3.31 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 50.0 $\pm$ 6 % | 3.32 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                                          | 100 mW input power | 6.55 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 65.1 W/kg $\pm$ 19.9 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 100 mW input power | 2.43 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.2 W/kg $\pm$ 19.5 % (k=2) |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.2 $\Omega$ - 7.1 j $\Omega$ |
| Return Loss                          | - 22.4 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.4 $\Omega$ - 4.5 j $\Omega$ |
| Return Loss                          | - 25.3 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.136 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

|                 |                  |
|-----------------|------------------|
| Manufactured by | SPEAG            |
| Manufactured on | January 20, 2017 |

## DASY5 Validation Report for Head TSL

Date: 11.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1059**

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used:  $f = 3500$  MHz;  $\sigma = 2.91$  S/m;  $\epsilon_r = 38.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.8, 7.8, 7.8); 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=100 mW, d=10mm/Zoom Scan, dist=1.4mm**

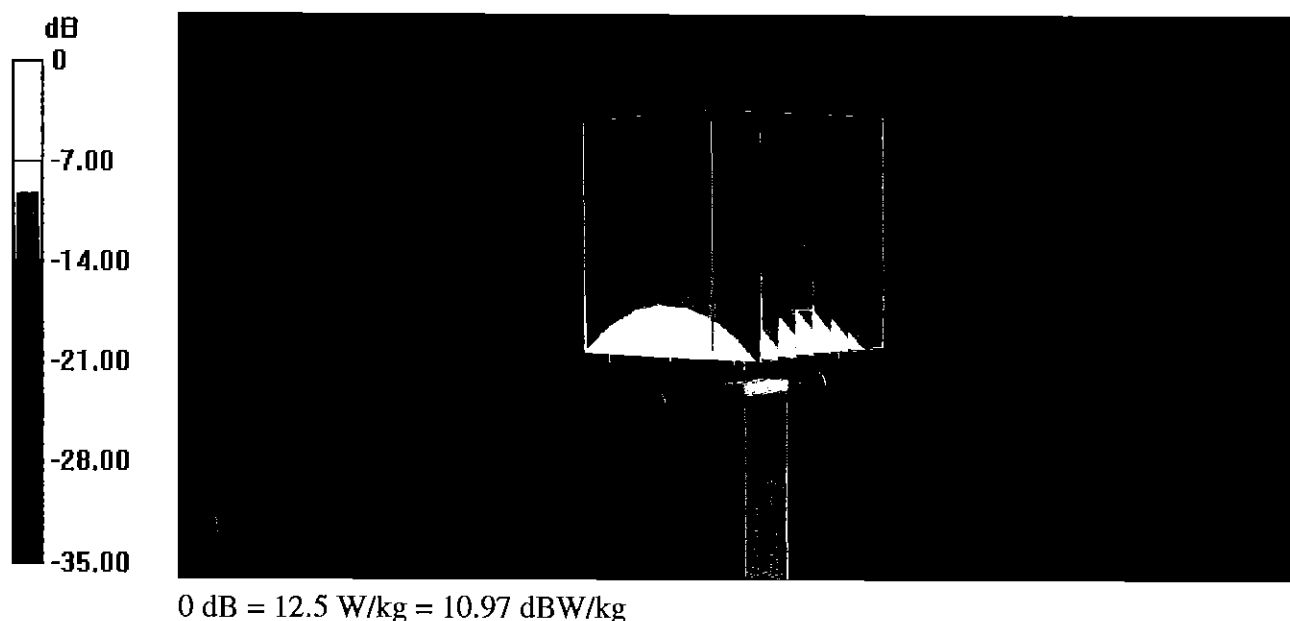
**(8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.59 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 6.44 W/kg; SAR(10 g) = 2.43 W/kg**

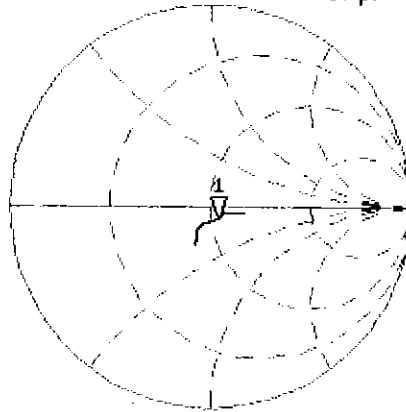
Maximum value of SAR (measured) = 12.5 W/kg



# Impedance Measurement Plot for Head TSL

11 Jan 2018 16:35:59  
 CH1 S11 1 U FS 1: 53.178  $\Omega$  -7.1387  $\Omega$  6.3699 pF 3 500.000 000 MHz

\*  
 Del  
 CA



Avg  
 15

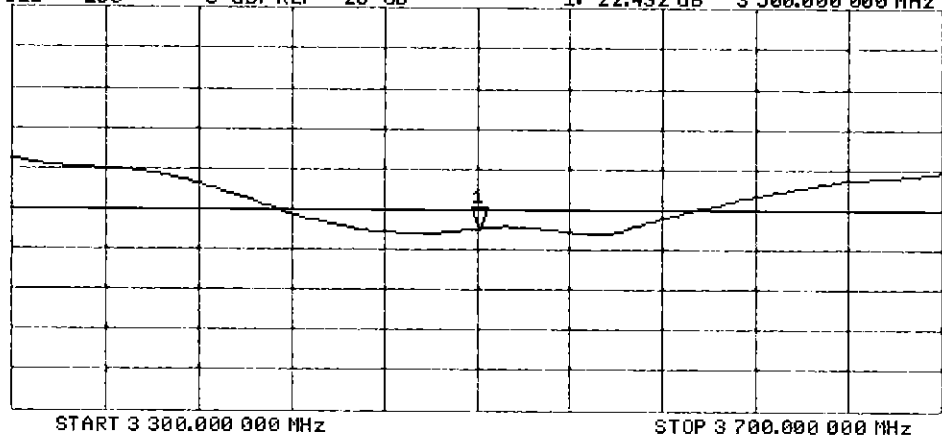
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -22.432 dB 3 500.000 000 MHz

CA

Avg  
 15

H1d



## DASY5 Validation Report for Body TSL

Date: 10.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1059**

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used:  $f = 3500$  MHz;  $\sigma = 3.32$  S/m;  $\epsilon_r = 50$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.43, 7.43, 7.43); 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=100 mW, d=10mm/Zoom Scan , dist=1.4mm**

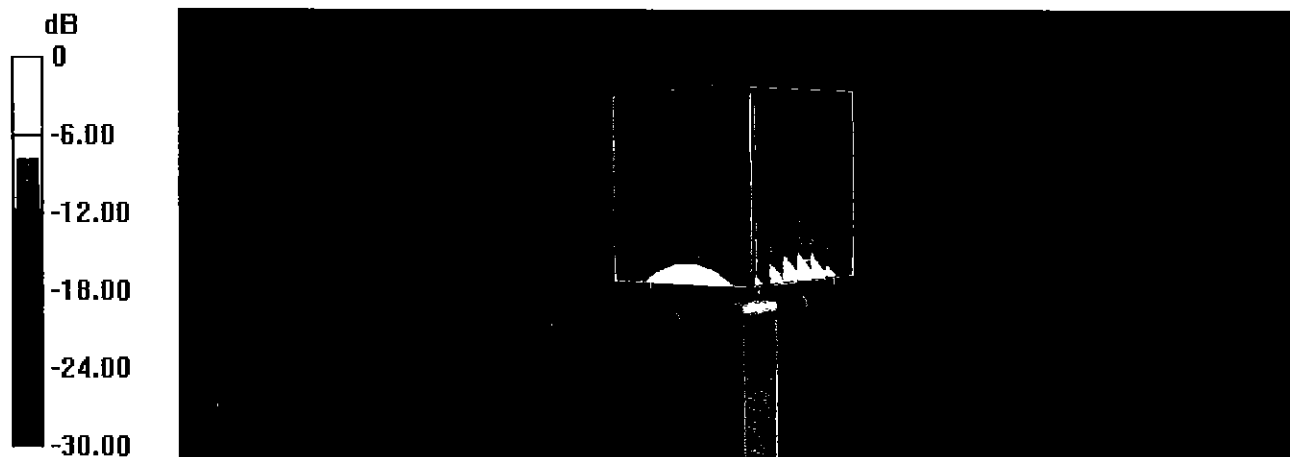
**(8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.18 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 17.9 W/kg

**SAR(1 g) = 6.55 W/kg; SAR(10 g) = 2.43 W/kg**

Maximum value of SAR (measured) = 12.6 W/kg

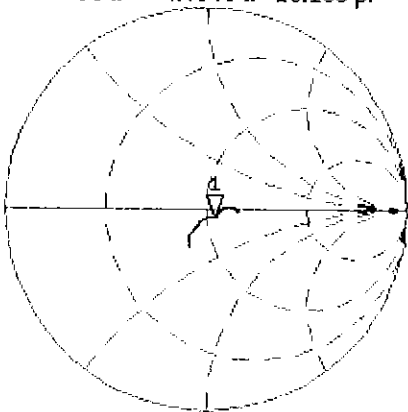


0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL

10 Jan 2018 11:28:56  
CH1 S11 1 U FS 1: 53.365  $\Omega$  -4.4648  $\Omega$  10.185 pF 3 500.000 000 MHz

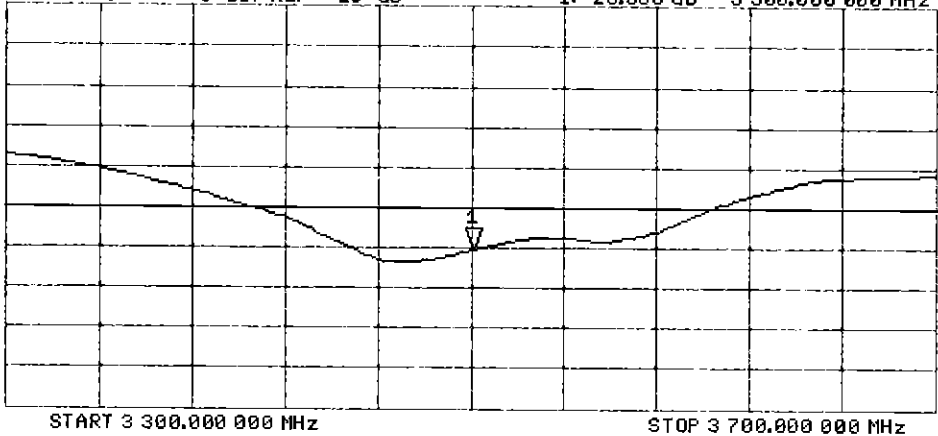
\*  
De1  
CA



Avg  
16  
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.338 dB 3 500.000 000 MHz

CA  
Avg  
16  
H1d



# Certification of Calibration

Object D3500V2 – SN: 1059

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

Extension Calibration date: 1/11/2019

Description: SAR Validation Dipole at 3500 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 2/8/2018   | Annual       | 2/8/2019   | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1207364       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1339018       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./Clock/Humidity Monitor                           | 3/31/2017  | Biennial     | 3/31/2019  | 170232394     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 5/2/2017   | Biennial     | 5/2/2019   | 170330156     |
| 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    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | 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           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 10/3/2018  | Annual       | 10/3/2019  | 1558          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/14/2018  | Annual       | 2/14/2019  | 3914          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 8/24/2018  | Annual       | 8/24/2019  | 3949          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

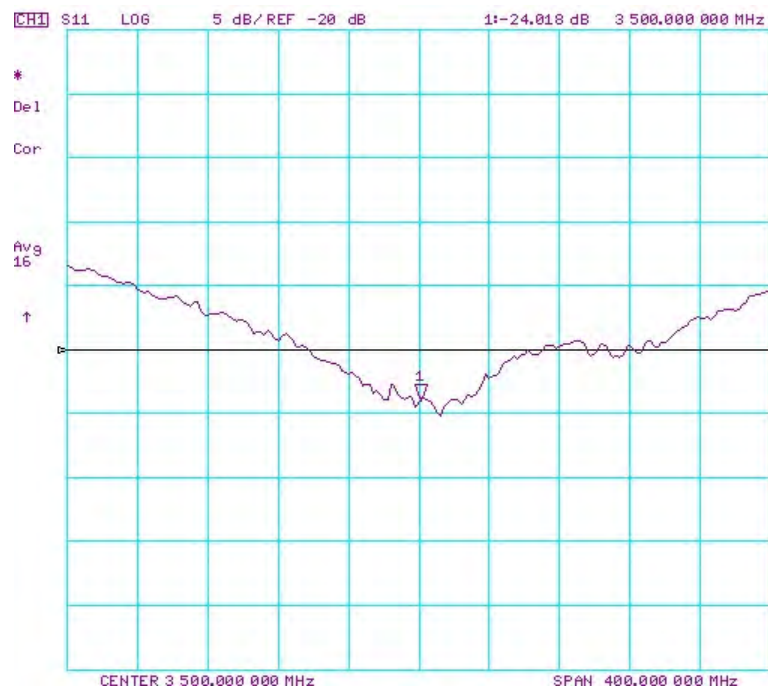
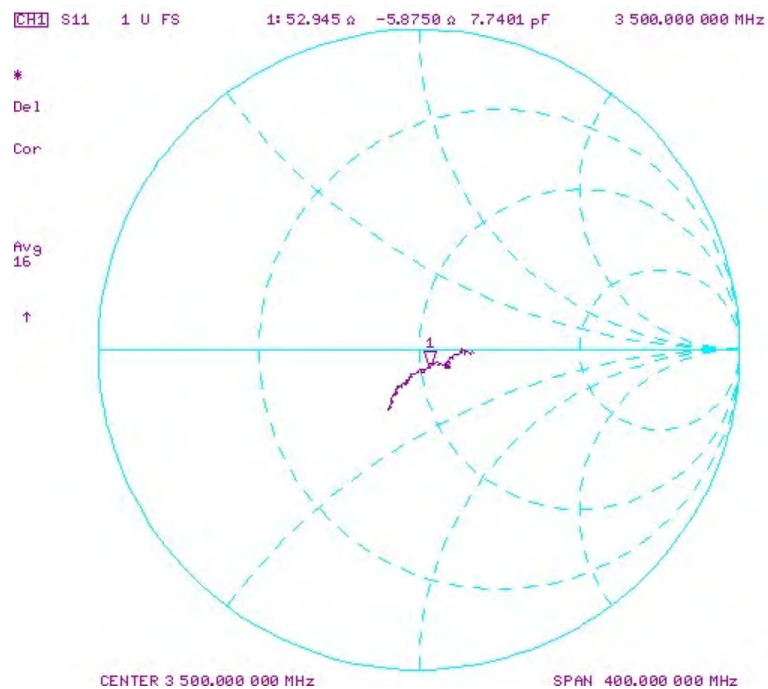
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

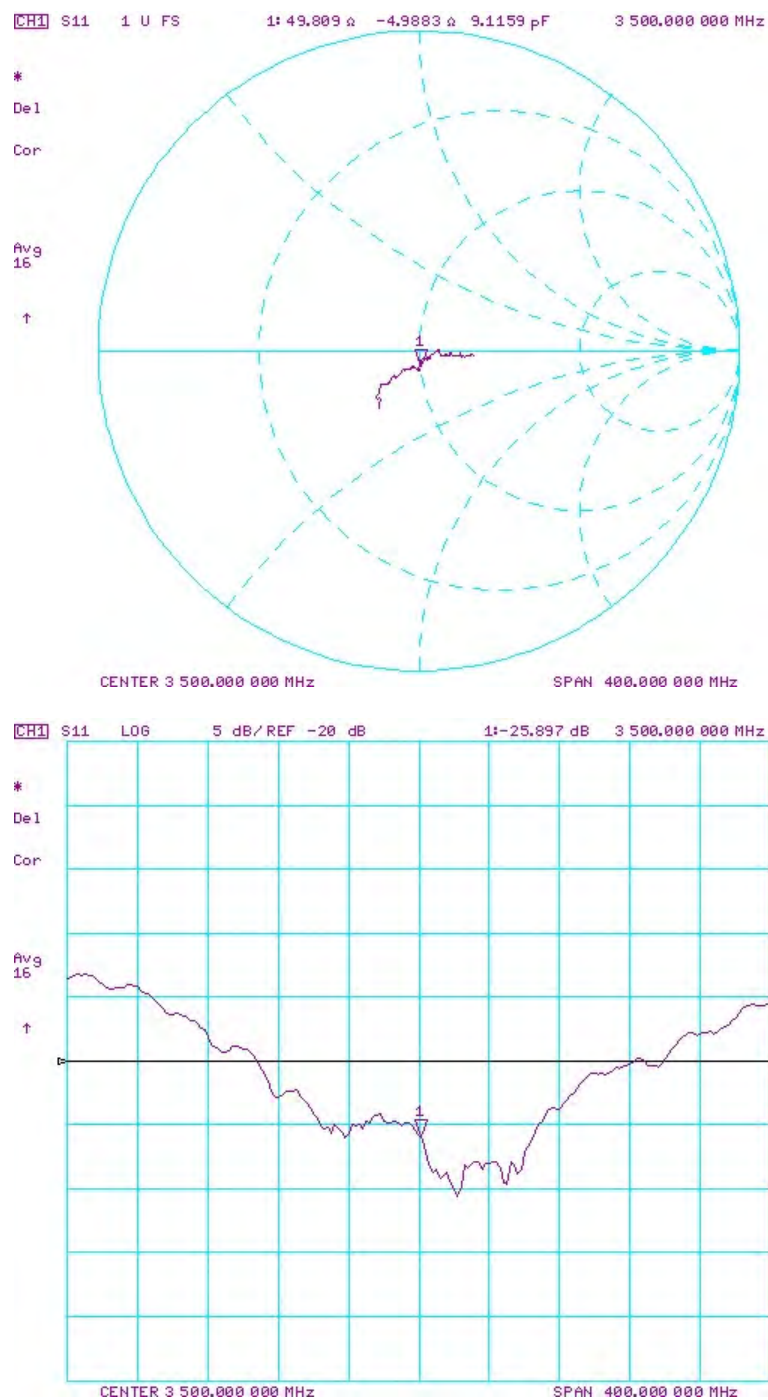
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 1/11/2018        | 1/16/2019      | 1.136                             | 6.46                                             | 6.23                                   | -3.56%           | 2.44                                              | 2.34                                    | -4.10%            | 53.2                                  | 52.9                               | 0.3                   | -7.1                                       | -5.9                                    | 1.2                        | -22.4                             | -24                            | -7.20%        | 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 |
| 1/11/2018        | 1/16/2019      | 1.136                             | 6.51                                             | 6                                      | -7.83%           | 2.42                                              | 2.26                                    | -6.61%            | 53.4                                  | 49.8                               | 3.6                   | -4.5                                       | -5                                      | 0.5                        | -25.3                             | -25.9                          | -2.40%        | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL



## Certification of Calibration

Object: D3500V2 – SN: 1059

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

Extension Calibration date: 1/11/2020

Description: SAR Validation Dipole at 3500 MHz.

### Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable DAK                                            | 9/10/2019  | Annual       | 9/10/2020  | 1045          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

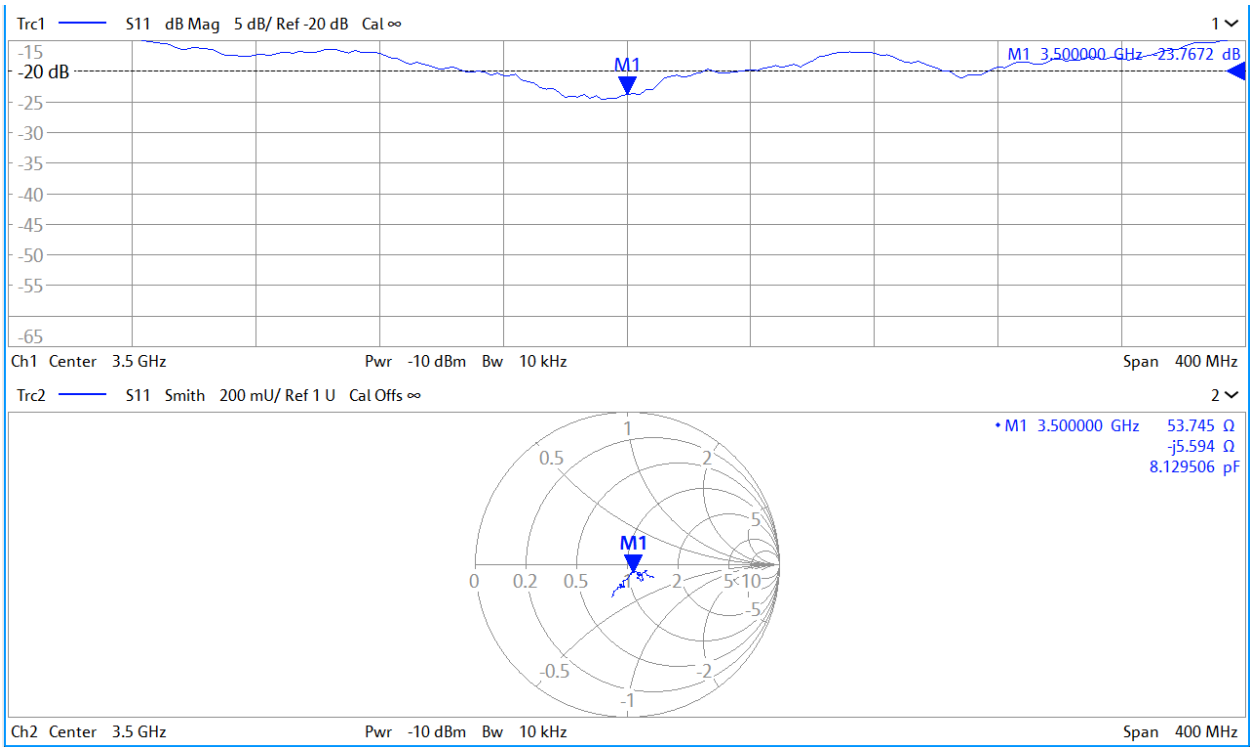
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

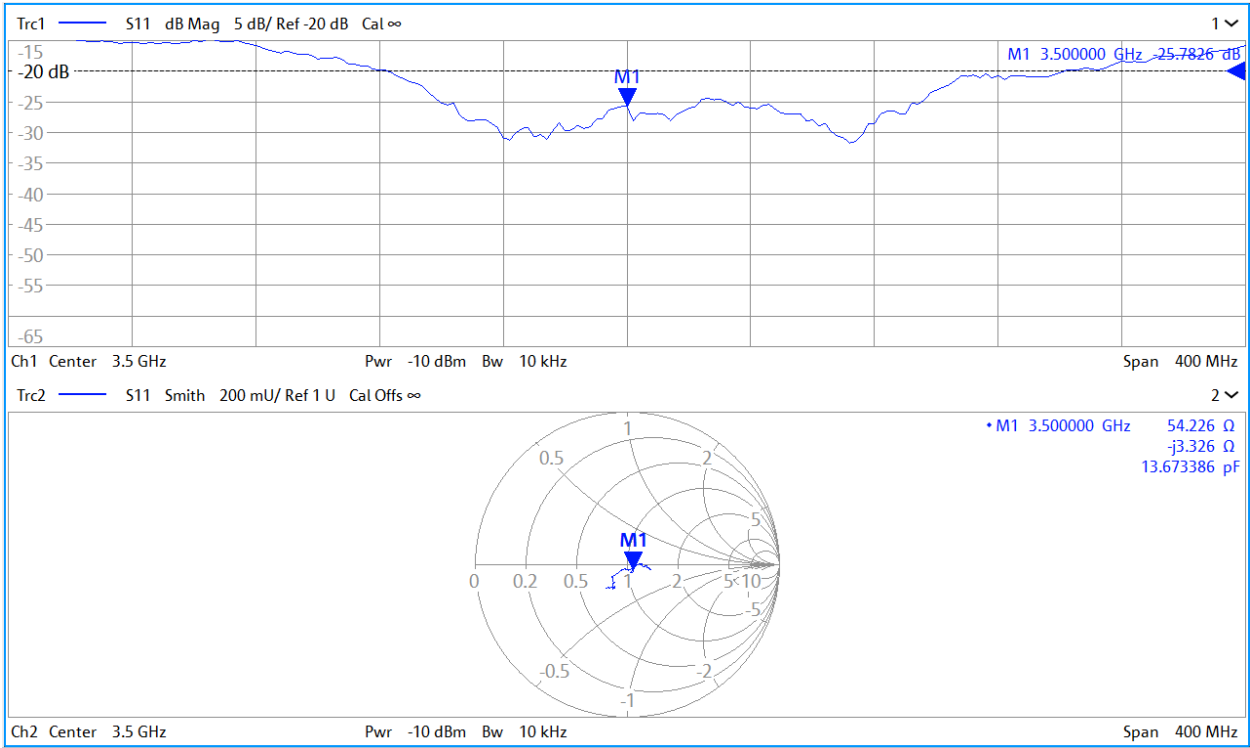
The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 1/11/2018        | 1/11/2020      | 1.136                             | 6.46                                             | 6.73                                   | 4.18%            | 2.44                                              | 2.56                                    | 4.92%             | 53.2                                  | 53.7                               | 0.5                   | -7.1                                       | -5.6                                    | 1.5                        | -22.4                             | -23.8                          | -6.10%        | 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 |
| 1/11/2018        | 1/11/2020      | 1.136                             | 6.51                                             | 6.53                                   | 0.31%            | 2.42                                              | 2.4                                     | -0.83%            | 53.4                                  | 54.2                               | 0.8                   | -4.5                                       | -3.3                                    | 1.2                        | -25.3                             | -25.8                          | -1.90%        | 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: **D3700V2-1018\_Jan18**

## CALIBRATION CERTIFICATE

Object **D3700V2 - SN:1018**

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

Calibration date: **January 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 ( $22 \pm 3^\circ\text{C}$ ) 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: 3503           | 30-Dec-17 (No. EX3-3503_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: **Michael Weber** Name  
Laboratory Technician Function

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

Signature

*[Signature]*

*[Signature]*

Issued: January 16, 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                      | V52.10.0                         |
| <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 = 4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| <b>Frequency</b>                    | 3700 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             | 37.7           | 3.12 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 38.3 $\pm$ 6 % | 3.07 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                                                | 100 mW input power | 6.54 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>65.8 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 | 2.41 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>24.2 W/kg <math>\pm</math> 19.5 % (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             | 51.0           | 3.55 mho/m           |
| <b>Measured Body TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 49.7 $\pm$ 6 % | 3.53 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                                                | 100 mW input power | 6.46 W/kg                                      |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>64.3 W/kg <math>\pm</math> 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 | 2.32 W/kg                                      |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>23.1 W/kg <math>\pm</math> 19.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.0 $\Omega$ - 8.3 j $\Omega$ |
| Return Loss                          | - 21.4 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.5 $\Omega$ - 6.3 j $\Omega$ |
| Return Loss                          | - 23.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.144 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | December 18, 2015 |

## DASY5 Validation Report for Head TSL

Date: 11.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1018**

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used:  $f = 3700$  MHz;  $\sigma = 3.07$  S/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.5, 7.5, 7.5); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm/Zoom Scan, dist=1.4mm**

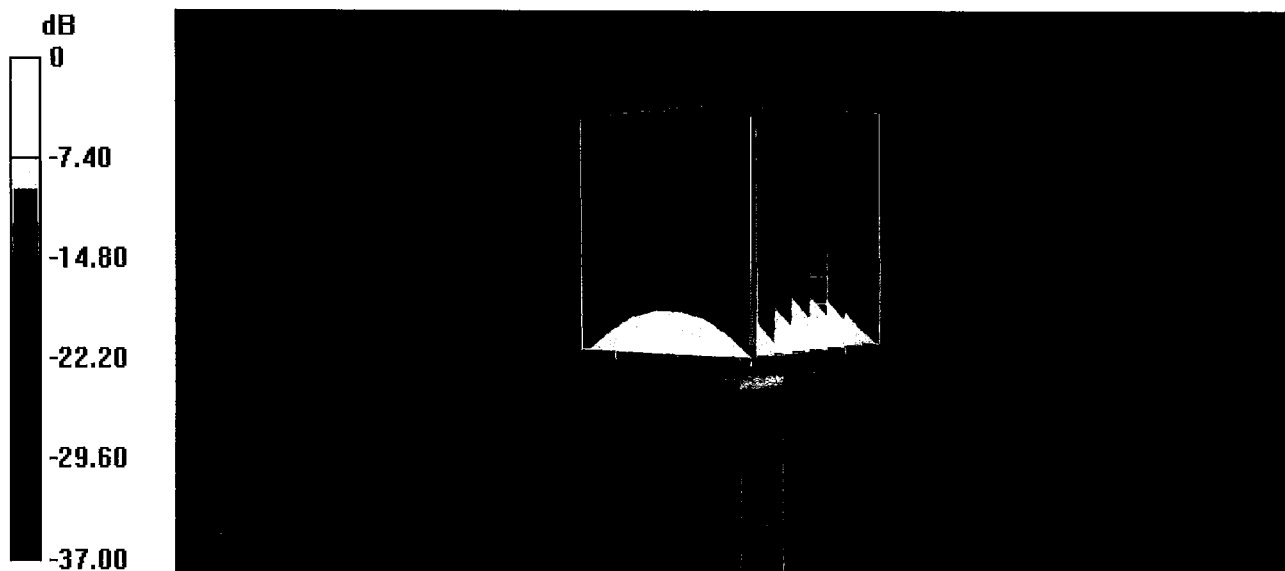
**(8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.40 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 18.5 W/kg

**SAR(1 g) = 6.54 W/kg; SAR(10 g) = 2.41 W/kg**

Maximum value of SAR (measured) = 12.6 W/kg

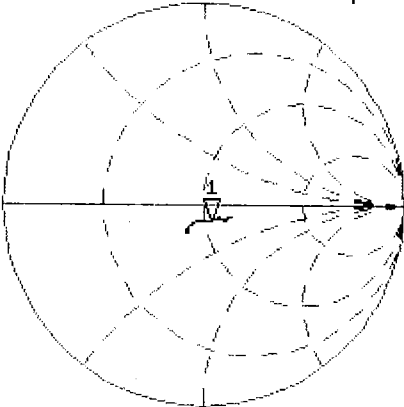


0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Head TSL

11 Jan 2018 16:39:21  
CH1 S11 1 U FS 1: 52.961  $\Omega$  -8.3184  $\Omega$  5.1711 pF 3 700.000 000 MHz

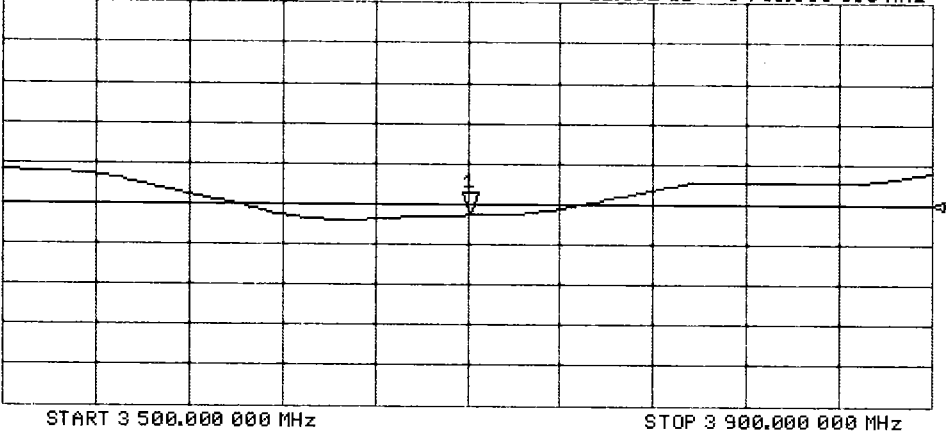
\*  
De1  
CA



Avg  
16  
H1d

CH2 S11 LOG 5 dB/ REF -20 dB 1:-21.361 dB 3 700.000 000 MHz

CA  
Avg  
16  
H1d



## DASY5 Validation Report for Body TSL

Date: 10.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1018**

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used:  $f = 3700$  MHz;  $\sigma = 3.53$  S/m;  $\epsilon_r = 49.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.28, 7.28, 7.28); 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=100 mW, d=10mm/Zoom Scan , dist=1.4mm

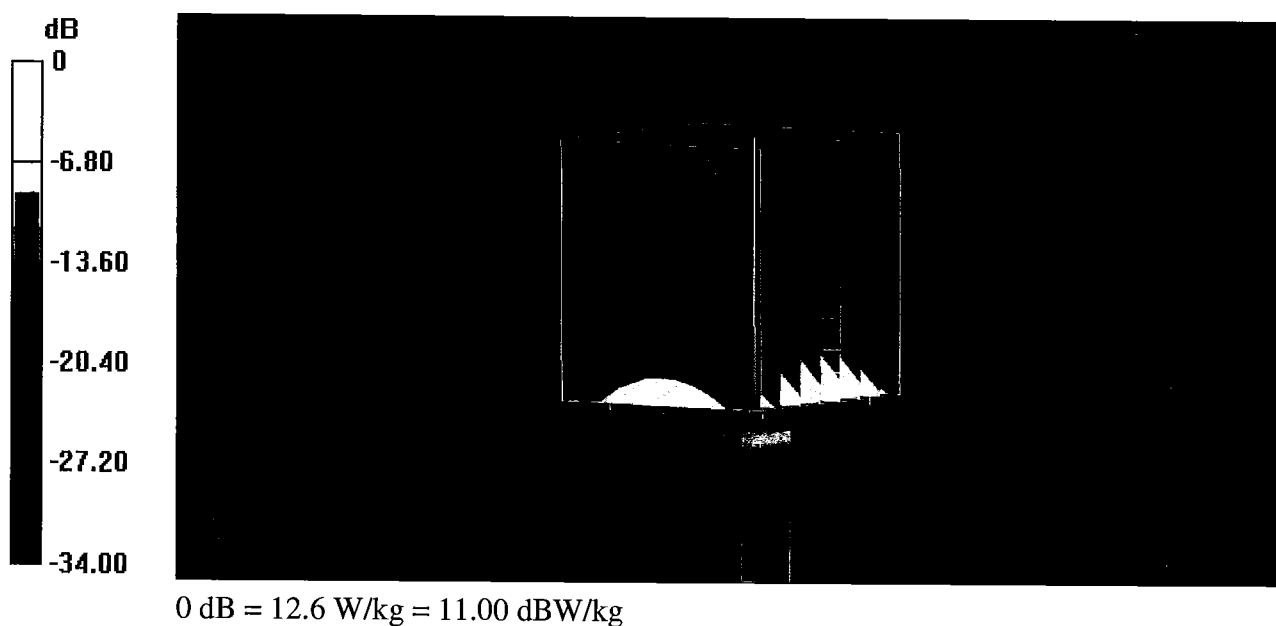
(8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.16 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 18.4 W/kg

**SAR(1 g) = 6.46 W/kg; SAR(10 g) = 2.32 W/kg**

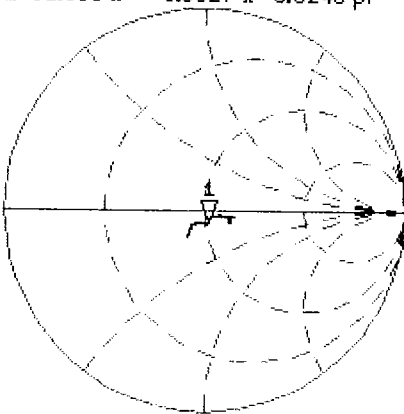
Maximum value of SAR (measured) = 12.6 W/kg



Impedance Measurement Plot for Body TSL

10 Jan 2018 11:46:43  
CH1 S11 1 U FS 1: 51.508  $\Omega$  -6.3027  $\Omega$  6.8248 pF 3 700.000 000 MHz

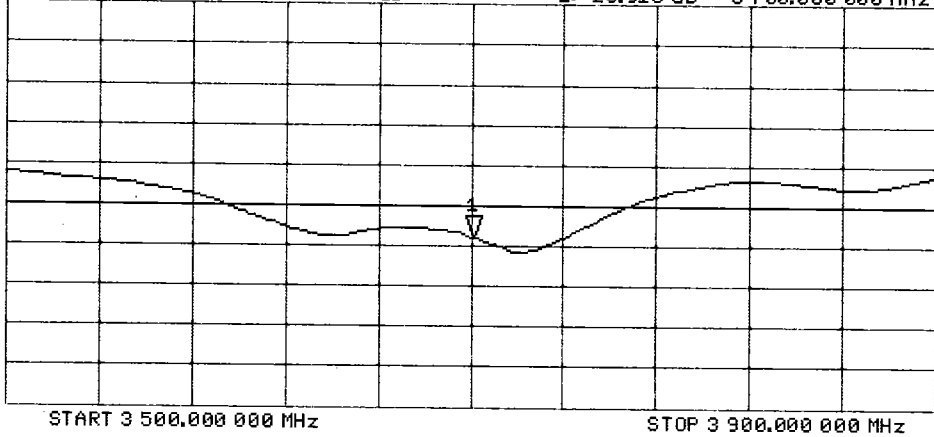
\*  
Del  
CA



Avg  
16  
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.913 dB 3 700.000 000 MHz

CA  
Avg  
16  
H1d



# Certification of Calibration

Object D3700V2 – SN: 1018

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

Extension Calibration date: 1/11/2019

Description: SAR Validation Dipole at 3500 MHz.

## Calibration Equipment used:

| Manufacturer          | Model     | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|-----------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Agilent               | 8753ES    | S-Parameter Network Analyzer                            | 2/8/2018   | Annual       | 2/8/2019   | US39170122    |
| Agilent               | N5182A    | MXG Vector Signal Generator                             | 4/18/2018  | Annual       | 4/18/2019  | MY47420800    |
| Amplifier Research    | 15S1G6    | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1207364       |
| Anritsu               | MA2411B   | Pulse Power Sensor                                      | 3/2/2018   | Annual       | 3/2/2019   | 1339018       |
| Anritsu               | ML2495A   | Power Meter                                             | 10/21/2018 | Annual       | 10/21/2019 | 941001        |
| Control Company       | 4040      | Therm./Clock/Humidity Monitor                           | 3/31/2017  | Biennial     | 3/31/2019  | 170232394     |
| Control Company       | 4352      | Ultra Long Stem Thermometer                             | 5/2/2017   | Biennial     | 5/2/2019   | 170330156     |
| 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    |
| MiniCircuits          | VLF-6000+ | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| Mini-Circuits         | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator           | 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           |
| Seekonk               | NC-100    | Torque Wrench                                           | 7/11/2018  | Annual       | 7/11/2019  | N/A           |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 10/3/2018  | Annual       | 10/3/2019  | 1558          |
| SPEAG                 | DAE4      | Dasy Data Acquisition Electronics                       | 6/18/2018  | Annual       | 6/18/2019  | 1334          |
| SPEAG                 | DAK-3.5   | Dielectric Assessment Kit                               | 9/11/2018  | Annual       | 9/11/2019  | 1091          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 2/14/2018  | Annual       | 2/14/2019  | 3914          |
| SPEAG                 | EX3DV4    | SAR Probe                                               | 8/24/2018  | Annual       | 8/24/2019  | 3949          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

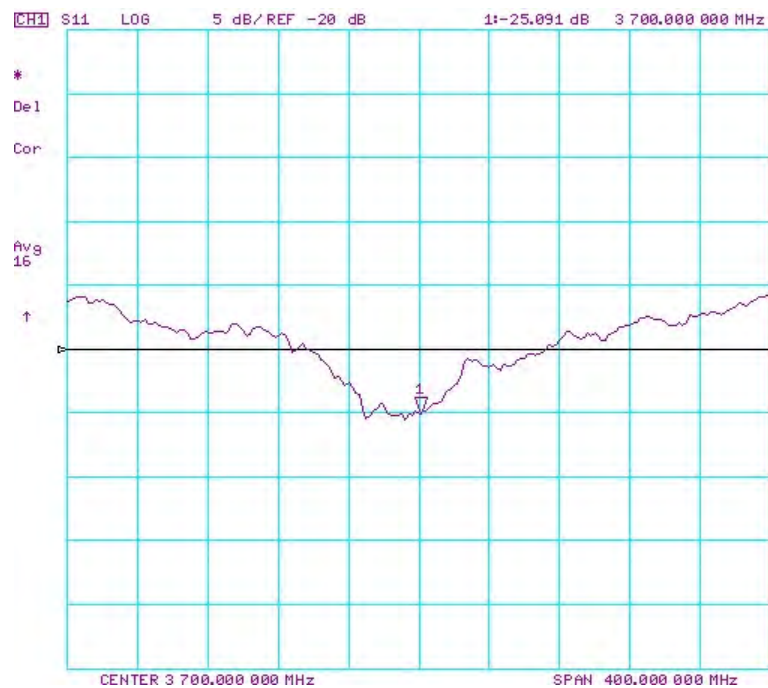
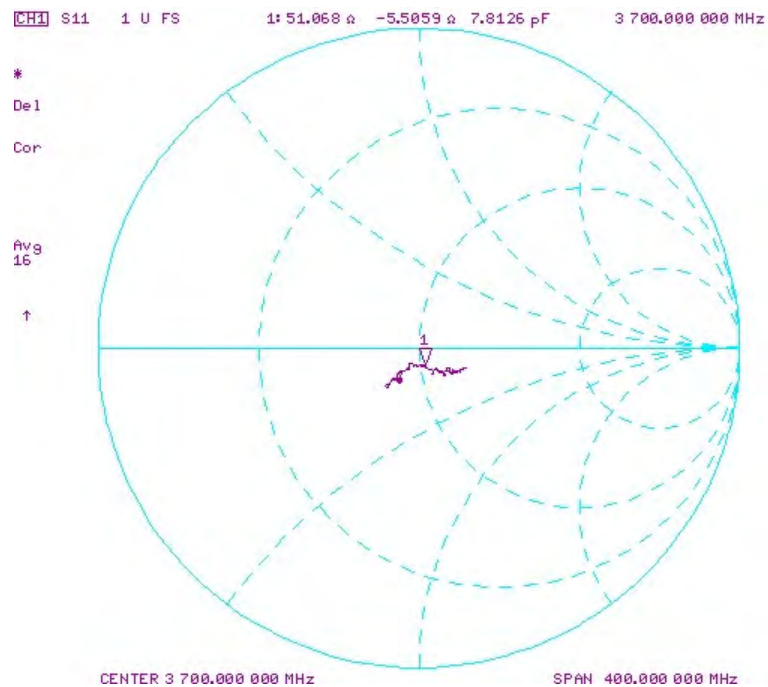
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

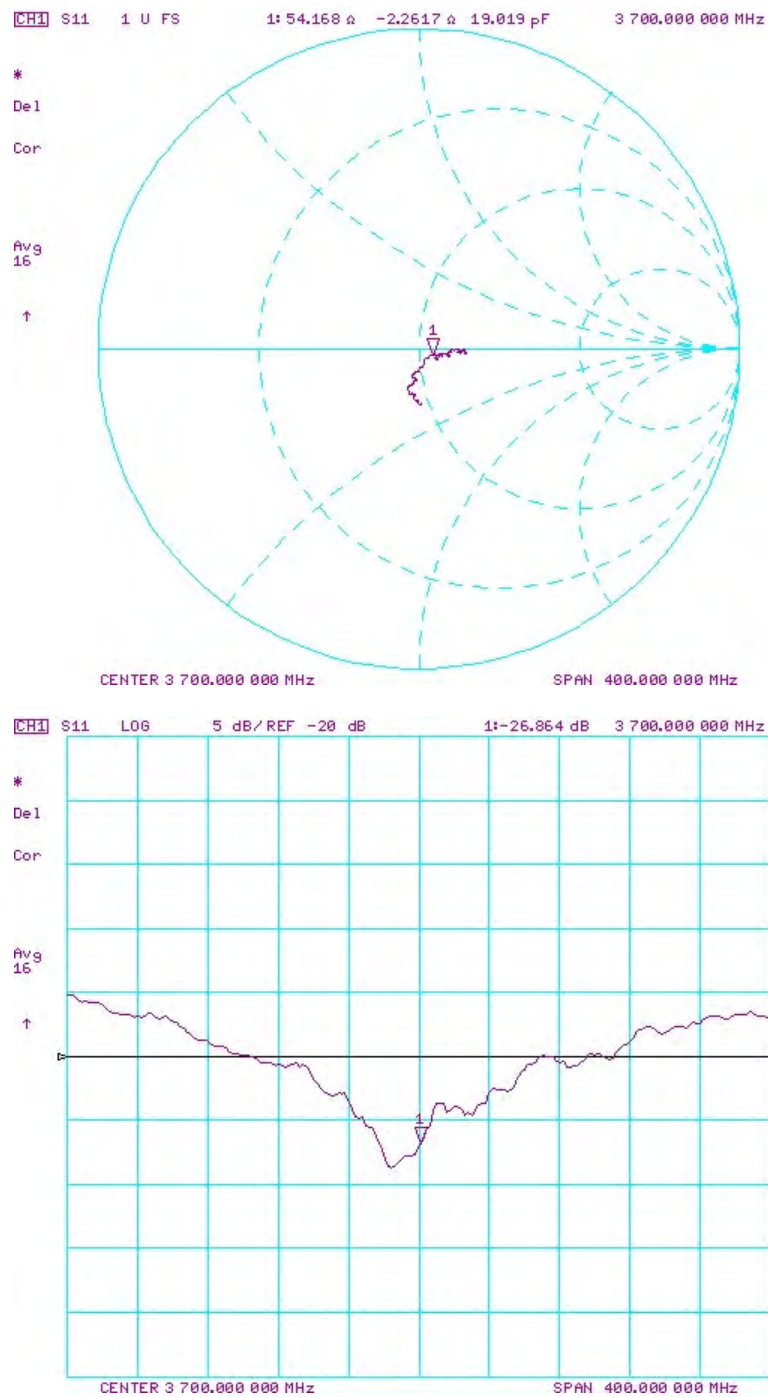
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 1/11/2018        | 1/11/2019      | 1.144                             | 6.58                                             | 6.22                                   | -5.47%           | 2.42                                              | 2.27                                    | -6.20%            | 53                                    | 51.1                               | 1.9                   | -8.3                                       | -5.5                                    | 2.8                        | -21.4                             | -25.1                          | -17.20%       | 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 |
| 1/11/2018        | 1/11/2019      | 1.144                             | 6.43                                             | 6.08                                   | -5.44%           | 2.31                                              | 2.21                                    | -4.33%            | 51.5                                  | 54.2                               | 2.7                   | -6.3                                       | -2.3                                    | 4                          | -23.9                             | -20.9                          | -12.40%       | PASS      |

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL



## Certification of Calibration

Object: D3700V2 – SN: 1018

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

Extension Calibration date: 1/11/2020

Description: SAR Validation Dipole at 3700 MHz.

### Calibration Equipment used:

| Manufacturer          | Model         | Description                                             | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|-----------------------|---------------|---------------------------------------------------------|------------|--------------|------------|---------------|
| Control Company       | 4040          | Therm./Clock/Humidity Monitor                           | 6/29/2019  | Biennial     | 6/29/2021  | 192291470     |
| Control Company       | 4352          | Ultra Long Stem Thermometer                             | 8/2/2018   | Biennial     | 8/2/2020   | 181334684     |
| Amplifier Research    | 15S1G6        | Amplifier                                               | CBT        | N/A          | CBT        | 433971        |
| Narda                 | 4772-3        | Attenuator (3dB)                                        | CBT        | N/A          | CBT        | 9406          |
| Keysight Technologies | 85033E        | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 7/2/2019   | Annual       | 7/2/2020   | MY53401181    |
| Rohde & Schwarz       | ZNLE6         | Vector Network Analyzer                                 | 10/11/2019 | Annual       | 10/11/2020 | 101307        |
| Mini-Circuits         | BW-N20W5+     | DC to 18 GHz Precision Fixed 20 dB Attenuator           | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | DAKS-3.5      | Portable DAK                                            | 9/10/2019  | Annual       | 9/10/2020  | 1045          |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/14/2019  | Annual       | 8/14/2020  | 1315051       |
| Anritsu               | MA2411B       | Pulse Power Sensor                                      | 8/8/2019   | Annual       | 8/8/2020   | 1339008       |
| Agilent               | N5182A        | MXG Vector Signal Generator                             | 8/19/2019  | Annual       | 8/19/2020  | MY47420837    |
| Seekonk               | NC-100        | Torque Wrench                                           | 5/9/2018   | Biennial     | 5/9/2020   | 22217         |
| MiniCircuits          | ZHDC-16-63-S+ | Bidirectional Coupler                                   | CBT        | N/A          | CBT        | N/A           |
| MiniCircuits          | VLF-6000+     | Low Pass Filter                                         | CBT        | N/A          | CBT        | N/A           |
| SPEAG                 | EX3DV4        | SAR Probe                                               | 2/19/2019  | Annual       | 2/19/2020  | 3914          |
| SPEAG                 | DAE4          | Dasy Data Acquisition Electronics                       | 2/14/2019  | Annual       | 2/14/2020  | 1272          |

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

|                | Name             | Function                 | Signature               |
|----------------|------------------|--------------------------|-------------------------|
| Calibrated By: | Brodie Halfoster | Test Engineer            | <i>BRODIE HALFOSTER</i> |
| Approved By:   | Kaitlin O'Keefe  | Senior Technical Manager | <i>KOK</i>              |

# DIPOLE CALIBRATION EXTENSION

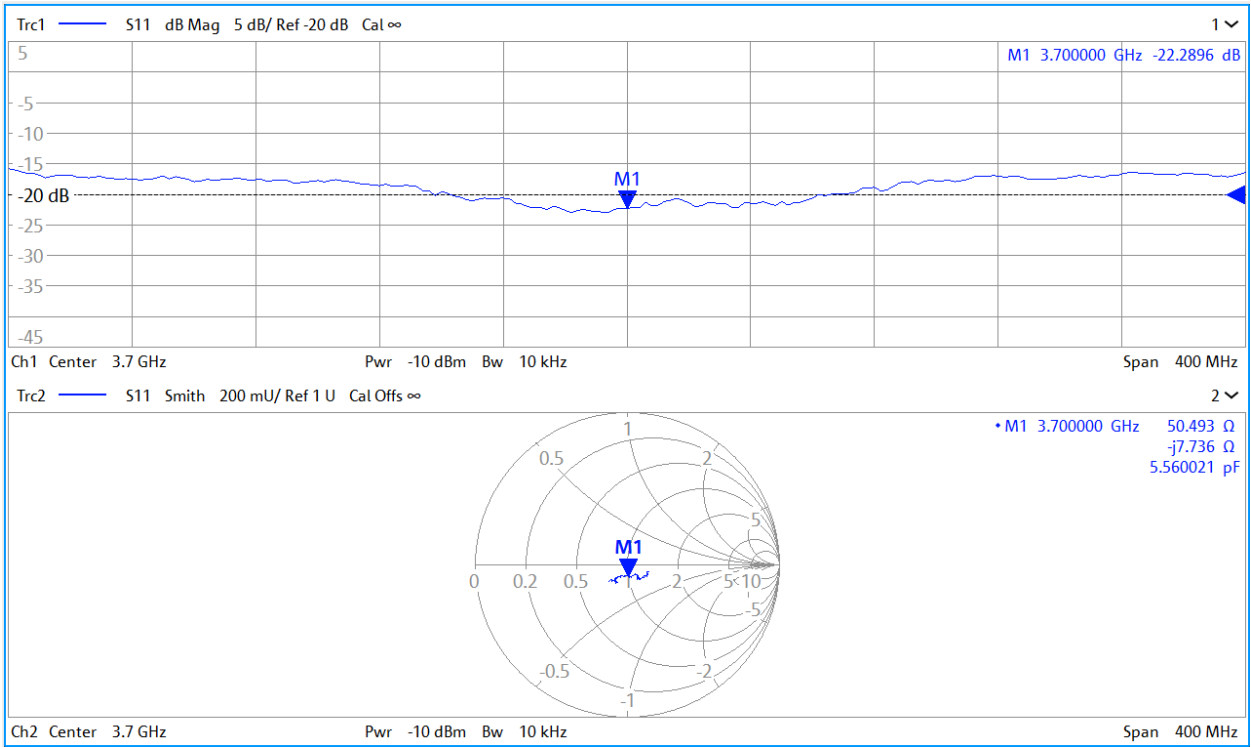
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

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.

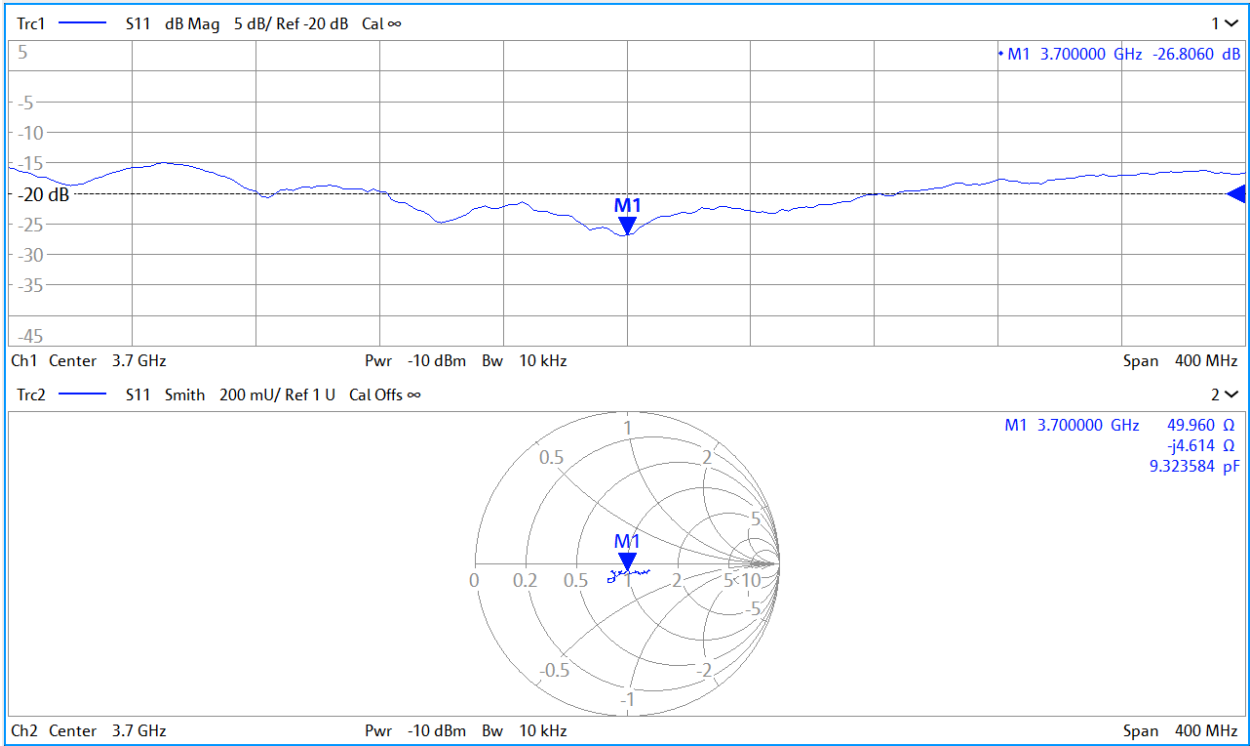
The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

| 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 |
|------------------|----------------|-----------------------------------|--------------------------------------------------|----------------------------------------|------------------|---------------------------------------------------|-----------------------------------------|-------------------|---------------------------------------|------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------|----------------------------|-----------------------------------|--------------------------------|---------------|-----------|
| 1/11/2018        | 1/11/2020      | 1.144                             | 6.58                                             | 7.05                                   | 7.80%            | 2.42                                              | 2.6                                     | 7.44%             | 53                                    | 50.5                               | 2.5                   | -8.3                                       | -7.7                                    | 0.6                        | -21.4                             | -22.3                          | -4.20%        | 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 |
| 1/11/2018        | 1/11/2020      | 1.144                             | 6.43                                             | 6.6                                    | 2.64%            | 2.31                                              | 2.36                                    | 2.16%             | 51.5                                  | 50                                 | 1.5                   | -6.3                                       | -4.6                                    | 1.7                        | -23.9                             | -26.8                          | -12.20%       | 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: **D5GHzV2-1191\_Sep19**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1191**

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

BN ✓  
09/26/2019

Calibration date: **September 17, 2019**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 03-Apr-19 (No. 217-02892/02893) | Apr-20                |
| Power sensor NRP-Z91        | SN: 103244         | 03-Apr-19 (No. 217-02892)       | Apr-20                |
| Power sensor NRP-Z91        | SN: 103245         | 03-Apr-19 (No. 217-02893)       | Apr-20                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-19 (No. 217-02894)       | Apr-20                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895)       | Apr-20                |
| Reference Probe EX3DV4      | SN: 3503           | 25-Mar-19 (No. EX3-3503_Mar19)  | Mar-20                |
| DAE4                        | SN: 601            | 30-Apr-19 (No. DAE4-601_Apr19)  | Apr-20                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

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

Issued: September 18, 2019

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                                                                                                                | V52.10.2                         |
| <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>                    | 5200 MHz $\pm$ 1 MHz<br>5250 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5750 MHz $\pm$ 1 MHz<br>5800 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 | 35.1 $\pm$ 6 % | 4.53 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 | 8.13 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>80.8 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 | 2.32 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.0 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 | 34.6 ± 6 %   | 4.88 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 | 8.33 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>82.7 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 | 2.36 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 | 34.4 ± 6 %   | 5.03 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 | 8.08 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>80.2 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 | 2.29 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>22.7 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 49.0         | 5.30 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 46.9 ± 6 %   | 5.44 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5200 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.55 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>74.9 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 | 2.11 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>20.9 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 | 46.9 ± 6 %   | 5.51 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 | 7.76 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>77.0 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 | 2.16 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.4 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 | 46.2 ± 6 %   | 5.98 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 | 7.93 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>78.6 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 | 2.22 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.9 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 | 46.0 ± 6 %   | 6.19 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 | 7.75 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>76.9 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 | 2.15 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.3 W/kg ± 19.5 % (k=2)</b> |

### Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.2         | 6.00 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 45.9 ± 6 %   | 6.26 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Body TSL at 5800 MHz

|                                                             |                    |                                 |
|-------------------------------------------------------------|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | Condition          |                                 |
| SAR measured                                                | 100 mW input power | 7.66 W/kg                       |
| SAR for nominal Body TSL parameters                         | normalized to 1W   | <b>76.0 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 | 2.12 W/kg                       |
| SAR for nominal Body TSL parameters                           | normalized to 1W   | <b>21.0 W/kg ± 19.5 % (k=2)</b> |