



In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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## Appendix(Additional assessments outside the scope of CNAS L0570)

### Antenna Parameters with Head TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 47.6Ω- 7.55jΩ |
| Return Loss                          | - 21.9dB      |

### Antenna Parameters with Body TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 44.9Ω- 7.14jΩ |
| Return Loss                          | - 20.7dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.013 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 |
|-----------------|-------|



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## DASY5 Validation Report for Head TSL

Date: 06.10.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1111**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.943$  S/m;  $\epsilon_r = 39.18$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(6.92, 6.92, 6.92) @ 2600 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

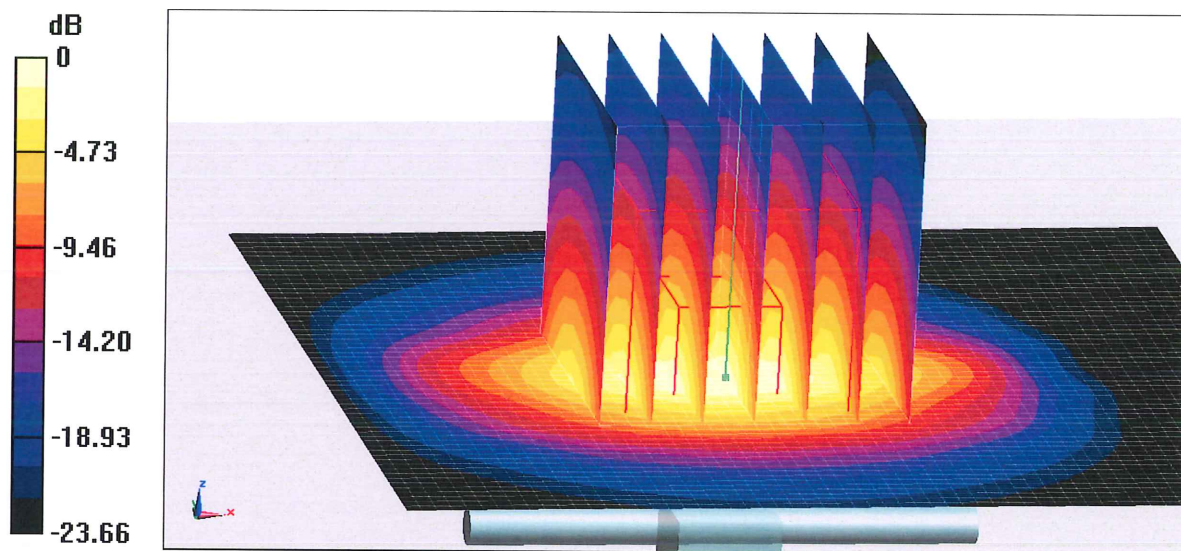
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.6 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 31.8 W/kg

**SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.4 W/kg**

Maximum value of SAR (measured) = 25.1 W/kg



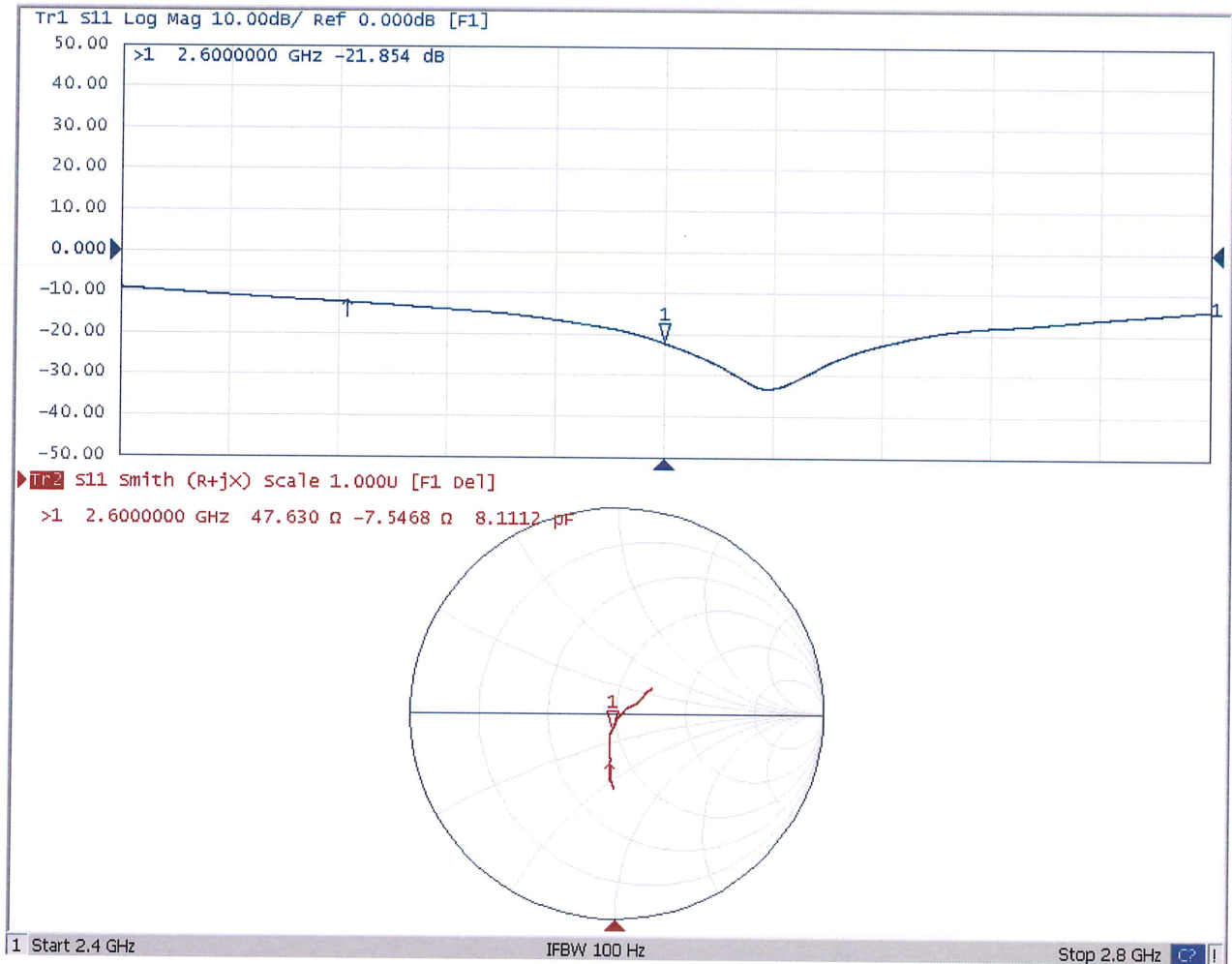
**0 dB = 25.1 W/kg = 14.00 dBW/kg**



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## Impedance Measurement Plot for Head TSL





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## DASY5 Validation Report for Body TSL

Date: 06.10.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1111**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.148$  S/m;  $\epsilon_r = 51.87$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.06, 7.06, 7.06) @ 2600 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

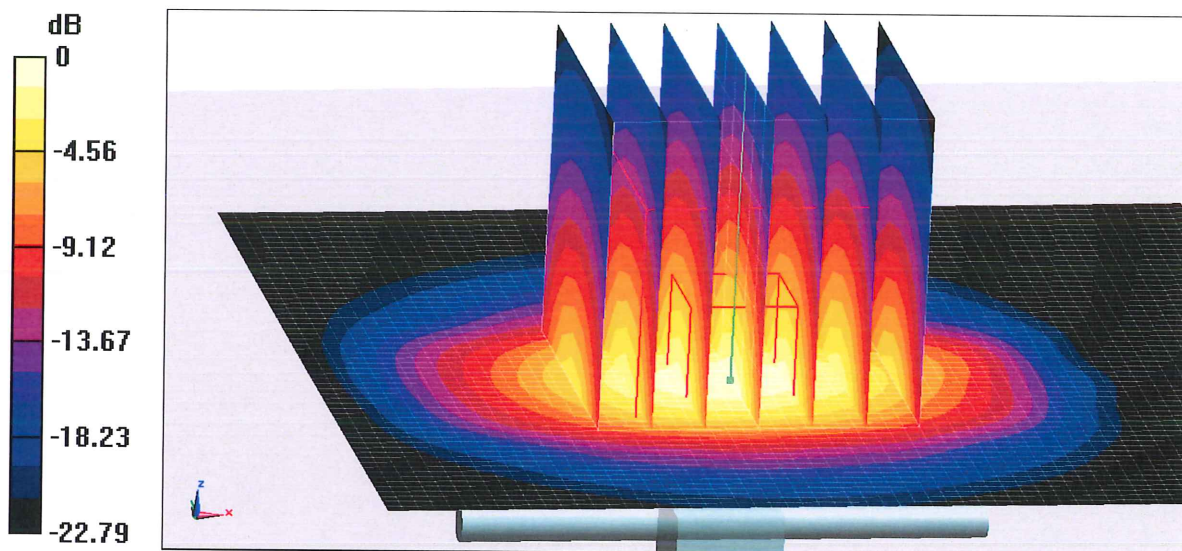
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 83.12 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 29.8 W/kg

**SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.14 W/kg**

Maximum value of SAR (measured) = 23.8 W/kg

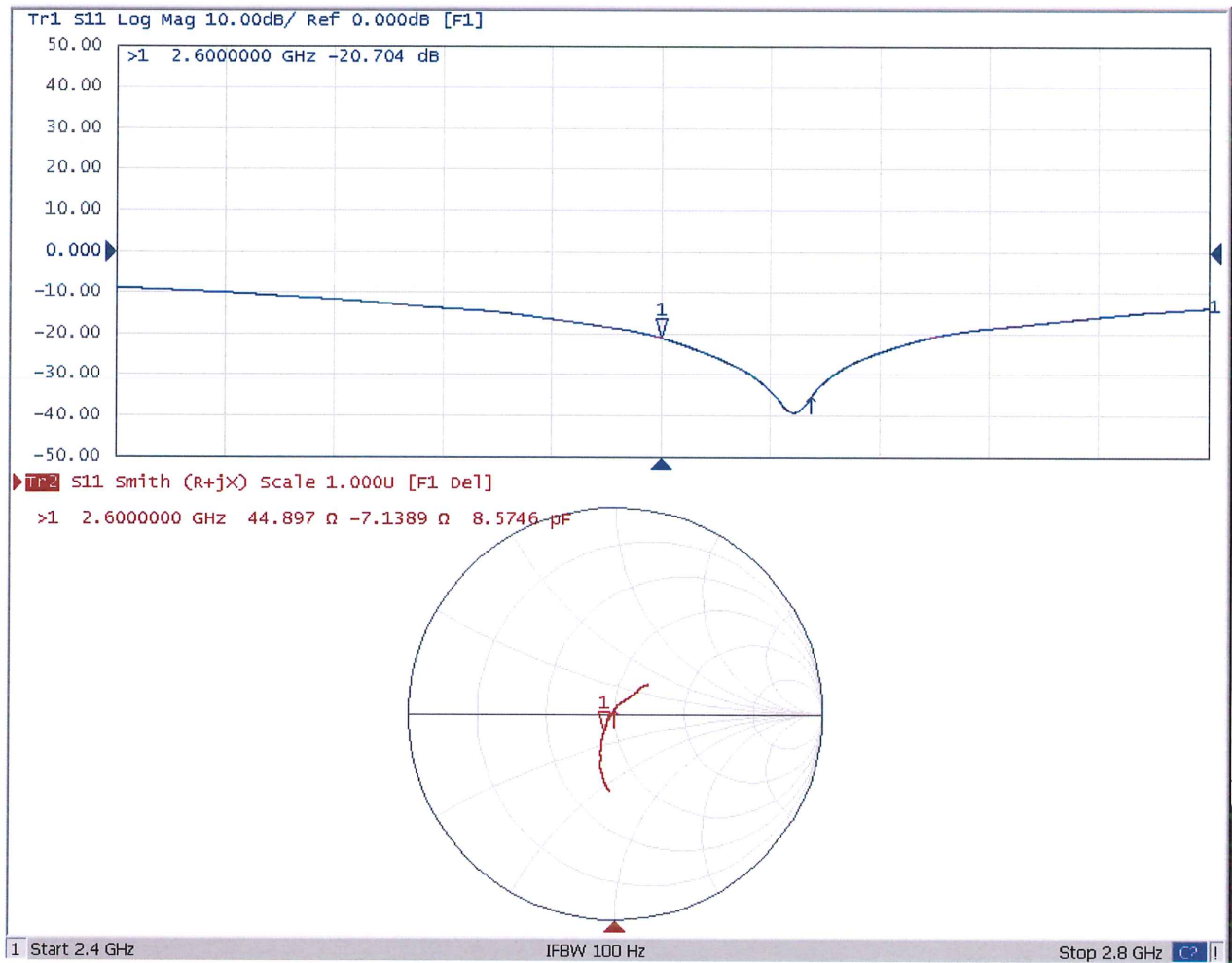


0 dB = 23.8 W/kg = 13.77 dBW/kg



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## Impedance Measurement Plot for Body TSL





## Dipole Internal Calibration Record

|               |                |               |               |                  |              |
|---------------|----------------|---------------|---------------|------------------|--------------|
| Asset No. :   | E-435          | Model No. :   | D2600V2       | Serial No. :     | 1111         |
| Environmental | 23.0°C, 39.8 % | Original Cal. | June 10, 2019 | Next Cal. Date : | June 9, 2022 |

### Standard List

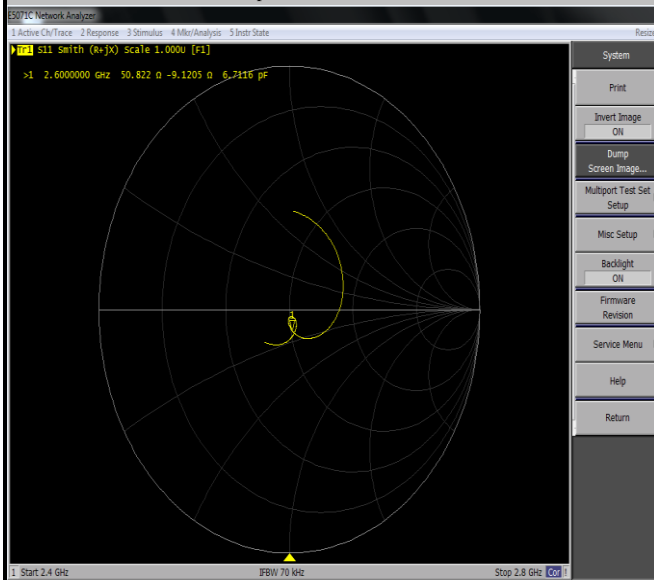
|   |                    |                                                                                                                                                                                            |
|---|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | IEEE Std 1528-2013 | IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013 |
| 2 | 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      |
| 3 | KDB865664          | SAR Measurement Requirements for 100 MHz to 6 GHz                                                                                                                                          |

### Equipment Information

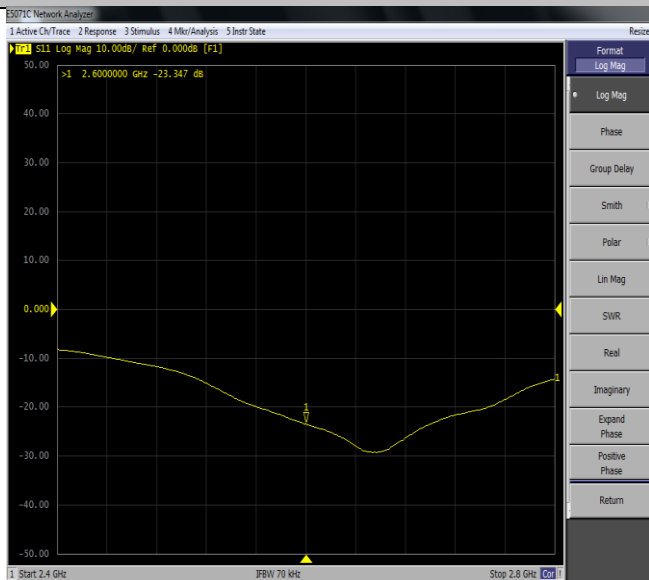
|                      |                |             |                    |                    |                   |
|----------------------|----------------|-------------|--------------------|--------------------|-------------------|
| Equipment :          | Manufacturer : | Model No. : | Serial No. :       | Cal.Organization : | Cal. Date :       |
| Power Amplifier      | Mini-Circuits  | ZHL-42W+    | QA1333003          | N/A                | March 10, 2020    |
| DC Source metter     | lteck          | IT6154      | 006104126768201001 | N/A                | July 25, 2020     |
| Power Meter          | Anritsu        | ML2495A     | 1128008            | N/A                | June 11, 2020     |
| Power Sensor         | Anritsu        | MA2411B     | 1126001            | N/A                | June 11, 2020     |
| Power Meter          | Anritsu        | MA2487A     | 6K00004714         | N/A                | September 3, 2020 |
| Power Sensor         | Anritsu        | MA2491A     | 1725282            | N/A                | September 3, 2020 |
| Directional Coupler  | Woken          | TS-PCCOM-05 | 107090019          | N/A                | March 1, 2020     |
| Signal Generator     | R & S          | N5172B      | MY53051229         | N/A                | June 20, 2020     |
| ENA Network Analyzer | Agilent        | E5071C      | MY46524658         | N/A                | April 7, 2020     |

| Model No | For Head Tissue                      |                      |                       |           |        |
|----------|--------------------------------------|----------------------|-----------------------|-----------|--------|
|          | Item                                 | Originak Cal. Result | Verified on 2021/1/26 | Deviation | Result |
| D2600V2  | Impedance, transformed to feed point | 47.6Ω-7.55jΩ         | 50.822Ω-9.1205jΩ      | <5Ω       | Pass   |
|          | Return Loss(dB)                      | -21.9                | -23.347               | 6.6%      | Pass   |
|          | SAR Value for 1g(mW/g)               | 14.4                 | 15.5                  | 7.6%      | Pass   |
|          | SAR Value for 10g(mW/g)              | 6.4                  | 6.73                  | 5.2%      | Pass   |

### Impedance Test-Head



### Return Loss-Head



Test Laboratory: BTL

Date: 2021/1/15

**System Check\_H2600**

Frequency: 2600 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 23.0°C; Liquid Temperature: 22.0°C

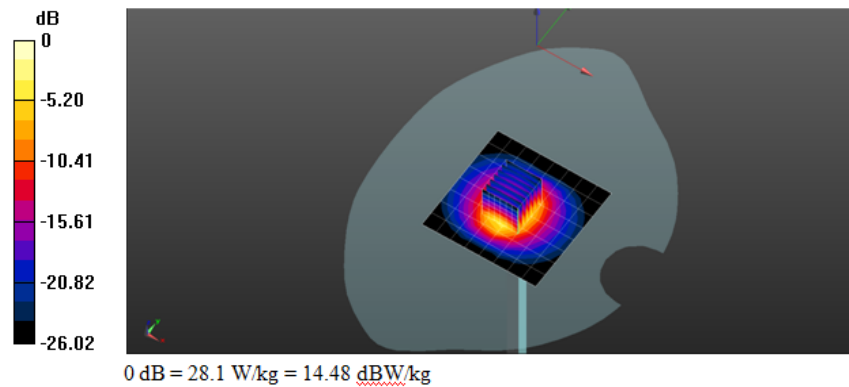
Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.054$  S/m;  $\epsilon_r = 39.336$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1486; Calibrated: 2020/6/4
- Probe: EX3DV4 - SN7369; ConvF(7.44, 7.44, 7.44) @ 2600 MHz; Calibrated: 2020/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: SAM Twin Phantom V5.0; Type: QD 000 P40 C; Serial: TP-1897

**Configuration/Pin=250mW/Area Scan (9x9x1):** Measurement grid:  $dx=12$ mm,  $dy=12$ mm  
Maximum value of SAR (measured) = 26.0 W/kg

**Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
Reference Value = 114.9 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 36.3 W/kg  
**SAR(1 g) = 15.5 W/kg; SAR(10 g) = 6.73 W/kg**  
Smallest distance from peaks to all points 3 dB below = 9.5 mm  
Ratio of SAR at M2 to SAR at M1 = 41.4%  
Maximum value of SAR (measured) = 28.1 W/kg



Calibrator:

*Aven Jo*

Approver:

*Peter Chen*



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Client

**BTL Inc .**

Certificate No: **Z19-60210**

## CALIBRATION CERTIFICATE

Object **D2300V2 - SN: 1054**

Calibration Procedure(s) **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**

Calibration date: **June 13, 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(Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|------------------------------------------|-----------------------|
| Power Meter NRP2        | 106277     | 20-Aug-18 (CTTL, No.J18X06862)           | Aug-19                |
| Power sensor NRP8S      | 104291     | 20-Aug-18 (CTTL, No.J18X06862)           | Aug-19                |
| Reference Probe EX3DV4  | SN 7514    | 27-Aug-18(SPEAG,No.EX3-7514_Aug18)       | Aug-19                |
| DAE4                    | SN 1556    | 20-Aug-18(SPEAG,No.DAE4-1556_Aug18)      | Aug-19                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 23-Jan-19 (CTTL, No.J19X00336)           | Jan-20                |
| NetworkAnalyzer E5071C  | MY46110673 | 24-Jan-19 (CTTL, No.J19X00547)           | Jan-20                |

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

Issued: June 17, 2019

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



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### Glossary:

|       |                                            |
|-------|--------------------------------------------|
| TSL   | tissue simulating liquid                   |
| ConvF | sensitivity in TSL / NORM <sub>x,y,z</sub> |
| 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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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%.