



# TEST REPORT

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--|
| <b>KCTL Inc.</b><br>65, Sinwon-ro, Yeongtong-gu,<br>Suwon-si, Gyeonggi-do, 16677, Korea<br>TEL: 82-31-285-0894 FAX: 82-505-299-8311<br><a href="http://www.kctl.co.kr">www.kctl.co.kr</a> | Report No.:<br><b>KR19-SPF0011-B</b><br>Page (1) of (109) |  |
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## 1. Client

- Name : DREAMUS COMPANY
- Address : 5, Bangbae-ro 18-gil, Seocho-gu, Seoul, Republic of Korea
- Date of Receipt : 2019-04-11

## 2. Use of Report : -

## 3. Name of Product and Model : SP2000 / PPF33

## 4. Manufacturer and Country of Origin : DREAMUS COMPANY / Korea

## 5. FCC ID : QDMPPF33

## 6. Date of Test : 2019-05-14 to 2019-05-25

## 7. Test Standards : IEEE 1528-2013, ANSI/IEEE C95.1, KDB Publication

## 8. Test Results : Refer to the test result in the test report

|             |                                  |                               |
|-------------|----------------------------------|-------------------------------|
| Affirmation | Tested by                        | Technical Manager             |
|             | Name : Kyounghoo Min (Signature) | Name : Jongwon Ma (Signature) |

2019-06-11

## KCTL Inc.

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|                                                                                                                                                                                           |                                                           |                                                                                     |
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#### Report revision history

| Date       | Revision                                         | Page No |
|------------|--------------------------------------------------|---------|
| 2019-05-31 | Initial report                                   | -       |
| 2019-06-07 | Revised Bluetooth Average Conducted Output Power | 21      |
|            | Revised Simultaneous Transmission Configurations | 26      |
| 2019-06-11 | Revised SAR Test Exclusions Applied table        | 22      |
|            |                                                  |         |
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Please note: Report KR19-SPF00011-B issued on 2019-06-11 supersedes previously issued report KR19-SPF00011-A issued on 2019-06-07.

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## 1. General information

Client : DREAMUS COMPANY  
 Address : 5, Bangbae-ro 18gil, Seocho-gu, Seoul, Republic of Korea  
 Manufacturer : DREAMUS COMPANY  
 Address : 5, Bangbae-ro 18gil, Seocho-gu, Seoul, Republic of Korea  
 Contact Person : Yewon.Jeong / yewon.jeong@iriver.com  
 Laboratory : KCTL Inc.  
 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea  
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132  
                           VCCI Registration No. : R-3327, G-198, C-3706, T-1849  
                           Industry Canada Registration No. : 8035A  
                           KOLAS No.: KT231

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## 2. Device information

### 2.1 Basic description

|                   |                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT Type          | SP2000                                                                                                                                                |
| Brand Name        | DREAMUS COMPANY                                                                                                                                       |
| Mode of Operation | WLAN 2.4 GHz / 5 GHz, Bluetooth                                                                                                                       |
| Model Number      | PPF33                                                                                                                                                 |
| Serial Number     | 57                                                                                                                                                    |
| Tx Freq. Range    | WLAN 2.4 GHz: 2 412 MHz ~ 2 462 MHz<br>WLAN 5.2 GHz: 5 180 MHz ~ 5 240 MHz<br>WLAN 5.8 GHz: 5 745 MHz ~ 5 825 MHz<br>Bluetooth: 2 402 MHz ~ 2 480 MHz |

### 2.2 Summary of SAR Test Results

| Band                                      | Equipment Class | Highest Reported |
|-------------------------------------------|-----------------|------------------|
|                                           |                 | 1g Body (W/kg)   |
| 802.11b                                   | DTS             | 0.05             |
| U-II-1                                    | NII             | 1.29             |
| U-NII-3                                   | NII             | 0.22             |
| Simultaneous SAR per KDB 690783 D01v01r03 |                 | N/A              |

|                                                                                                                                                                                           |                                                    |                                                                                     |
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### 3. Report Overview

This report details the results of testing carried out on the samples listed in section 2, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this test report is used in any configuration other than that detailed in the test report, the manufacturer must ensure the new configuration complies with all relevant standards and certification requirements. Any mention of KCTL Inc. Wireless lab or testing done by KCTL Inc. Wireless lab made in connection with the distribution or use of the tested product must be approved in writing by KCTL Inc. Wireless lab.

### 4. Test Lab Declaration or Comments

None

### 5. Applicant Declaration or Comments

None

## 6. SAR Test Methods and Procedures

The tests documented in this report were performed in accordance with IEEE Standard 1528-2003 & IEEE 1528a-2005 and the following published KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D06 Hotspot Mode v02r01
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)
- April 2019 TCB Workshop Notes (Tissue Simulating Liquids)

## 7. Measurement Uncertainty

Per KDB 865664 D01 SAR measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is  $< 1.5 \text{ W/kg}$  and the measured 10-g SAR within a frequency band is  $< 3.75 \text{ W/kg}$ . The expanded SAR measurement uncertainty must be  $\leq 30\%$ , for a confidence interval of  $k = 2$ . If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Standard 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less  $1.5 \text{ W/kg}$  and highest measured 10-g SAR is less  $3.75 \text{ W/kg}$ . Therefore, the measurement uncertainty table is not required in this report.

## 8. Specific Absorption Rate

### 8.1 Introduction

The SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational / controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

### 8.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt} \left( \frac{dW}{dm} \right) = \frac{d}{dt} \left( \frac{dW}{\rho dv} \right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$\text{SAR} = C \left( \frac{\delta T}{\delta t} \right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$\text{SAR} = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength. However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

### 8.3 SAR Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.3-2003, Copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements

(NCRP) in "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

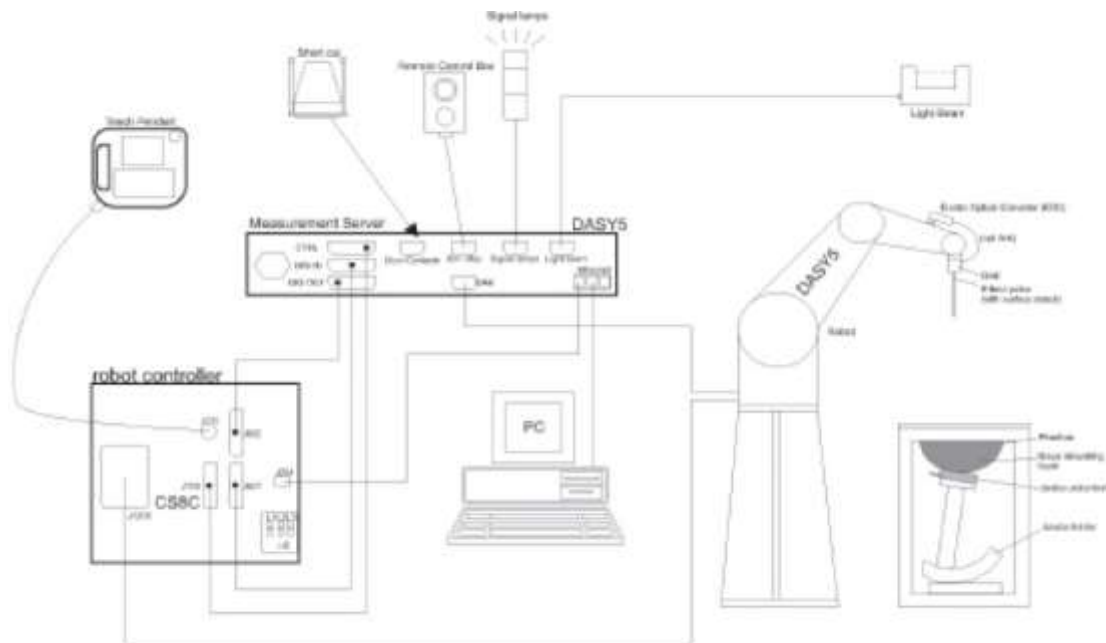
(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.

| Human Exposure                                                    | Uncontrolled Environment<br>General Population | Controlled Environment<br>Occupational |
|-------------------------------------------------------------------|------------------------------------------------|----------------------------------------|
| <b>Partial Peak SAR <sup>1)</sup></b><br>(Partial)                | 1.60 m W/g                                     | 8.00 m W/g                             |
| <b>Partial Average SAR <sup>2)</sup></b><br>(Whole Body)          | 0.08 m W/g                                     | 0.40 m W/g                             |
| <b>Partial Peak SAR <sup>3)</sup></b><br>(Hands/Feet/Ankle/Wrist) | 4.00 m W/g                                     | 20.00 m W/g                            |

- 1) The spatial Peak value of the SAR averaged over any 1g gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
- 2) The spatial Average value of the SAR averaged over the whole body.
- 3) The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

## 9. The SAR Measurement System



### <SAR System Configuration>

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- Data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Windows XP or Windows 7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

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## 9.1 Data Acquisition Electronics

|                      |                                                                                                                                                                                                                                                     |                                                                                     |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Type                 | DAE3, DAE4                                                                                                                                                                                                                                          |  |
| Construction         | Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop. |                                                                                     |
| Calibration          | ISO/IEC 17025 calibration (Annual)                                                                                                                                                                                                                  |                                                                                     |
| Measurement Range    | -100 – +300 mV (16 bit resolution and two range settings: 4 mV, 400 mV)                                                                                                                                                                             |                                                                                     |
| Input Offset Voltage | < 5 $\mu$ V (with auto zero)                                                                                                                                                                                                                        |                                                                                     |
| Input Resistance     | 200 Mohm                                                                                                                                                                                                                                            |                                                                                     |
| Input Bias Current   | < 50 fA                                                                                                                                                                                                                                             |                                                                                     |

## 9.2 Isotropic E-field Probe

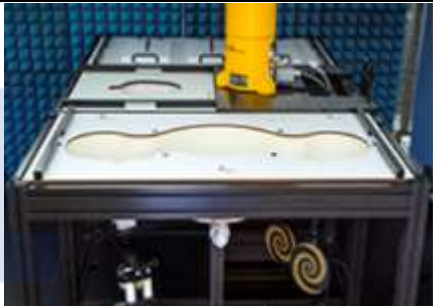
|               |                                                                                                                                            |                                                                                      |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Type          | EX3DV4                                                                                                                                     |  |
| Construction  | Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material(resistant to organic solvents) |                                                                                      |
| Calibration   | ISO/IEC 17025 calibration (Annual)                                                                                                         |                                                                                      |
| Frequency     | 10 MHz to 6 GHz<br>Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)                                                                               |                                                                                      |
| Directivity   | $\pm 0.3$ dB in TSL (rotation around probe axis)<br>$\pm 0.5$ dB in TSL (rotation normal to probe axis)                                    |                                                                                      |
| Dynamic Range | 10 $\mu$ W/g to > 100 mW/g<br>Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)                                                     |                                                                                      |
| Dimensions    | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm       |                                                                                      |

|               |                                                                                                                                            |                                                                                       |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type          | ES3DV3                                                                                                                                     |  |
| Construction  | Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material(resistant to organic solvents) |                                                                                       |
| Calibration   | ISO/IEC 17025 calibration (Annual)                                                                                                         |                                                                                       |
| Frequency     | 10 MHz to 4 GHz<br>Linearity: $\pm 0.2$ dB (30 MHz to 4 GHz)                                                                               |                                                                                       |
| Directivity   | $\pm 0.3$ dB in TSL (rotation around probe axis)<br>$\pm 0.5$ dB in TSL (rotation normal to probe axis)                                    |                                                                                       |
| Dynamic Range | 10 $\mu$ W/g to > 100 mW/g<br>Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)                                                     |                                                                                       |
| Dimensions    | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 3.9 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 2 mm       |                                                                                       |

### 9.3 System Validation Dipoles

|                  |                                                                                                                                                                                              |                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Type             | Dipole Antenna                                                                                                                                                                               |  |
| Construction     | Symmetrical dipole with $\lambda/4$ balun. Enables measurement of feed point impedance with network analyzers (NWA) Matched for use near flat phantoms filled with tissue simulating liquids |                                                                                     |
| Calibration      | ISO/IEC 17025 calibration (Biennial)                                                                                                                                                         |                                                                                     |
| Frequency        | 300 MHz to 6 GHz                                                                                                                                                                             |                                                                                     |
| Return Loss      | > 20 dB at specified validation position                                                                                                                                                     |                                                                                     |
| Power Capability | >100 W ( $f < 1$ GHz); >40 W ( $f > 1$ GHz)                                                                                                                                                  |                                                                                     |

### 9.4 Phantom

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Type            | Twin SAM                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| Construction    | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body-mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. |                                                                                     |
| Material        | Vinyl ester, fiberglass reinforced (VE-GF)                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                     |
| Shell Thickness | $2 \pm 0.2$ mm ( $6 \pm 0.2$ mm at ear point)                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                     |
| Dimensions      | Length: 1000 mm<br>Width: 500 mm<br>Height: adjustable feet                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                     |
| Filling Volume  | approx. 25 liters                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type            | ELI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| Construction    | The ELI phantom is used for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids by teaching three points with the robot. |                                                                                       |
| Material        | Vinyl ester, fiberglass reinforced (VE-GF)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                       |
| Shell Thickness | $2 \pm 0.2$ mm (bottom plate)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                       |
| Dimensions      | Major axis: 600 mm / Minor axis: 400 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                       |
| Filling Volume  | approx. 300 liters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                       |

|                                                                                                                                                                                           |                                                     |                                                                                     |
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## 9.5 Device Holder for Transmitters

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                     |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Construction | In combination with the Twin SAM or ELI phantoms, the Mounting Device for Hand-held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to Standard or other specifications. The device holder can be locked for positioning at different phantom sections |                                                                                     |
| Type         | MD4HHTV5                                                                                                                                                                                                                                                                                                                                                                                                                                | MD4LAPV5                                                                            |
| Photo        |                                                                                                                                                                                                                                                                                                                                                        |  |
| Material     | Polyoxymethylene(POM)                                                                                                                                                                                                                                                                                                                                                                                                                   | Polyoxymethylene(POM), PET-G, Foam                                                  |

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## 10. Test Equipment Information

|                           |                                                                 |                 |                     |                              |
|---------------------------|-----------------------------------------------------------------|-----------------|---------------------|------------------------------|
| Test Platform             | SPEAG DASY5 System                                              |                 |                     |                              |
| Version                   | DASY5 : Version 52.10.2.1495<br>SEMCAD : Version 14.6.12 (7450) |                 |                     |                              |
| Location                  | KCTL Inc.                                                       |                 |                     |                              |
| Manufacture               | SPEAG                                                           |                 |                     |                              |
| Hardware Reference        |                                                                 |                 |                     |                              |
| Equipment                 | Model                                                           | Serial Number   | Date of Calibration | Due date of next Calibration |
| Shield Room               | Shield Room                                                     | 8F - #1         | N/A                 | N/A                          |
| Shield Room               | Shield Room                                                     | 8F - #2         | N/A                 | N/A                          |
| DASY5 Robot               | TX90XL Speag                                                    | F07/554JA1/A/01 | N/A                 | N/A                          |
| DASY5 Controller          | TX90XL Speag                                                    | F07/554JA1/C/01 | N/A                 | N/A                          |
| DASY5 Robot               | TX90XL Speag                                                    | F12/5L7FA1/A/01 | N/A                 | N/A                          |
| DASY5 Controller          | TX90XL Speag                                                    | F12/5L7FA1/C/01 | N/A                 | N/A                          |
| Phantom                   | Twin SAM Phantom                                                | 1363            | N/A                 | N/A                          |
| Phantom                   | Twin SAM Phantom                                                | 1728            | N/A                 | N/A                          |
| Mounting Device           | Mounting Device                                                 | None            | N/A                 | N/A                          |
| DAE                       | DAE4                                                            | 666             | 2019-01-25          | 2020-01-25                   |
| DAE                       | DAE4                                                            | 1567            | 2019-02-05          | 2020-02-05                   |
| Probe                     | EX3DV4                                                          | 3865            | 2018-08-29          | 2019-08-29                   |
| Probe                     | EX3DV4                                                          | 3928            | 2019-01-31          | 2020-01-31                   |
| Signal Generator          | E4438C                                                          | MY42080486      | 2019-05-13          | 2020-05-13                   |
| Dual Power Meter          | E4419B                                                          | GB43312301      | 2019-05-13          | 2020-05-13                   |
| Power Sensor              | 8481H                                                           | 3318A19377      | 2019-05-13          | 2020-05-13                   |
| Power Sensor              | 8481H                                                           | 3318A19379      | 2019-05-13          | 2020-05-13                   |
| Attenuator                | 8491B 3dB                                                       | 17387           | 2019-05-13          | 2020-05-13                   |
| Attenuator                | 8491B-6dB                                                       | MY39270294      | 2019-05-13          | 2020-05-13                   |
| Attenuator                | 8491B 10dB                                                      | 29425           | 2019-05-13          | 2020-05-13                   |
| Power Amplifier           | 2055-BBS3Q7E9I                                                  | 1005D/C0521     | 2019-03-08          | 2020-03-08                   |
| Power Amplifier           | 5190FE                                                          | 1012            | 2019-05-14          | 2020-05-14                   |
| Dual Directional Coupler  | 772D                                                            | 2839A00719      | 2019-05-13          | 2020-05-13                   |
| Low Pass Filter           | LA-30N                                                          | 40058           | 2019-05-13          | 2020-05-13                   |
| Low Pass Filter           | LA-60N                                                          | 40059           | 2019-05-13          | 2020-05-13                   |
| Dipole Validation Kits    | D2450V2                                                         | 895             | 2018-07-24          | 2020-07-24                   |
| Dipole Validation Kits    | D5GHzV2                                                         | 1130            | 2018-05-25          | 2020-05-25                   |
| Network Analyzer          | E5071B                                                          | MY42403524      | 2019-01-04          | 2020-01-04                   |
| Dielectric Assessment kit | DAK-3.5                                                         | 1078            | 2018-08-22          | 2019-08-22                   |
| Humidity/Temp.            | MHB-382SD                                                       | 23107           | 2018-06-14          | 2019-06-14                   |
| Humidity/Temp.            | MHB-382SD                                                       | 46307           | 2019-04-10          | 2020-04-10                   |

## 11. System Verification

### 11.1 Tissue Verification

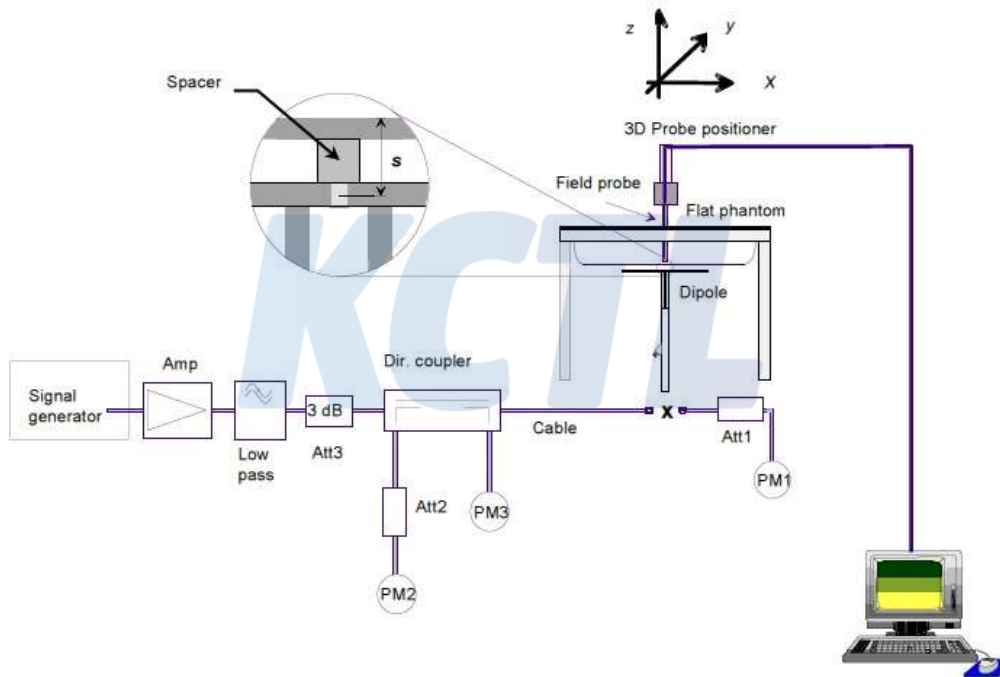
The dielectric properties for this Tissue Simulant Liquids were measured by using the SPEAG Model DAK3.5 Dielectric Probe in conjunction with Agilent E5071B Network Analyzer (300 kHz – 8 500 MHz). The Conductivity ( $\sigma$ ) and Permittivity ( $\rho$ ) are listed in Table 1. For the SAR measurement given in this report. The temperature variation of the Tissue Simulant Liquids was  $(22 \pm 2) ^\circ\text{C}$ .

| Freq. (MHz) | Tissue Type | Limit/Measured       | Permittivity ( $\rho$ )             | Conductivity ( $\sigma$ )        | Temp ( $^\circ\text{C}$ ) |
|-------------|-------------|----------------------|-------------------------------------|----------------------------------|---------------------------|
| 2 450       | HSL         | Recommended Limit    | $39.20 \pm 5 \%$<br>(37.24 ~ 41.16) | $1.80 \pm 5 \%$<br>(1.71 ~ 1.89) | $22 \pm 2$                |
|             |             | Measured, 2019-05-25 | 39.46                               | 1.82                             | 20.27                     |
| 5 200       | HSL         | Recommended Limit    | $36.00 \pm 5 \%$<br>(34.20 ~ 37.80) | $4.66 \pm 5 \%$<br>(4.43 ~ 4.89) | $22 \pm 2$                |
|             |             | Measured, 2019-05-14 | 35.72                               | 4.62                             | 20.68                     |
| 5 800       | HSL         | Recommended Limit    | $35.30 \pm 5 \%$<br>(33.54 ~ 37.07) | $5.27 \pm 5 \%$<br>(5.01 ~ 5.53) | $22 \pm 2$                |
|             |             | Measured, 2019-05-22 | 35.79                               | 5.46                             | 20.56                     |

<Table 1.Measurement result of Tissue electric parameters>

**11.2 Test System Verification**

The microwave circuit arrangement for system verification is sketched below picture. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within  $\pm 10\%$  from the target SAR values. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the Table 2. During the tests, the ambient temperature of the laboratory was in the range  $(22 \pm 2) ^\circ\text{C}$ , the relative humidity was in the range  $(50 \pm 20)\%$  and the liquid depth Above the ear/grid reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.



| Validation Kit | Dipole Ant. S/N | Frequency (MHz) | Tissue Type | Limit/Measurement (Normalized to 1 W) |                                     |
|----------------|-----------------|-----------------|-------------|---------------------------------------|-------------------------------------|
|                |                 |                 |             | 1 g                                   |                                     |
| D2450V2        | 895             | 2 450           | HSL         | Recommended Limit (Normalized)        | $51.30 \pm 10\%$<br>(46.17 ~ 56.43) |
|                |                 |                 |             | Measured, 2019-05-25                  | 50.80                               |
| D5GHzV2        | 1130            | 5 200           | HSL         | Recommended Limit (Normalized)        | $77.50 \pm 10\%$<br>(69.75 ~ 85.25) |
|                |                 |                 |             | Measured, 2019-05-14                  | 79.10                               |
| D5GHzV2        | 1130            | 5 800           | HSL         | Recommended Limit (Normalized)        | $83.00 \pm 10\%$<br>(74.70 ~ 91.30) |
|                |                 |                 |             | Measured, 2019-05-22                  | 80.90                               |

&lt;Table 2. Test System Verification Result&gt;

## 12. SAR Measurement Procedures

### 12.1 SAR Scan Procedures

#### Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 1.4 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

#### Step 2: Area Scan & Zoom Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot and Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly. Area Scan & Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04.

|                                                                                                                                                                                                                                                                                       |                         |                                                              | ≤ 3 GHz                                                                                                                                                                                                                                                           | > 3 GHz                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface                                                                                                                                                                                |                         |                                                              | 5 mm ± 1 mm                                                                                                                                                                                                                                                       | $\frac{1}{2} \cdot \delta \ln(2)$ mm 0.5 mm                    |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location                                                                                                                                                                                             |                         |                                                              | 30° ± 1°                                                                                                                                                                                                                                                          | 20° ± 1°                                                       |
| Maximum area scan spatial resolution: ΔxArea, ΔyArea                                                                                                                                                                                                                                  |                         |                                                              | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm                                                                                                                                                                                                                            | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm                       |
|                                                                                                                                                                                                                                                                                       |                         |                                                              | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. |                                                                |
| Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom                                                                                                                                                                                                                                  |                         |                                                              | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm*                                                                                                                                                                                                                             | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm*                       |
| Maximum zoom scan spatial resolution, normal to phantom surface                                                                                                                                                                                                                       | uniform grid: ΔzZoom(n) |                                                              | ≤ 5 mm                                                                                                                                                                                                                                                            | 3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm    |
|                                                                                                                                                                                                                                                                                       | graded grid             | ΔzZoom(1): between 1st two points closest to phantom surface | ≤ 4 mm                                                                                                                                                                                                                                                            | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm  |
|                                                                                                                                                                                                                                                                                       |                         | ΔzZoom(n>1): between subsequent points                       | ≤ 1.5 · ΔzZoom(n-1) mm                                                                                                                                                                                                                                            |                                                                |
| Minimum zoom scan volume                                                                                                                                                                                                                                                              | x, y, z                 |                                                              | ≥ 30 mm                                                                                                                                                                                                                                                           | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm |
| Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.                                                                                                                                                        |                         |                                                              |                                                                                                                                                                                                                                                                   |                                                                |
| * When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz. |                         |                                                              |                                                                                                                                                                                                                                                                   |                                                                |

#### Step 3: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

### 13. WLAN Measured Procedures

#### 13.1 General Device Setup

The normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 – 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

#### 13.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is  $> 1.2$  W/kg. When different maximum output powers is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is  $> 1.2$  W/kg.

#### 13.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements.

When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels.

When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency point requirements.

#### 13.4 2.4 GHz SAR Test Requirement

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following.

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is  $> 0.8$  W/kg, SAR is required for that position using the next highest measured output power channel; i.e., all channels require testing.

2.4 GHz 802.11g/n OFDM are additionally evaluated for SAR if highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is  $> 1.2$  W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

### 13.5 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz band, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel band width, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

### 13.6 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration. When the reported SAR is  $\leq 0.8$  W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is  $\leq 1.2$  W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements.

### 13.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is  $\leq 1.2$  W/kg, no additional SAR tests for the subsequent test configurations are required.

## 14. RF Average Conducted Output Power

### 14.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

#### 14.1.1 Maximum Tune-up power

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

| Band            | Ant   | Mode                 | Channel     | Output Power (dB m) |              |          |
|-----------------|-------|----------------------|-------------|---------------------|--------------|----------|
|                 |       |                      |             | Target              | Max. Allowed | SAR Test |
| WLAN<br>2.4 GHz | Ant 0 | 802.11b              | All Channel | 12.50               | 14.00        | Yes      |
|                 |       | 802.11g              | All Channel | 11.50               | 13.00        | No       |
|                 |       | 802.11n(HT20)        | All Channel | 11.50               | 13.00        | No       |
|                 |       | 802.11n(HT40)        | All Channel | 11.50               | 13.00        | No       |
| WLAN<br>5.2 GHz | Ant 0 | 802.11a              | All Channel | 13.00               | 14.50        | Yes      |
|                 |       | 802.11n(HT20)        | All Channel | 12.50               | 14.00        | No       |
|                 |       | 802.11n(HT40)        | All Channel | 12.50               | 14.00        | No       |
|                 |       | 802.11ac(VHT80)      | All Channel | 12.50               | 14.00        | No       |
| WLAN<br>5.8 GHz | Ant 0 | 802.11a              | All Channel | 11.50               | 13.00        | Yes      |
|                 |       | 802.11n(HT20)        | All Channel | 10.50               | 12.00        | No       |
|                 |       | 802.11n(HT40)        | All Channel | 10.50               | 12.00        | No       |
|                 |       | 802.11ac(VHT80)      | All Channel | 10.50               | 12.00        | No       |
| Bluetooth       | Ant 0 | BDR(GFSK)            | All Channel | 0.50                | 2.00         | No       |
|                 |       | EDR ( $\pi/4$ DQPSK) | All Channel | -3.50               | -2.00        | No       |
|                 |       | EDR(8DPSK)           | All Channel | -3.50               | -2.00        | No       |

#### 14.1.2 WLAN Average Conducted Output Power

| Band            | Ant   | Mode    | Conducted Powers (dBm) |       |       |
|-----------------|-------|---------|------------------------|-------|-------|
|                 |       |         | Low                    | Mid.  | High  |
| WLAN<br>2.4 GHz | Ant 0 | 802.11b | 13.13                  | 13.30 | 13.24 |
| WLAN<br>5.2 GHz | Ant 0 | 802.11a | 14.23                  | 14.29 | 14.02 |
| WLAN<br>5.8 GHz | Ant 0 | 802.11a | 12.67                  | 12.72 | 12.75 |

#### 14.1.3 Bluetooth Average Conducted Output Power

| Mode                 | Ant   | Conducted Powers (dBm) |       |       |
|----------------------|-------|------------------------|-------|-------|
|                      |       | Low                    | Mid.  | High  |
| BDR(GFSK)            | Ant 0 | -0.88                  | 0.64  | 1.58  |
| EDR ( $\pi/4$ DQPSK) | Ant 0 | -3.39                  | -2.56 | -2.33 |
| EDR(8DPSK)           | Ant 0 | -3.35                  | -2.50 | -2.28 |

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**15. SAR Test Exclusions Applied**

Per FCC KDB 447498 D01v06, The SAR exclusion threshold for distance < 50 mm is defined by the following equation:

$$\frac{\text{Max Power of Channel (mW)}}{\text{Test Separation Distance (mm)}} * \sqrt{\text{Frequency (GHz)}} \leq 3.0$$

For 100 MHz to 6 GHz and test separation distances > 50 mm, SAR exclusion threshold are determined by the following:

$$[(\text{Threshold at 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) * (f(\text{MHz})/150)] \text{ mW}$$

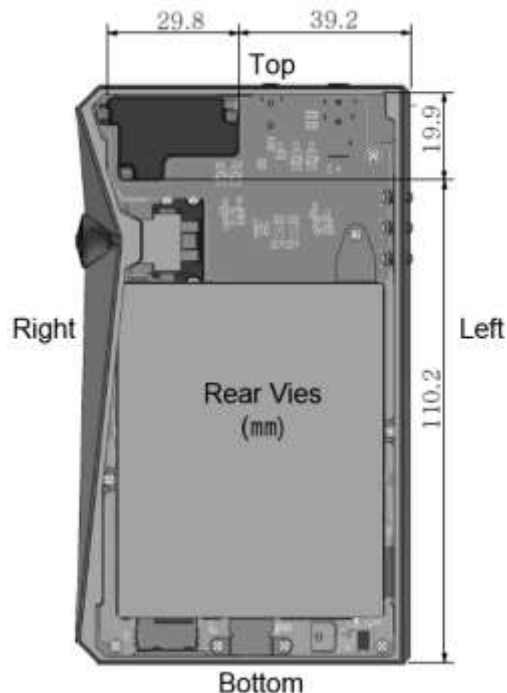
at 100 MHz to 1500 MHz

$$[(\text{Threshold at 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) * 10] \text{ mW}$$

at > 1500 MHz and ≤ 6 GHz

| Separation distances (mm) |                    |                          |      |                  |                  |                |                  |                  |        |        |  |
|---------------------------|--------------------|--------------------------|------|------------------|------------------|----------------|------------------|------------------|--------|--------|--|
| Front                     |                    | Rear                     |      | Left             |                  | Right          |                  | Top              |        | Bottom |  |
| 5                         |                    | 5                        |      | 39               |                  | 5              |                  | 5                |        | 110    |  |
| Mode                      | Frequency<br>(MHz) | Maximum<br>Allowed Power |      | SAR Exemption    |                  |                |                  |                  |        |        |  |
|                           |                    | (dBm)                    | (mW) | Front            | Rear             | Left           | Right            | Top              | Bottom |        |  |
| Bluetooth                 | 2 480              | 2.00                     | 2    | 0.63<br>Exempt   | 0.63<br>Exempt   | 0.08<br>Exempt | 0.63<br>Exempt   | 0.63<br>Exempt   | N/A    |        |  |
| WLAN                      | 2 437              | 14.00                    | 25   | 7.81<br>Measure  | 7.81<br>Measure  | 1.00<br>Exempt | 7.81<br>Measure  | 7.81<br>Measure  | N/A    |        |  |
|                           | 5 200              | 14.50                    | 28   | 12.77<br>Measure | 12.77<br>Measure | 1.64<br>Exempt | 12.77<br>Measure | 12.77<br>Measure | N/A    |        |  |
|                           | 5 825              | 13.00                    | 20   | 9.65<br>Measure  | 9.65<br>Measure  | 1.24<br>Exempt | 9.65<br>Measure  | 9.65<br>Measure  | N/A    |        |  |

Note: Formulas round separation distance to nearest mm and power to nearest mW before calculating thresholds or exemption values.



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**16. SAR Test Results****16.1 WLAN 2.4 GHz Body SAR Test Results****802.11b Ant 0**

| EUT Position | Distance (mm) | Frequency (MHz) | Measured Conducted Power (dB m) | Max. Tune-up Power (dB m) | Power Scaling Factor | Duty Cycle Compensate Factor | Measured 1 g SAR (W/kg) | Scaled 1 g SAR (W/kg) | Plot No. |
|--------------|---------------|-----------------|---------------------------------|---------------------------|----------------------|------------------------------|-------------------------|-----------------------|----------|
| Front        | 5             | 2 437           | 13.30                           | 14.00                     | 1.175                | 1.010                        | 0.000                   | 0.000                 |          |
| Rear         | 5             | 2 437           | 13.30                           | 14.00                     | 1.175                | 1.010                        | 0.038                   | <b>0.045</b>          | #1       |
| Right        | 5             | 2 437           | 13.30                           | 14.00                     | 1.175                | 1.010                        | 0.000                   | 0.000                 |          |
| Top          | 5             | 2 437           | 13.30                           | 14.00                     | 1.175                | 1.010                        | 0.000                   | 0.000                 |          |

**16.2 WLAN 5.3 GHz Body SAR Test Results****802.11a Ant 0**

| EUT Position              | Distance (mm) | Frequency (MHz) | Measured Conducted Power (dB m) | Max. Tune-up Power (dB m) | Power Scaling Factor | Duty Cycle Compensate Factor | Measured 1 g SAR (W/kg) | Scaled 1 g SAR (W/kg) | Plot No. |
|---------------------------|---------------|-----------------|---------------------------------|---------------------------|----------------------|------------------------------|-------------------------|-----------------------|----------|
| Front                     | 5             | 5 200           | 14.29                           | 14.50                     | 1.050                | 1.075                        | 0.044                   | 0.049                 |          |
| Rear                      | 5             | 5 200           | 14.29                           | 14.50                     | 1.050                | 1.075                        | 1.140                   | <b>1.287</b>          | #2       |
| Right                     | 5             | 5 200           | 14.29                           | 14.50                     | 1.050                | 1.075                        | 0.033                   | 0.037                 |          |
| Top                       | 5             | 5 200           | 14.29                           | 14.50                     | 1.050                | 1.075                        | 0.116                   | 0.131                 |          |
| Rear                      | 5             | 5 180           | 14.23                           | 14.50                     | 1.064                | 1.075                        | 1.060                   | 1.213                 |          |
| Rear                      | 5             | 5 240           | 14.02                           | 14.50                     | 1.117                | 1.075                        | 0.891                   | 1.070                 |          |
| Rear-ear                  | 5             | 5 200           | 14.29                           | 14.50                     | 1.050                | 1.075                        | 0.925                   | 1.044                 |          |
| Repeated (See Section 16) |               |                 |                                 |                           |                      |                              |                         |                       |          |
| Rear                      | 5             | 5 200           | 14.29                           | 14.50                     | 1.050                | 1.075                        | 1.090                   | 1.230                 |          |

**16.3 WLAN 5.8 GHz Body SAR Test Results****802.11a Ant 0**

| EUT Position | Distance (mm) | Frequency (MHz) | Measured Conducted Power (dB m) | Max. Tune-up Power (dB m) | Power Scaling Factor | Duty Cycle Compensate Factor | Measured 1 g SAR (W/kg) | Scaled 1 g SAR (W/kg) | Plot No. |
|--------------|---------------|-----------------|---------------------------------|---------------------------|----------------------|------------------------------|-------------------------|-----------------------|----------|
| Front        | 5             | 5 825           | 12.75                           | 13.00                     | 1.059                | 1.075                        | 0.000                   | 0.000                 |          |
| Rear         | 5             | 5 825           | 12.75                           | 13.00                     | 1.059                | 1.075                        | 0.189                   | <b>0.215</b>          | #3       |
| Right        | 5             | 5 825           | 12.75                           | 13.00                     | 1.059                | 1.075                        | 0.008                   | 0.009                 |          |
| Top          | 5             | 5 825           | 12.75                           | 13.00                     | 1.059                | 1.075                        | 0.011                   | 0.012                 |          |

**General Notes:**

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 447498 D01v06.
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings and the standard batteries are the only options.
4. Liquid tissue depth was at least 15 cm.
5. The EUT is tested 2<sup>nd</sup> hot-spot peak, if it is less than 2 dB below the highest peak.
6. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
7. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.

**WLAN & Bluetooth Notes:**

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2W/kg.
3. When the maximum reported 1g averaged SAR is  $\leq 0.8$  W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was  $\leq 1.20$  W/kg or all test channels were measured.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance.
5. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
6. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure requirements, is adjusted by the ratio of the subsequent test configuration to the initial test configuration specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg, SAR is not required for that subsequent test configuration.
7. WLAN & Bluetooth transmission was verified using a spectrum analyzer.

**17. SAR Measurement Variability**

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

- 1) Repeated measurements are not required when the original highest measured SAR is  $< 0.80$  W/kg.
- 2) **When the original highest measured SAR is  $\geq 0.80$  W/kg, the measurement was repeated once.**
- 3) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was  $> 1.20$  or when the original or repeated measurement was  $\geq 1.45$  W/kg ( $\sim 10\%$  from the 1-g SAR limit).
- 4) A third repeated measurement was performed only if the original, first or second repeated measurement was  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

| Band         | Frequency (MHz) | EUT Position | Separation Distance (mm) | Measured 1 g SAR (W/kg) | Repeated 1g SAR (W/kg) | Ratio |
|--------------|-----------------|--------------|--------------------------|-------------------------|------------------------|-------|
| WLAN 5.2 GHz | 5 200           | Rear         | 5                        | 1.14                    | 1.09                   | 0.96  |

## 18. Simultaneous Transmission

### 18.1 Simultaneous Transmission Configurations

| No | Scenario                  | Operation |
|----|---------------------------|-----------|
| 1  | WLAN 2.4 GHz + Bluetooth  | No        |
| 2  | WLAN 5 GHz + Bluetooth    | No        |
| 3  | WLAN 2.4 GHz + WLAN 5 GHz | No        |

This device does not have simultaneous transmission.

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## 18. Test System Verification Results

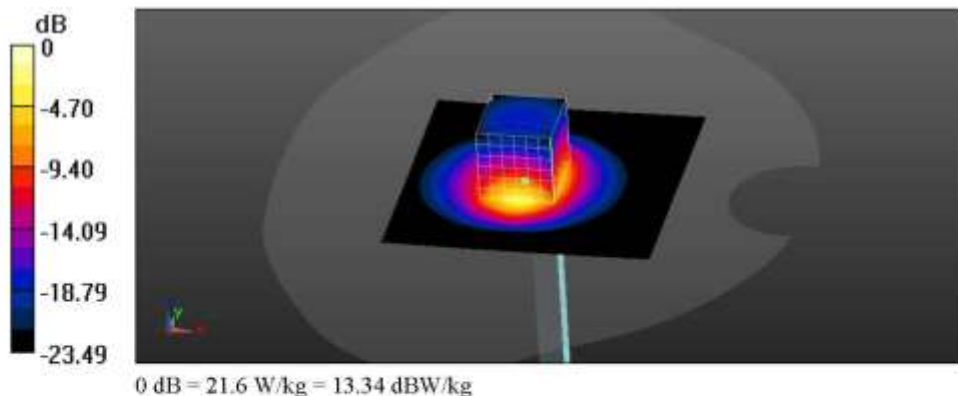
Date: 2019-05-25

Test Laboratory: KCTL Inc.

File Name: Head\_D2450(190525).da5:0**DUT: Dipole 2450 MHz D2450V2, Type: D2450V2, Serial: D2450V2 - SN:895**Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.819$  S/m;  $\epsilon_r = 39.459$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3865; ConvF(7.72, 7.72, 7.72) @ 2450 MHz; Calibrated: 2018-08-29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn666; Calibrated: 2019-01-25
- Phantom: Twin-SAM V4.0 (30deg probe tilt)\_1\_20180808; Type: QD 000 P40 CC; Serial: 1363
- Measurement SW: DASY52, Version 52.10 (2);

**Configuration/d=10 mm, Pin=250 mW, dist=1.4 mm (EX-Probe)/Area Scan (91x91x1):**  
Interpolated grid: dx=1.200 mm, dy=1.200 mm  
Maximum value of SAR (interpolated) = 19.4 W/kg**Configuration/d=10 mm, Pin=250 mW, dist=1.4 mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 86.89 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 27.0 W/kg  
**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.73 W/kg**  
Maximum value of SAR (measured) = 21.6 W/kg

Date: 2019-05-14

Test Laboratory: KCTL Inc.

File Name: [Head\\_D5.2GHz\(190514\).da52:0](#)**DUT: Dipole D5GHzV2, Type: D5GHzV2, Serial: D5GHzV2 - SN:1130**

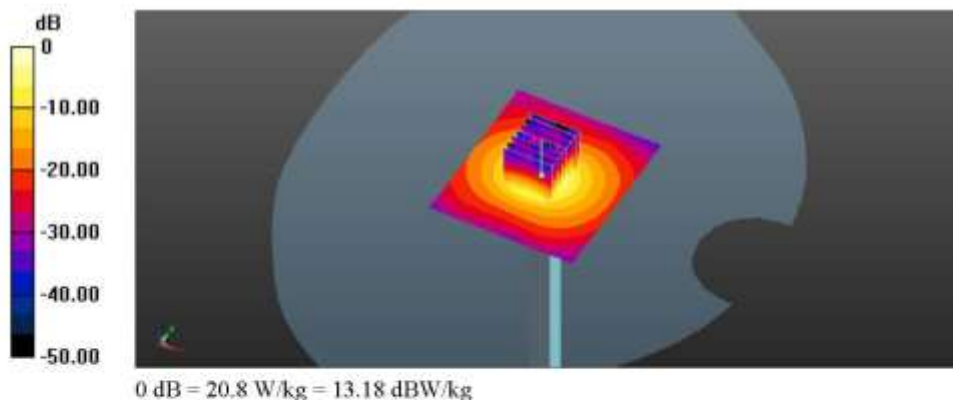
Communication System: UID 0, CW (0); Communication System Channel Number: 0;  
Frequency: 5200 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.624$  S/m;  $\epsilon_r = 35.723$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3865; ConvF(4.88, 4.88, 4.88) @ 5200 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn666; Calibrated: 2019-01-25
- Phantom: SAM twin 1728; Type: QD000P40CD; Serial: TP:1728
- Measurement SW: DASY52, Version 52.8 (4);

**Configuration/d=10mm, Pin=100mW, f=5200MHz/Area Scan (71x81x1):** Interpolated  
grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 19.5 W/kg

**Configuration/d=10mm, Pin=100mW, f=5200MHz/Zoom Scan (7x7x7)/Cube 0:**  
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 71.85 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 34.1 W/kg  
**SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.26 W/kg**  
Maximum value of SAR (measured) = 20.8 W/kg



Date: 2019-05-22

Test Laboratory: KCTL Inc.

File Name: [Head\\_D5.8GHz\(190522\).da52:0](#)**DUT: Dipole D5GHzV2, Type: D5GHzV2, Serial: D5GHzV2 - SN:1130**

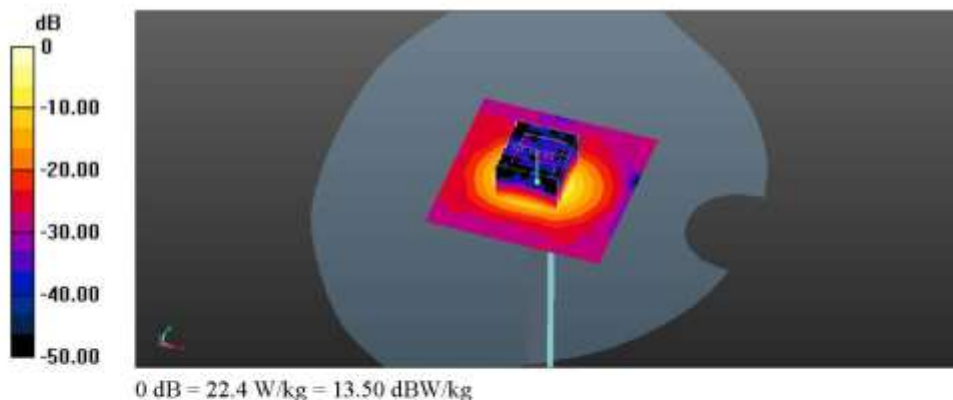
Communication System: UID 0, CW (0); Communication System Channel Number: 4;  
Frequency: 5800 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.457$  S/m;  $\epsilon_r = 35.788$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.7, 4.7, 4.7) @ 5800 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: SAM twin 1728; Type: QD000P40CD; Serial: TP:1728
- Measurement SW: DASY52, Version 52.10 (2);

**Configuration/d=10mm, Pin=100mW, f=5800MHz/Area Scan (91x91x1):** Interpolated  
grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 22.4 W/kg

**Configuration/d=10mm, Pin=100mW, f=5800MHz/Zoom Scan (9x9x7)/Cube 0:**  
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 63.70 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 41.7 W/kg  
**SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.29 W/kg**  
Maximum value of SAR (measured) = 22.4 W/kg



## 19. Test Results

#1

Date: 2019-05-25

Test Laboratory: KCTL Inc.

File Name: [2.802.11b\\_f.2\\_437\\_Rear\\_5 mm.da53:0](#)

DUT: PPF33, Type: SP2000, Serial: 57

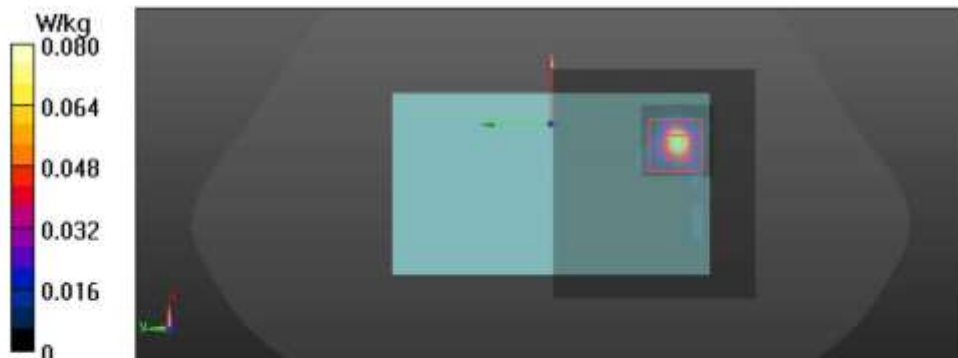
Communication System: UID 0, 2.4G WLAN (0); Frequency: 2437 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.804$  S/m;  $\epsilon_r = 39.464$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3865; ConvF(7.72, 7.72, 7.72) @ 2437 MHz; Calibrated: 2018-08-29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn666; Calibrated: 2019-01-25
- Phantom: Twin-SAM V4.0 (30deg probe tilt)\_1\_20180808; Type: QD 000 P40 CC; Serial: 1363
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11b\_f.2\_437\_Rear\_5 mm/Area Scan (81x71x1): Interpolated grid:  
dx=1.200 mm, dy=1.200 mm  
Maximum value of SAR (interpolated) = 0.126 W/kg

Configuration/802.11b\_f.2\_437\_Rear\_5 mm/Zoom Scan (7x7x7)/Cube 0: Measurement  
grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 0 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 0.150 W/kg  
SAR(1 g) = 0.038 W/kg; SAR(10 g) = 0.0087 W/kg  
Maximum value of SAR (measured) = 0.0803 W/kg



#2

Date: 2019-05-14

Test Laboratory: KCTL Inc.

File Name: [2.802.11a\\_f.5 200\\_Rear\\_5 mm.da53:0](#)

DUT: PPF33, Type: SP2000, Serial: 57

Communication System: UID 0, 5GWLAN; Communication System Channel Number: 40;

Frequency: 5200 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.624$  S/m;  $\epsilon_r = 35.723$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3865; ConvF(4.88, 4.88, 4.88) @ 5200 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn666; Calibrated: 2019-01-25
- Phantom: SAM twin 1728; Type: QD000P40CD; Serial: TP:1728
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11a\_f.5 200\_Rear\_5 mm/Area Scan (101x81x1): Interpolated grid:

dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 3.15 W/kg

Configuration/802.11a\_f.5 200\_Rear\_5 mm/Zoom Scan (9x9x7)/Cube 0: Measurement

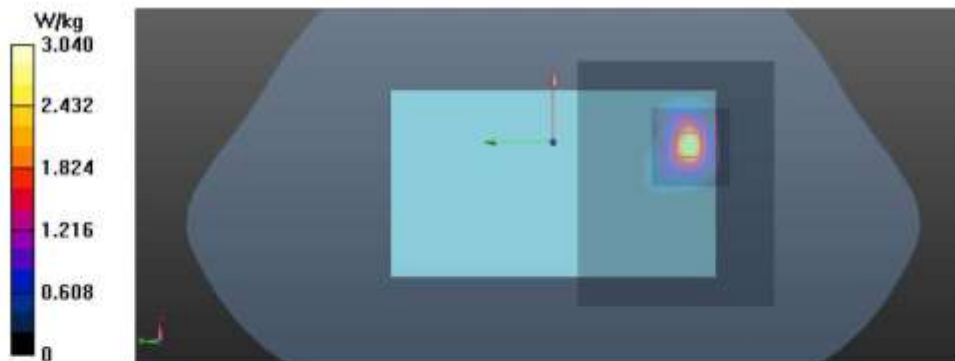
grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 5.037 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 5.47 W/kg

SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.301 W/kg

Maximum value of SAR (measured) = 3.04 W/kg



#3

Date: 2019-05-22

Test Laboratory: KCTL Inc.

File Name: [2.802.11a\\_f.5 825 Rear\\_5 mm.da53:0](#)

DUT: PPF33, Type: SP2000, Serial: 57

Communication System: UID 0, 5GWLAN (0); Communication System Channel Number:  
165; Frequency: 5825 MHz; Duty Cycle: 1:1Medium parameters used:  $f = 5825$  MHz;  $\sigma = 5.479$  S/m;  $\epsilon_r = 35.781$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.7, 4.7, 4.7) @ 5825 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: SAM twin 1728; Type: QD000P40CD; Serial: TP:1728
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11n20\_f.5 825\_Rear\_5 mm/Area Scan (101x81x1): Interpolated grid:  
dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.559 W/kg

Configuration/802.11n20\_f.5 825\_Rear\_5 mm/Zoom Scan (8x8x7)/Cube 0: Measurement  
grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.514 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 1.10 W/kg

SAR(1 g) = 0.189 W/kg; SAR(10 g) = 0.038 W/kg

Maximum value of SAR (measured) = 0.616 W/kg

