



# 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>KR20-SPF0057-A</b><br>Page (1) of (59) |  |
|---|--|--|

**1. Client**

- Name : UNIVERSAL GLOBAL SCIENTIFIC INDUSTRIAL CO.,LTD.
- Address : 141, Lane 351, Sec.1, Taiping Road., Tsautuen, Nantou 54261, Taiwan
- Date of Receipt : 2020-11-17

**2. Use of Report** : Class II Permissive Change

**3. Name of Product and Model** : 802.11b/g/n + BT Wireless LAN Module

- Model Number : WM-BN-BM-26\_A\_FF3
- Manufacturer and Country of Origin: UNIVERSAL GLOVAL SCIENTIFIC INDUSTRIAL CO., LTD. / 141, Lane 351, Sec.1, Taiping Road., Tsautuen, Nantou 54261, Taiwan

**4. Host Product Name** : Digital Camera

- Host Model Name : FF210001
- Manufacturer : FUJIFILM Corporation
- Brand Name : FUJIFILM

**5. FCC ID Number** : COF-WMBNBM26A

**6. Date of Test** : 2020-11-25

**7. Location of Test** : ☒ Permanent Testing Lab ☐ On Site Testing  
 (Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

**8. Test Standards** : IEEE 1528-2013, IEEE/ANSI C95.1-1992  
 KDB248227D01v02r02, KDB865664D01v01r04  
 KDB865664D02v01r02, KDB447498D01v06

**9. Test Results** : Refer to the test result in the test report

|             |   |  |
|-------------|---|--|
| Affirmation | Tested by<br><br>Name : Mungi Jeong (Signature) | Technical Manager<br><br>Name : Jongwon Ma (Signature) |
|-------------|---|--|

2021-05-12

KCTL Inc.

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## REPORT REVISION HISTORY

| Date       | Revision  | Page No |
|------------|---|---------|
| 2020-12-07 | Originally issued                                     | -       |
| 2021-05-12 | Changed Bluetooth Band & Equipment Class: Section 2.2 | 5       |
|            |   |         |
|            |   |         |
|            |   |         |

Note: The Report No. KR20-SPF0057 is superseded by the report No. KR20-SPF0057-A

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### Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:

### Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.


☒ Statement not required by the standard or client used for type testing

(Note: When standard requires a statement concerning the uncertainty of the measurement systems used for tests, this should be reported above. The informative text in parenthesis should be delete in both cases after selecting the applicable option)

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## 1. General information

Client : UNIVERSAL GLOBAL SCIENTIFIC INDUSTRIAL CO.,LTD.  
 Address : 141, Lane 351, Sec.1,Taiping Road., Tsaotuen, Nantou 54261, Taiwan  
 Manufacturer : FUJIFILM Corporation  
 Address : 7-3, Akasaka 9-Chome, Minato-ku, Tokyo 107-0052 Japan  
 Factory : FUJIFILM Optics Co., Ltd.  
 Address : 1-6 Matsusakadaira, Taiwa-cho, Kurokawa-gun, Miyagi  
 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

## 1.2 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.

## 2. Device information

### 2.1 Basic description

|                             |            |   |
|-----------------------------|------------|---|
| Product Name                |            | 802.11b/g/n + BT Wireless LAN Module  |
| Product Model Number        |            | WM-BN-BM-26_A_FF3   |
| Product Manufacturer        |            | UNIVERSAL GLOVAL SCIENTIFIC INDUSTRIAL CO., LTD.                                |
| Host Product Name           |            | Digital Camera  |
| Host Model Number           |            | FF210001  |
| Host Manufacturer           |            | FUJIFILM Corporation  |
| Brand Name                  |            | FUJIFILM  |
| Product<br>Serial<br>Number | Radiation  | 003   |
|                             | Conduction | P1OP-0002   |
| Mode of Operation           |            | WLAN 2.4 GHz , Bluetooth  |
| Tx Freq. Range              |            | WLAN 2.4 GHz: 2 412.0 MHz ~ 2 462.0 MHz<br>Bluetooth: 2 402.0 MHz ~ 2 480.0 MHz |

Note: RF exposure evaluation covers only BLE portion, Bluetooth BDR and EDR mode not used and excluded in SAR report.

### 2.2 Summary of SAR Test Results

| Band                                      | Equipment Class | Highest Reported |
|---|-----------------|------------------|
|   |                 | 1g SAR (W/kg)    |
|   |                 | Body             |
| 2.4 GHz WLAN                              | DTS             | < 0.1            |
| BLE                                       | DTS             | < 0.1            |
| Simultaneous SAR per KDB 690783 D01v01r03 |                 | N/A              |

## 2.3 #WLAN Antenna information

|            |              |
|------------|--------------|
| Antenna    | Chip antenna |
| Frequency  | 2.4G         |
| Gain (dBi) | 3.68         |

## 2.4 #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.

### 2.4.1 #Maximum WLAN and Bluetooth Output Power

| Band         | Mode          | Channel     | Output Power (dB m) |              |          |
|--------------|---------------|-------------|---------------------|--------------|----------|
|              |               |             | Target              | Max. Allowed | SAR Test |
| WLAN 2.4 GHz | 802.11b       | All Channel | 12.00               | 14.00        | Yes      |
|              | 802.11g       | All Channel | 12.00               | 14.00        | No       |
|              | 802.11n(HT20) | All Channel | 12.00               | 14.00        | No       |

| Band      | Mode | Channel     | Output Power (dB m) |              |          |
|-----------|------|-------------|---------------------|--------------|----------|
|           |      |             | Target              | Max. Allowed | SAR Test |
| Bluetooth | LE   | All Channel | 4.00                | 6.00         | Yes      |

## 2.5 SAR Test Configurations

### 2.5.1 #DUT Antenna Locations

A diagram showing the location of the device antennas can be found in Appendix C.

### 2.5.2 SAR Test Exclusion Considerations

Per FCC KDB 447498 D01v06, the 1g SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{\text{Max Power of Channel(mW)}}{\text{Test Separation Distance(mm)}} \times \sqrt{\text{Frequency(GHz)}} \leq 3.0(1g - SAR)$$

Per FCC KDB 447498 D01v06, the 1g SAR exclusion threshold for distances > 50 mm is defined by the following equation:

$$\{[\text{Power allowed at numeric threshold for 50 mm}] + [(\text{Test separation distance} - 50 \text{ mm}) \times 10]\} \text{ mW, for } > 1500 \text{ MHz and } \leq 6 \text{ GHz}$$

| Band         | Freq. [MHz] | Output Power |    | Separation distances [mm] |      |      |       |     |        | SAR Exemption |              |             |              |              |             |
|--------------|-------------|--------------|----|---------------------------|------|------|-------|-----|--------|---------------|--------------|-------------|--------------|--------------|-------------|
|              |             | dBm          | mW | Front                     | Rear | Left | Right | Top | Bottom | Front         | Rear         | Left        | Right        | Top          | Bottom      |
| 2.4 GHz WLAN | 2 462.0     | 14.00        | 25 | 12                        | 59   | 16   | 130   | 59  | 43     | 3.27 Measure  | 186mW EXEMPT | 2.45 EXEMPT | 896mW EXEMPT | 186mW EXEMPT | 0.91 EXEMPT |
| Bluetooth LE | 2 480.0     | 6.00         | 4  | 12                        | 59   | 16   | 130   | 59  | 43     | 0.52 EXEMPT   | 185mW EXEMPT | 0.39 EXEMPT | 895mW EXEMPT | 185mW EXEMPT | 0.15 EXEMPT |

Note 1: For distances < 5mm, a distance of 5mm is used to determine SAR exclusion and estimated SAR value.

Note 2: Output power is the maximum rated power (including tune-up or manufacturing tolerances) and includes source-based averaging.

Note 3: If the antenna separation distance is > 50mm then the value listed is the output power threshold, above which SAR measurement is required. For separation <= 50mm the value is the KDB 447498 calculated value and must be less than 3.0 for SAR exemption.

Note 4: Formulas round separation distance to nearest mm and power to nearest mW before calculating thresholds or exemption values.

| Mode         | Device Edge for SAR Testing (Front View) |      |           |            |     |        |
|--------------|--|------|-----------|------------|-----|--------|
|              | Front                                    | Rear | Left Edge | Right Edge | Top | Bottom |
| 2.4 GHz WLAN | Yes                                      | No   | No        | No         | No  | No     |
| Bluetooth LE | *Yes                                     | No   | No        | No         | No  | No     |

Note: Request of the applicant, the Bluetooth LE SAR test was performed.



## 2.6 #Simultaneous Transmission Configurations

According to FCC KDB 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

| No. | Scenario                    | RF Exposure Condition |
|-----|-----------------------------|-----------------------|
|     |                             | Body                  |
| 1   | 2.4 GHz WLAN + Bluetooth LE | No                    |

### Notes:

- It does not to transmit simultaneously the Bluetooth LE and 2.4 GHz WLAN.
- It is to use the Bluetooth LE and 2.4 GHz WLAN same antenna path.

## 2.7 SAR Test Methods and Procedures

The tests documented in this report were performed in accordance with IEEE 1528-2013 and the following published KDB procedures:

- IEEE 1528-2013
- IEEE/ANSI C95.1-1992
- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)



### 3. Specific Absorption Rate

#### 3.1 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.

#### 3.2 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 ( $\rho$ ). The equation description is as below:

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

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

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

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

Where: C is the specific heat capacity,  $\delta T$  is the temperature rise and  $\delta t$  is the exposure duration, or related to the electrical field in the tissue by

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

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  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.

## 4. SAR Measurement Procedures

### 4.1 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.

|   |   |   | $\leq 3\text{ GHz}$  | $> 3\text{ GHz}$  |
|---|---|---|--|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface  |   |   | $5\text{ mm} \pm 1\text{ mm}$  | $\frac{1}{2} \cdot \delta \cdot \ln(2)\text{ mm}$ 0.5 mm  |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location   |   |   | $30^{\circ} \pm 1^{\circ}$   | $20^{\circ} \pm 1^{\circ}$  |
| Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$  |   |   | $\leq 2\text{ GHz}: \leq 15\text{ mm}$<br>$2 - 3\text{ GHz}: \leq 12\text{ mm}$  | $3 - 4\text{ GHz}: \leq 12\text{ mm}$<br>$4 - 6\text{ GHz}: \leq 10\text{ mm}$  |
|   |   |   | 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 $\leq$ 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: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$  |   |   | $\leq 2\text{ GHz}: \leq 8\text{ mm}$<br>$2 - 3\text{ GHz}: \leq 5\text{ mm}^*$  | $3 - 4\text{ GHz}: \leq 5\text{ mm}^*$<br>$4 - 6\text{ GHz}: \leq 4\text{ mm}^*$  |
| Maximum zoom scan spatial resolution, normal to phantom surface   | uniform grid: $\Delta z_{\text{Zoom}}(n)$ |   | $\leq 5\text{ mm}$   | $3 - 4\text{ GHz}: \leq 4\text{ mm}$<br>$4 - 5\text{ GHz}: \leq 3\text{ mm}$<br>$5 - 6\text{ GHz}: \leq 2\text{ mm}$    |
|   | graded grid                               | $\Delta z_{\text{Zoom}}(1)$ : between 1st two points closest to phantom surface | $\leq 4\text{ mm}$   | $3 - 4\text{ GHz}: \leq 3\text{ mm}$<br>$4 - 5\text{ GHz}: \leq 2.5\text{ mm}$<br>$5 - 6\text{ GHz}: \leq 2\text{ mm}$  |
|   |   | $\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points                       | $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)\text{ mm}$   |   |
| Minimum zoom scan volume  | x, y, z                                   |   | $\geq 30\text{ mm}$  | $3 - 4\text{ GHz}: \geq 28\text{ mm}$<br>$4 - 5\text{ GHz}: \geq 25\text{ mm}$<br>$5 - 6\text{ GHz}: \geq 22\text{ mm}$ |
| Note: $\delta$ 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 $\leq 1.4\text{ W/kg}$ , $\leq 8\text{ mm}$ , $\leq 7\text{ mm}$ and $\leq 5\text{ mm}$ 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.

## 5. RF Exposure Limits

**UNCONTROLLED ENVIRONMENTS** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

**CONTROLLED ENVIRONMENTS** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

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

## **6. SAR General Measurement Procedures**

### **6.1 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.

### **6.2 SAR Testing with 802.11 Transmitters**

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.

#### **6.2.1 General Device Setup**

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.

#### **6.2.2 Initial Test Position Procedure**

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is  $\leq 0.4$  W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is  $\leq 0.8$  W/kg or all test positions are measured.

### 6.2.3 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.

### 6.2.4 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.

### 6.2.5 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.

## 6.2.6 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. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

## 7. RF Average Conducted Output Power

### 7.1 WLAN Average Conducted Output Power

| Band         | Freq. [MHz] | Channel | Mode    |         |               |
|--------------|-------------|---------|---------|---------|---------------|
|              |             |         | 802.11b | 802.11g | 802.11n(HT20) |
| WLAN 2.4 GHz | 2 412.0     | 1       | 12.07   | 12.47   | 12.47         |
|              | 2 437.0     | 6       | 12.22   | 12.72   | 12.53         |
|              | 2 462.0     | 11      | 12.53   | 13.19   | 12.93         |

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.

Power Measurement Setup



### 7.2 Bluetooth Average Conducted Output Power

| Mode | Freq. [MHz] | Channel | Conducted Powers |
|------|-------------|---------|------------------|
|      |             |         | (dBm)            |
| LE   | 2 402.0     | 0       | 5.32             |
|      | 2 440.0     | 19      | 5.74             |
|      | 2 480.0     | 39      | 5.61             |



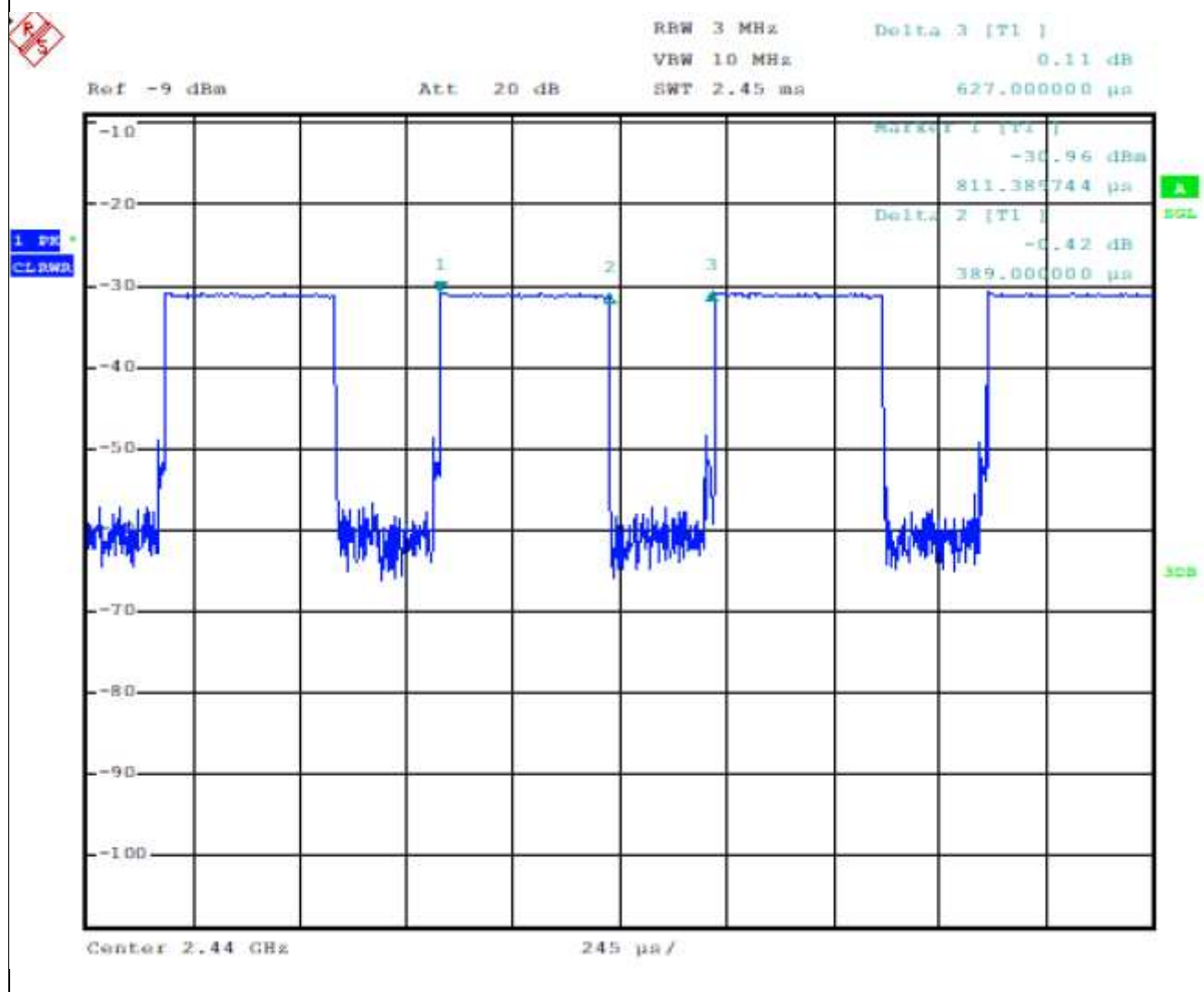
**KCTL Inc.**

65, Sinwon-ro, Yeongtong-gu,  
Suwon-si, Gyeonggi-do, 16677, Korea  
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**7.3 Wireless Band Duty Cycle**

| Wireless Bands | Frequency Bands | Mode         |                  | Duty Cycle (%) |                              |
|----------------|-----------------|--------------|------------------|----------------|------------------------------|
| WLAN           | 2.4 GHz         | 802.11b      |                  | 99.70          |                              |
| Bluetooth      | Mode            | On Time (ms) | On-Off Time (ms) | Duty Cycle (%) | Duty Cycle Compensate Factor |
|                | LE              | 0.389        | 0.627            | 62.0           | 1.613                        |



## 8. System Verification

### 8.1 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.<br>(MHz) | Limit/Measured    |            | Permittivity ( $\rho$ )             | Conductivity ( $\sigma$ )        | Temp.<br>( $^\circ\text{C}$ ) |
|----------------|-------------------|------------|-------------------------------------|----------------------------------|-------------------------------|
| 2 450.0        | Recommended Limit |            | $39.20 \pm 5 \%$<br>(37.24 ~ 41.16) | $1.80 \pm 5 \%$<br>(1.71 ~ 1.89) | $22 \pm 2$                    |
|                | Measured          | 2020-11-25 | 39.70                               | 1.85                             | 20.97                         |

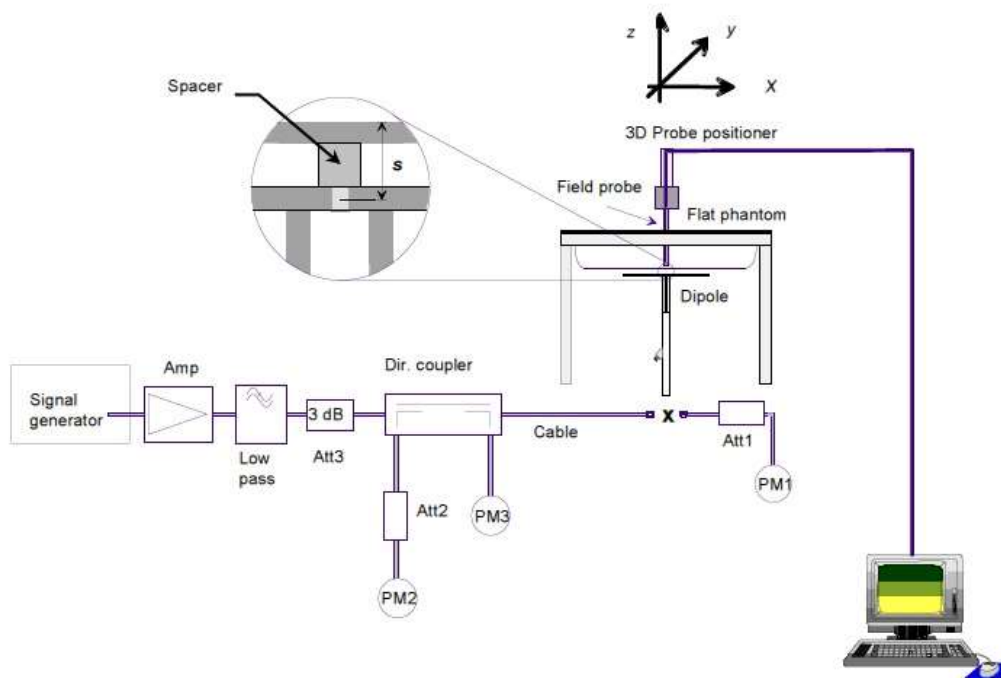
<Table 1. Measurement result of Tissue electric parameters>

## 8.2 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.



| Verification Kit  | Probe S/N          | Frequency (MHz) | Tissue Type | Limit/Measured (Normalized to 1 W) |                                  |
|-------------------|--------------------|-----------------|-------------|------------------------------------|----------------------------------|
|                   |                    |                 |             | Recommended Limit 1g (Normalized)  | 52.40 $\pm$ 10 % (47.16 ~ 57.64) |
| 2450V2<br>SN: 895 | EX3DV4<br>SN: 7541 | 2 450.0         | HSL         | Measured                           | 2020-11-25<br>53.50              |

<Table 1. System Verification>

## 9. SAR Test Results

### 9.1 Standalone Body SAR Test Results

| WLAN 2.4 GHz |              |               |                 |                                |                          |                      |                              |                        |                      |          |
|--------------|--------------|---------------|-----------------|--------------------------------|--------------------------|----------------------|------------------------------|------------------------|----------------------|----------|
| Mode         | EUT Position | Distance (mm) | Frequency (MHz) | Measured Conducted Power (dBm) | Max. Tune-up Power (dBm) | Power Scaling Factor | Duty Cycle Compensate Factor | Measured 1g SAR (W/kg) | Scaled 1g SAR (W/kg) | Plot No. |
| 802.11b      | Front Tilt   | 0             | 2 462.0         | 12.53                          | 14.00                    | 1.403                | 1.003                        | 0.024                  | 0.034                |          |
|              | Front        | 0             | 2 462.0         | 12.53                          | 14.00                    | 1.403                | 1.003                        | 0.061                  | <b>0.086</b>         | 1        |

| Bluetooth    |              |               |                 |                                |                          |                      |                              |                        |                      |          |
|--------------|--------------|---------------|-----------------|--------------------------------|--------------------------|----------------------|------------------------------|------------------------|----------------------|----------|
| Mode         | EUT Position | Distance (mm) | Frequency (MHz) | Measured Conducted Power (dBm) | Max. Tune-up Power (dBm) | Power Scaling Factor | Duty Cycle Compensate Factor | Measured 1g SAR (W/kg) | Scaled 1g SAR (W/kg) | Plot No. |
| Bluetooth LE | Front Tilt   | 0             | 2 440.0         | 5.74                           | 6.00                     | 1.062                | 1.613                        | N/A                    | N/A                  |          |
|              | Front        | 0             | 2 440.0         | 5.74                           | 6.00                     | 1.062                | 1.613                        | N/A                    | <b>N/A</b>           | 2        |

#### General Notes:

- The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
- All modes of operation were investigated, and worst-case results are reported.
- Battery is fully charged for all readings and the standard batteries are the only options.
- Liquid tissue depth was at least 15 cm.
- 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.
- SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
- The "N/A" means there is no SAR value or the SAR is too low to be.

#### WLAN Notes:

- 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 (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
- 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.
- 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 for 1g evaluations or all test channels were measured.
- WLAN transmission was verified using a spectrum analyzer.
- In case of "Front Tilt" position, it has been additionally verified considering the case of lens mounting. Refer to the appendix E for detailed location.
- WLAN & Bluetooth transmission was verified using a spectrum analyzer.

## 10. 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 (~ 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 |
|------|-----------------|--------------|--------------------------|-------------------------|------------------------|-------|
| N/A  |                 |              |                          |                         |                        |       |

## 11. Measurement Uncertainty

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, 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.

## 12. Test Equipment Information

|                             |   |                 |                     |                              |
|-----------------------------|---|-----------------|---------------------|------------------------------|
| Test Platform               | SPEAG DASY5 System  |                 |                     |                              |
| Version                     | DASY52: 52.10.4.1527 / SEMCAD: 14.6.14 (7483)                       |                 |                     |                              |
| Location                    | KCTL Inc, 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea |                 |                     |                              |
| Manufacture                 | SPEAG   |                 |                     |                              |
| Hardware Reference          |   |                 |                     |                              |
| Equipment                   | Model   | Serial Number   | Date of Calibration | Due date of next Calibration |
| Shield Room                 | -   | 8F - 2          | -                   | -                            |
| DASY5 Robot                 | TX90XL  | F12/5L7FA1/A/01 | -                   | -                            |
| Phantom                     | 2mm Oval Phantom ELI5   | 1178            | -                   | -                            |
| Mounting Device             | Mounting Device   | -               | -                   | -                            |
| DAE                         | DAE4  | 1586            | 2020-04-22          | 2021-04-22                   |
| Probe                       | EX3DV4  | 7541            | 2020-07-30          | 2021-07-30                   |
| ESG Vector Signal Generator | E4438C  | MY42080486      | 2020-05-11          | 2021-05-11                   |
| Dual Power Meter            | E4419B  | GB43312301      | 2020-05-12          | 2021-05-12                   |
| Power Sensor                | 8481H   | 3318A 19379     | 2020-05-12          | 2021-05-12                   |
| Power Sensor                | 8481H   | 3318A 19377     | 2020-05-12          | 2021-05-12                   |
| Attenuator                  | 8491B 3dB   | 17387           | 2020-05-12          | 2021-05-12                   |
| Attenuator                  | 8491B 10dB  | 29425           | 2020-05-12          | 2021-05-12                   |
| Attenuator                  | 8491B-6dB   | MY39270294      | 2020-05-12          | 2021-05-12                   |
| Power Amplifier             | 2055-BBS3Q7E9I  | 1005D/C0521     | 2020-03-12          | 2021-03-12                   |
| Dual Directional Coupler    | 772D  | 2839A00719      | 2020-05-12          | 2021-05-12                   |
| Low Pass Filter             | LA-30N  | 40058           | 2020-05-12          | 2021-05-12                   |
| Dipole Validation Kits      | D2450V2   | 895             | 2020-07-21          | 2022-07-21                   |
| Network Analyzer            | E5071B  | MY42403524      | 2020-02-27          | 2021-02-27                   |
| Dielectric Assessment Kit   | DAK-3.5   | 1078            | 2020-05-19          | 2021-05-19                   |
| Humidity/Temp.              | MHB-382SD   | 23107           | 2020-05-14          | 2021-05-14                   |



### 13. Test System Verification Results

Date: 2020-11-25

Test Laboratory: KCTL Inc.

File Name: [2450 MHz Verification Input Power 100 mW 2020-11-25.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 (interpolated):  $f = 2450$  MHz;  $\sigma = 1.849$  S/m;  $\epsilon_r = 39.696$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7541; ConvF(7.54, 7.54, 7.54) @ 2450 MHz; ; Calibrated: 2020-07-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1586; Calibrated: 2020-04-22
- Phantom: ELI v5.0 sn1178; Type: QDOVA002AA; Serial: TP:1178
- Measurement SW: DASY52, Version 52.10 (4);

**Configuration/2450 MHz Verification Input Power 100 mW 2020-11-25/Area Scan (10x11x1):**

Measurement grid: dx=12mm, dy=12mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 7.31 W/kg

**Configuration/2450 MHz Verification Input Power 100 mW 2020-11-25/Zoom Scan (7x7x7)/Cube**

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

Reference Value = 72.88 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 11.4 W/kg

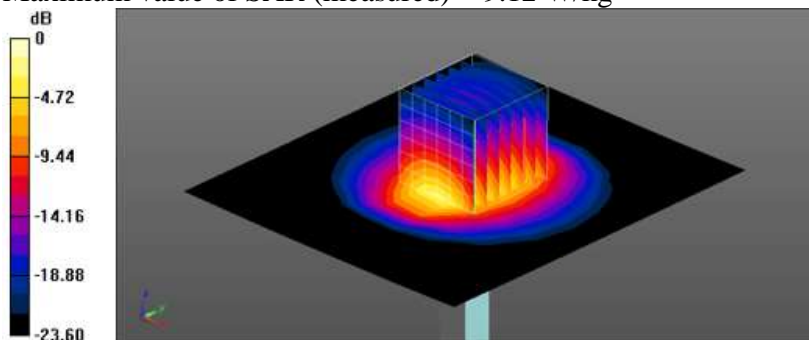
**SAR(1 g) = 5.35 W/kg; SAR(10 g) = 2.44 W/kg**

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 46.5%

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 9.12 W/kg



0 dB = 9.12 W/kg = 9.60 dBW/kg

## 14. Test Results

1)

Date: 2020-11-25

Test Laboratory: KCTL Inc.

File Name: [1. 2.4G 802.11b Body.da53:0](#)**DUT: FF210001, Type: Digital Camera, Serial: 003**

Communication System: UID 0, 2.4GWLAN (0); Frequency: 2462 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2462$  MHz;  $\sigma = 1.863$  S/m;  $\epsilon_r = 39.652$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7541; ConvF(7.54, 7.54, 7.54) @ 2462 MHz; ; Calibrated: 2020-07-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1586; Calibrated: 2020-04-22
- Phantom: ELI v5.0 sn1178; Type: QDOVA002AA; Serial: TP:1178
- Measurement SW: DASY52, Version 52.10 (4);

**Configuration/802.11 b\_CH11\_Front\_0 mm/Area Scan (9x10x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 0.0779 W/kg

**Configuration/802.11 b\_CH11\_Front\_0 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.976 V/m; Power Drift = 0.18 dB

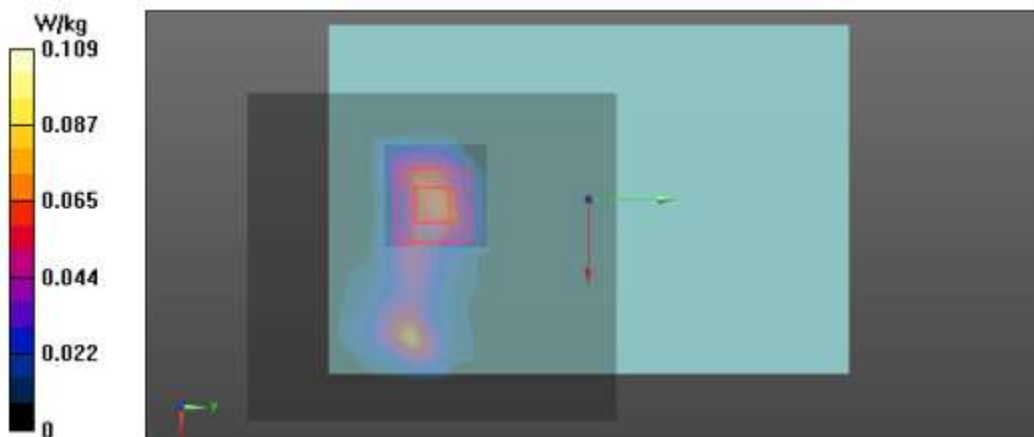
Peak SAR (extrapolated) = 0.140 W/kg

**SAR(1 g) = 0.061 W/kg; SAR(10 g) = 0.023 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.1 mm

Ratio of SAR at M2 to SAR at M1 = 45%

Maximum value of SAR (measured) = 0.109 W/kg



2)

Date: 2020-11-25

Test Laboratory: KCTL Inc.

File Name: [2. Bluetooth Body.da53:0](#)

**DUT: FF210001, Type: Digital Camera, Serial: 003**

Communication System: UID 0, Bluetooth LE (0); Frequency: 2440 MHz; Duty Cycle: 1:1.61287  
 Medium parameters used:  $f = 2440$  MHz;  $\sigma = 1.838$  S/m;  $\epsilon_r = 39.721$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7541; ConvF(7.54, 7.54, 7.54) @ 2440 MHz; ; Calibrated: 2020-07-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1586; Calibrated: 2020-04-22
- Phantom: ELI v5.0 sn1178; Type: QDOVA002AA; Serial: TP:1178
- Measurement SW: DASY52, Version 52.10 (4);

**Configuration/Bluetooth\_CH19\_Front\_0 mm/Area Scan (9x10x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 0.00144 W/kg

**Configuration/Bluetooth\_CH19\_Front\_0 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0 V/m; Power Drift = 0.00 dB

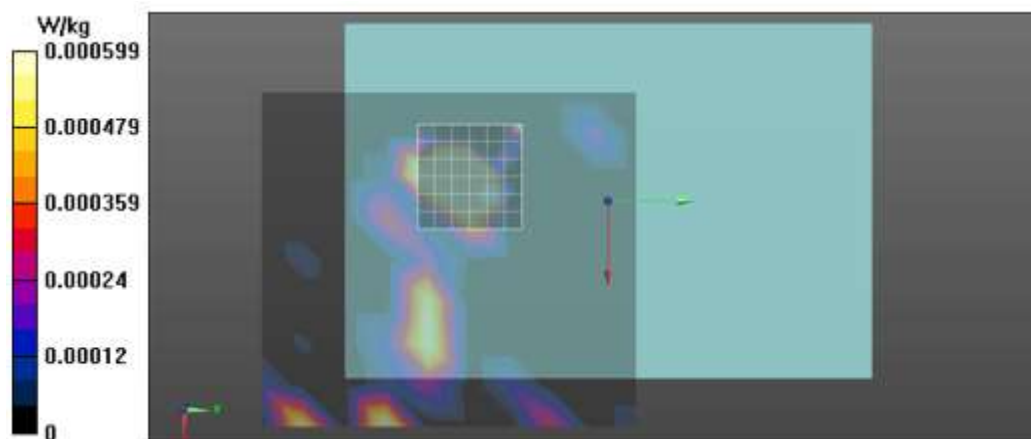
Peak SAR (extrapolated) = 0 W/kg

**SAR(1 g) = n.a. ; SAR(10 g) = n.a.**

Smallest distance from peaks to all points 3 dB below: Larger than measurement grid

Ratio of SAR at M2 to SAR at M1 = 0%

Maximum value of SAR (measured) = 0.000599 W/kg



## Appendixes List

|                   |   |
|-------------------|---|
| <b>Appendix A</b> | A.1 Probe Calibration certificate (EX3DV4_7541)<br>A.2 Dipole Calibration certificate (D2450V2_895) |
| <b>Appendix B</b> | SAR Tissue Specification  |
| <b>Appendix C</b> | #Antenna Location & Distance  |
| <b>Appendix D</b> | EUT Photo   |
| <b>Appendix E</b> | Test Setup Photo  |