**KES Co., Ltd.**
3701, 40, Simin-daero 365beon-gil,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr



# FCC SAR Test Report

| | | |
|---|---|---|
| **Report No.** | : | **KES-SR-23T0016** |
| **FCC ID** | : | **2AWVMPIXX1826N** |
| **Applicant** | : | **PIXXGEN Corporation** |
| **Address** | : | **5F, SMART BAY, 123, Beolmal-ro, Dongan-gu- Anyang-si, Gyeonggi-do, 14056, Republic of Korea** |
| **Manufacturer** | : | **PIXXGEN Corporation** |
| **Address** | : | **5F, SMART BAY, 123, Beolmal-ro, Dongan-gu- Anyang-si, Gyeonggi-do, 14056, Republic of Korea** |
| **DUT Type** | : | **Flat Panel X-ray Detector for NDT,Security & EOD** |
| **Model Name** | : | **PIXX1826N** |
| **Multiple Model Name:** | : | **N/A** |
| **Serial Number** | : | **N/A** |
| **Date of Testing** | : | **2023.09.01** |
| **Issued Date** | : | **2023.10.06** |

**CERTIFICATION:** The above equipment have been tested by **KES Co., Ltd. Laboratory**, and found compliance with the requirement of the above standards. I attest to the accuracy of data. All measurements reported herein were performed by me of were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by any government agency.

**Tested By :** Yedam Ahn / Engineer

**Approved By :** Wihan Jeong / Technical Manager

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This test report is not related to KS Q ISO/IEC 17025 and KOLAS

## Revision history

| Report No. | Reason for Change | Date Issued |
|---|---|---|
| KES-SR-23T0016 | Initial release | 2023.10.06 |
| | | |
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| | | |

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## 1. General Information

| | |
|---|---|
| **Applicant:** | **PIXXGEN Corporation** |
| **Applicant address:** | **5F, SMART BAY, 123, Beolmal-ro, Dongan-gu- Anyang-si, Gyeonggi-do, 14056, Republic ofKorea** |
| **Test site:** | **KES Co., Ltd.** |
| **Test site address:** | **3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea** |
| **Test Facility** | **FCC Accreditation Designation No.: KR0100, Registration No.: 4769B** |
| **FCC rule part(s):** | **CFR §2.1093** |
| **FCC ID:** | **2AWVMPIXX1826N** |
| **Test device serial No.:** | ☒ **Production** ☐ **Pre-production** ☐ **Engineering** |

### 1.1. Highest SAR Summary

| | | | | | |
|---|---|---|---|---|---|
| **EUT Type** | Flat Panel X-ray Detector for NDT,Security & EOD | | | | |
| **Brand Name(Applicant)** | PIXXGEN Corporation | | | | |
| **Model Name** | PIXX1826N | | | | |
| **Additional Model Name** | N/A | | | | |
| **Antenna Type** | PCB Antenna | | | | |
| **EUT Stage** | Identical Prototype | | | | |
| **Equipment Class** | **Band** | **TX Frequency** | **1g Head (W/㎏)** | **1g Body (W/㎏)** | **10g Hands (W/㎏)** |
| **DTS** | 2.4 ㎓ WLAN | 2 412 ~ 2 462 ㎒ | N/A | **0.17** | N/A |
| Simultaneous SAR per 690783 D01v01r03 | | | N/A | N/A | N/A |

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 7 of this report;

### 1.2. Device Overview

| Band | Operating Modes | Tx Frequency |
|---|---|---|
| 2.4 ㎓ WLAN | 802.11n HT20 | 2 412 ~ 2 462 ㎒ |

### 1.3. Power Reduction for SAR

There is no power reduction used for any band/mode implemented in the device for SAR purposes.

## 1.4. Nominal and Maximum Output Power Specifications

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

**Maximum WLAN Output Power**

| Band / Mode | Modulated Averaged (dBm) | |
|---|---|---|
| 2.4 ㎓ WLAN / 802.11n HT20 | Maximum | 10.0 |
| | Nominal | 8.0 |

## 1.5. Simultaneous Transmission Capabilities

This device is not supported simultaneous transmission.

## 1.6. DUT Antenna Locations

The DUT antenna locations are included in the filing.

## 1.7. Near Field Communications (NFC) Antenna

This DUT does not support NFC function.

## 1.8. Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 248227 D01v02r02 (Wi-Fi SAR)
- FCC KDB Publication 447498 D01v06 (General RF Exposure Guidance)
- FCC KDB Publication 865664 D01v01r04 (SAR Measurement 100 MHz to 6 GHz)
- FCC KDB Publication 865664 D02v01r02 (RF Exposure Reporting)
- FCC KDB Publication 690783 D01v01r03 (SAR Listings on Grants)
- October 2016 TCBC workshop Notes (DUT Holder perturbations)
- April 2019 TCBC workshop Notes (Tissue Simulating Liquids (TSL))

## 1.9. Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. 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. The serial numbers used for each test are indicated alongside the results in Section 9.

## 2. Introduction

The FCC and Innovation, Science, and Economic Development Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3KHz to 300 GHz and Health Canada RF Exposure Guidelines Safety Code 6. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. 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.

### 2.1. SAR definition

Specific Absorption Rate is defined as 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). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1)

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

**Equation 2-1 SAR Mathematical Equation**

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

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

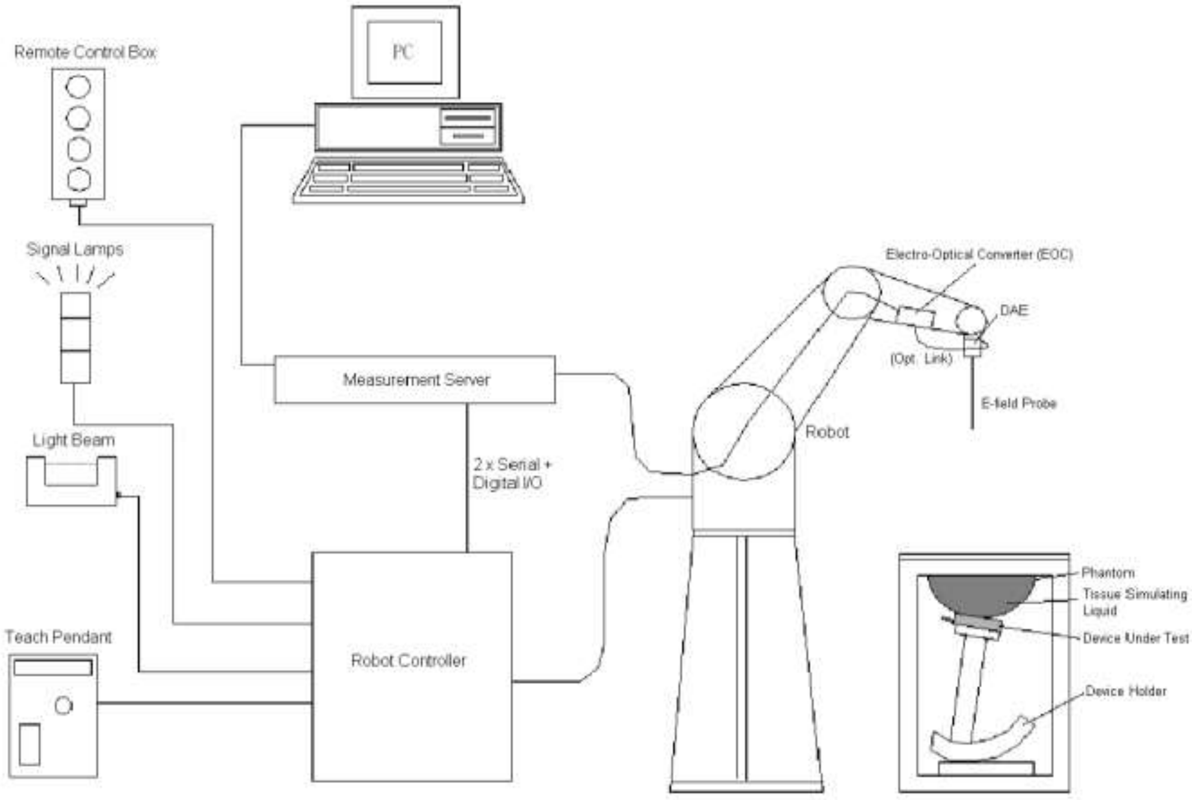
Where: σ = conductivity of the tissue (S/m)
ρ = mass density of the tissue (kg/m³)
E = rms electrical field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

## 2.2. SAR Measurement Setup

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 WinXP, Win7 or Win10 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.



## 3. Dosimetric Assessment

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEC/IEEE 1528-2013.

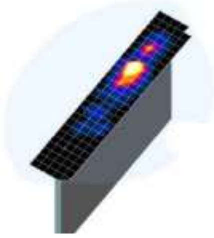


**Figure 4-1 Sample SAR Area Scan**

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

**Table 4-1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04***

| Frequency | Maximum Area Scan Resolution (mm) ($\Delta x_{area}$, $\Delta y_{area}$) | Maximum Zoom Scan Resolution (mm) ($\Delta x_{zoom}$, $\Delta y_{zoom}$) | Maximum Zoom Scan Spatial Resolution (mm) | | | Minimum Zoom Scan Volume (mm) (x,y,z) |
|---|---|---|---|---|---|---|
| | | | Uniform Grid | Graded Grid | | |
| | | | $\Delta z_{zoom}(n)$ | $\Delta z_{zoom}(1)$* | $\Delta z_{zoom}(n>1)$* | |
| ≤ 2 GHz | ≤ 15 | ≤ 8 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 2-3 GHz | ≤ 12 | ≤ 5 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 3-4 GHz | ≤ 12 | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 28 |
| 4-5 GHz | ≤ 10 | ≤ 4 | ≤ 3 | ≤ 2.5 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 25 |
| 5-6 GHz | ≤ 10 | ≤ 4 | ≤ 2 | ≤ 2 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 22 |

# 4. TEST CONFIGURATION POSITIONS

## 4.1. Device Holder

This device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

## 4.2. Positioning for Testing

Based on FCC guidance and expected exposure conditions, the device was positioned with the outside of the device touching the flat phantom and such that the location of maximum SAR was captured during SAR testing. The SAR test setup photograph is included in Appendix F.

## 5. RF Exposure Limits

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, Operating instruction and cautions statements are included in the user's manual.

### 5.1. Uncontrolled Environment

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.

### 5.2. Controlled Environment

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.

**Table 5-1 SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6**

| **Human Exposure Limits** | | |
|---|---|---|
| | Uncontrolled Environment<br>General Population<br>(W/kg) or (mW/g) | Controlled Environment<br>Occupational<br>(W/kg) or (mW/g) |
| **Peak Spatial Average SAR**<br>Head | 1.6 | 8.0 |
| **Whole Body SAR** | 0.08 | 0.4 |
| **Peak Spatial Average SAR**<br>Hands, Feet, Ankle, Wrists, etc. | 4.0 | 20 |

1. The Spatial Peak value of the SAR averaged over any 1 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. FCC Measurement Procedures

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

## 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. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

Per KDB Publication 447498 D01v06, testing of other required channels within the operating mode of a frequency band is not required when the reported 1g of 10g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1g or 10g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1g or 10g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1g or 10g respectively, when the transmission band is ≥ 200 MHz

## 6.2. Procedures Used to Establish RF signal for SAR

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. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR. Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviates by more than 5%, the SAR test and drift measurements are repeated.

As required by §§ 2.1091(d)(2) and 2.1093(d)(5), RF exposure compliance must be determined at the maximum average power level according to source-based time-averaging requirements to determine compliance for general population exposure conditions. Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged effective radiated power applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as for FRS (Part 95) devices and certain Part 15 transmitters with built-in integral antennas, the maximum output power and tolerance allowed for production units should be used to determine RF exposure test exclusion and compliance.

## 6.3. SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11n 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. See KDB Publication 248227D01v02r02 for more details.

### 6.3.1. 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 position 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 ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test position are measured.

### 6.3.2. OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 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 bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 80211n and 802.11ac or 802.11g then 802.11n is used for SAR measurement. When the maximum output power ware 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.

### 6.3.3. Initial Test Configuration Procedure

For OFDM, in 2.4 band, 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 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. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.
When the reported SAR ≤ 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 ≤ 1.2 W/kg or all channels are measured.

### 6.3.4. 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 applicable. When the highest reported SAR for the initial test configuration, adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power is ≤ 1.2 W/kg, no additional SAR testing for the subsequent test configurations is required.

# 7. RF Conducted Powers

## 7.1. WLAN Conducted Powers

**Table 7-1 2.4 GHz W-LAN Conducted Powers Ant.1**

| 2.4 GHz Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq. [MHz] | Channel | IEEE Transmission Mode | | |
| | | 802.11b | 802.11g | 802.11n |
| | | Average | Average | Average |
| 2 412 | 1 | - | - | 8.04 |
| 2437 | 6 | - | - | **8.48** |
| 2462 | 11 | - | - | 8.27 |

Note: The bolded data rates and channel above were tested for SAR.

# 8. System Verification

## 8.1. Tissue Verification

**Table 8-1 Measured Tissue Properties**

| Tissue Type | Measured Frequency (MHz) | Tissue Temp (℃) | Measured Conductivity (σ) | Measured Permittivity ($\varepsilon_r$) | Target Conductivity (σ) | Target Permittivity ($\varepsilon_r$) | Conductivity Deviation (%) | Permittivity Deviation (%) | Test Date |
|---|---|---|---|---|---|---|---|---|---|
| HSL2450 | 2 450 | 21.4 | 1.81 | 39.6 | 1.80 | 39.2 | 0.67 | 0.91 | 2023.09.01 |
| | 2 437 | | 1.80 | 39.6 | 1.79 | 39.2 | 0.53 | 0.92 | |

Tissue Verification Notes:

1. The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.
2. Per April 2019 TCBC Workshop Notes, effective February 19, 2019, FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

## 8.2. System Verification

Prior to SAR assessment, the system is verified to ±10 % of the SAR measurement on the reference dipole at the time of calibration by the calibration facility.

**Table 8-2 System Verification Results – 1 g**

| SAR System # | Test Date | Tissue Frequency (MHz) | Amb. Temp (℃) | Liquid Temp (℃) | Input Power (mW) | Dipole SN | Probe SN | 1W Target SAR-1 g (W/kg) | Measured SAR-1 g (W/kg) | Normalized to 1W SAR-1 g (W/kg) | Deviation (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2023.09.01 | 2 450 | 22.3 | 21.4 | 100 | 980 | 3879 | 51.50 | 5.32 | 53.20 | 3.30 |

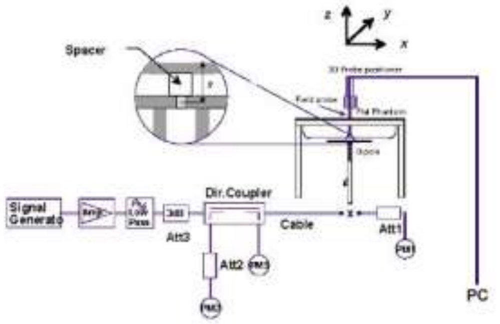



**Figure 8-1 System Verification Setup Diagram**

**Figure 8-2 System Verification Setup Photo**

# 9. SAR Data Summary

## 9.1. Standalone Body SAR Data

Table 9-1 DTS Body SAR

| Plot No. | Device Serial Number | Frequency | | Mode | Service | Test Position | Spacing (㎝) | Maximum Allowed Power [dBm] | Measured Conducted Power [dBm] | Scaling Factor (Duty Cycle) | Scaling Factor (Power) | Power Drift [dB] | Measured SAR 1g (W/kg) | Reported SAR 1g (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | Ch. | | | | | | | | | | | |
| 1 | SAR1 | 2 437 | 6 | 802.11n HT20 | OFDM | Front Side | 0 | 10.0 | 8.48 | 1.000 | 1.419 | 0.14 | 0.117 | 0.166 |
| ANSI / IEEE C95.1 1992 – SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure / General Population | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>Averaged over 1 gram | | | | | | |

## 9.2. SAR Test Notes

General Notes:

1. 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.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. 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.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.
7. Per FCC KDB 865664 D01v01r04, variability SAR tests may be performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Since the measured SAR results of this device were less than or equal to 0.8 W/kg, repeated SAR measurements are not required.
8. The front with touch configuration was only tested since only the front is touched to human body in normal operation condition of this device.

W-LAN Notes:

1. When the maximum reported 1g averaged SAR≤ 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 ≤ 1.20 W/kg or all test channels were measured.
2. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor to determine compliance.

## 10. SAR Measurement Uncertainty

**Table 10-1 Uncertainty of SAR equipment for measurement Body 0.3 GHz to 3 GHz**

| A | b | c | | d | e=f(d, k) | f | g | h=c x f/e | I=c x g/e | k |
|---|---|---|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Description | Tolerance /Uncertainty value (± %) | | Probability Distribution | Div. | Ci (1 g) | Ci (10 g) | Standard uncertainty ± %, (1 g) | Standard uncertainty ± %, (10 g) | $V_i$ or $V_{eff}$ |
| **Measurement system** | | | | | | | | | | |
| Probe calibration | 4 | 6.00 | | N | 1 | 1 | 1 | 6.00 | 6.00 | ∞ |
| Isotropy | 5 | 7.6 | | R | 1.732 | 1 | 1 | 4.39 | 4.39 | ∞ |
| Linearity | 7 | 4.7 | | R | 1.732 | 1 | 1 | 2.71 | 2.71 | ∞ |
| Probe modulation response | 8 | 2.4 | | R | 1.732 | 1 | 1 | 1.39 | 1.39 | ∞ |
| Detection limits | 9 | 0.25 | | R | 1.732 | 1 | 1 | 0.14 | 0.14 | ∞ |
| Boundary effect | 6 | 1 | | R | 1.732 | 1 | 1 | 0.58 | 0.58 | ∞ |
| Readout electronics | 10 | 0.3 | | N | 1 | 1 | 1 | 0.30 | 0.30 | ∞ |
| Response time | 11 | 0 | | R | 1.732 | 1 | 1 | 0.00 | 0.00 | ∞ |
| Integration time | 12 | 2.6 | | R | 1.732 | 1 | 1 | 1.50 | 1.50 | ∞ |
| RF ambient conditions—noise | 13 | 3 | | R | 1.732 | 1 | 1 | 1.73 | 1.73 | ∞ |
| RF ambient conditions—reflections | 13 | 3 | | R | 1.732 | 1 | 1 | 1.73 | 1.73 | ∞ |
| Probe positioner mech. restrictions | 14 | 0.4 | | R | 1.732 | 1 | 1 | 0.23 | 0.23 | ∞ |
| Probe positioning with respect to phantom shell | 15 | 2.9 | | R | 1.732 | 1 | 1 | 1.67 | 1.67 | ∞ |
| Post-processing | 16 | 2 | | R | 1.732 | 1 | 1 | 1.15 | 1.15 | ∞ |
| **Test sample related** | | | | | | | | | | |
| Device holder uncertainty | 18 | 1.1 | 1.1 | N | 1 | 1 | 1 | 1.10 | 1.10 | 41 |
| Test sample positioning | 17 | 3.2 | 3.1 | N | 1 | 1 | 1 | 3.20 | 3.10 | 59 |
| Power scaling | 19 | 0 | | R | 1.732 | 1 | 1 | 0.00 | 0.00 | ∞ |
| Drift of output power (measured SAR drift) | 20 | 5 | | R | 1.732 | 1 | 1 | 2.89 | 2.89 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| Phantom uncertainty (shape and thickness tolerances) | 21 | 7.2 | | R | 1.732 | 1 | 1 | 4.16 | 4.16 | ∞ |
| Algorithm for correcting SAR for deviations in permittivity and conductivity | 22 | 1.9 | | N | 1 | 1 | 0.84 | 1.90 | 1.60 | ∞ |
| Liquid conductivity (measured) | 22 | 1.91 | | N | 1 | 0.78 | 0.71 | 1.49 | 1.36 | 34 |
| Liquid permittivity (measured) | 22 | 1.81 | | N | 1 | 0.23 | 0.26 | 0.42 | 0.47 | 35 |
| Liquid permittivity (temperature uncertainty) | 23 | 2.24 | | R | 1.732 | 0.78 | 0.71 | 1.01 | 0.92 | ∞ |
| Liquid conductivity (temperature uncertainty) | 23 | 2.18 | | R | 1.732 | 0.23 | 0.26 | 0.29 | 0.33 | ∞ |
| **Combined standard uncertainty** | | | | RSS | | | | 11.10 | 11.00 | |
| **Expanded uncertainty** (95% *confidence interval*) | | | | $k$ = 2 | | | | **22.20** | **22.00** | |

## 11. Equipment List

| Equipment | Manufacturer | Model | Serial No. | Cal. Date | Next Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| SAR Chamber | Dymstec | N/A | N/A | N/A | N/A | N/A |
| Thermo-Hygrostat | ㈜한국문터스 | HK-030-AU1 | 1506231 | N/A | N/A | N/A |
| Staubli Robot Unit | Staubli | TX60L | F15/5Y7QA1/A/01 | N/A | N/A | N/A |
| Electro Optical Converter | SPEAG | EOC60 | 1096 | N/A | N/A | N/A |
| 2mm Oval Phantom V6.0 | SPEAG | QD OVA 003 AA | 2036 | N/A | N/A | N/A |
| Device Holder | SPEAG | Mounting Device Upgrade | SD 000 H99 AA | N/A | N/A | N/A |
| Data Acquisition Electronics | SPEAG | DAE4 | 1344 | 2023-01-20 | 2024-01-20 | 1 Year |
| E-Field Probe | SPEAG | EX3DV4 | 3879 | 2023-01-26 | 2024-01-26 | 1 Year |
| Dipole Antenna | SPEAG | D2450V2 | 980 | 2023-01-20 | 2025-01-20 | 2 Years |
| RF Signal Generator | ANRITSU | 68369B | 992113 | 2023-01-13 | 2024-01-13 | 1 Year |
| RF POWER AMPLIFIER | NONE | RFSPA24 | 001 | 2023-06-14 | 2024-06-14 | 1 Year |
| DUAL DIRECTIONAL COUPLER | HP | E4419B | GB40202055 | 2023-01-13 | 2024-01-13 | 1 Year |
| EPM Series Power Meter | Agilent | E9300H | MY41495967 | 2023-01-13 | 2024-01-13 | 1 Year |
| E-Series AVG Power Sensor | Agilent | E9300H | US39215405 | 2023-01-13 | 2024-01-13 | 1 Year |
| E-Series AVG Power Sensor | ANRITSU | ML2495A | 1438001 | 2023-01-13 | 2024-01-13 | 1 Year |
| POWER METER | ANRITSU | MA2411B | 1339205 | 2023-01-13 | 2024-01-13 | 1 Year |
| Pulse Power Sensor | HP | 8491B | 22234 | 2023-01-13 | 2024-01-13 | 1 Year |
| Attenuator | HP | E4419B | GB40202055 | 2023-01-13 | 2024-01-13 | 1 Year |
| Attenuator | Agilent | 8491B | 51229 | 2023-06-14 | 2024-06-14 | 1 Year |
| Low Pass Filter | FILTRON | F-LPCA-KOO1410 | 1408004S | 2023-01-13 | 2024-01-13 | 1 Year |
| DIELECTRIC ASSESSMENT KIT | SPEAG | DAK3.5 | 1205 | 2023-01-19 | 2024-01-19 | 1 Year |
| Network Analyzer | HP | 8720C | 3124A01008 | 2023-06-14 | 2024-06-14 | 1 Year |
| HYGRO-THERMOMETER | DAEKWANG | 811CE | NONE | 2023-06-19 | 2024-06-19 | 1 Year |
| DIGITAL THERMOMETER | NONE | TP101 | 191105 | 2023-01-17 | 2024-01-17 | 1 Year |
| Spectrum Analyzer | R&S | FSV 40 | 101002 | 2023-06-14 | 2024-06-14 | 1 Year |

Note:
1. CBT (Calibration Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. All equipment was used solely within its calibration period.

## 12. Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

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## Appendix A. SAR Plots for System Verification

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

Test Laboratory: KES Co., Ltd. Date: 2023-09-01

## System Verification for 2450 MHz

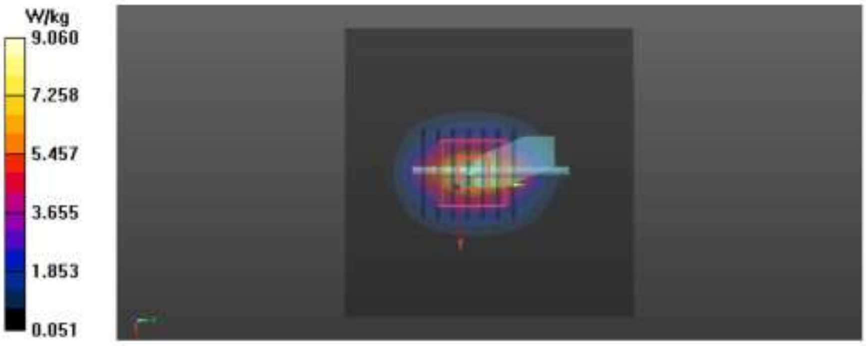
**DUT: Dipole D2450V2-SN: 980**

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2450 MHz; $\sigma$ = 1.812 S/m; $\varepsilon_r$ = 39.555; $\rho$ = 1000 kg/m$^3$
Ambient Temperature 22.3 °C; Liquid Temperature 21.4 °C

DASY5 Configuration:
- Probe: EX3DV4 - SN3879; ConvF(7.42, 7.42, 7.42) @ 2450 MHz; Calibrated: 2023-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1344; Calibrated: 2023-01-20
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2036
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Pin=100 mW/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 9.15 W/kg

**Pin=100 mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 69.95 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 11.3 W/kg
**SAR(1 g) = 5.32 W/kg; SAR(10 g) = 2.45 W/kg**
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 47.4%
Maximum value of SAR (measured) = 9.06 W/kg



## Appendix B. SAR Plots for SAR Measurement

The plots for SAR measurement are shown as follows.

Test Laboratory: KES Co., Ltd. Date: 2023-09-01

## P01_2.4 GHz WLAN_802.11b_Front Side_Ch.6_Ant.1

**DUT: PIXX1826N**

Communication System: UID 10415 - AAA, IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle);
Frequency: 2437 MHz;Duty Cycle: 1:1.4243
Medium: HSL2450 Medium parameters used: f = 2437 MHz; $\sigma$ = 1.798 S/m; $\varepsilon_r$ = 39.585; $\rho$ = 1000 kg/m$^3$
Ambient Temperature 22.3 ℃; Liquid Temperature 21.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3879; ConvF(7.42, 7.42, 7.42) @ 2437 MHz; Calibrated: 2023-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1344; Calibrated: 2023-01-20
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2036
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**- Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.129 W/kg

**- Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.704 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.189 W/kg
**SAR(1 g) = 0.117 W/kg; SAR(10 g) = 0.097 W/kg**
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 70.3%
Maximum value of SAR (measured) = 0.153 W/kg