| | |
|---|---|
| Test Report Serial Number: | 45461975 R3.0 |
| Test Report Date: | 6 September 2024 |
| Project Number: | 1671 |

# SAR Test Report - New Application

Applicant:

GARMIN

**Garmin International Inc.**
**1200 East 151 St.**
**Olathe, KS, 66062**
**USA**

| Maximum *reported* SAR | | |
|---|---|---|
| GMSK BLE | 0.99 | 1g Body (W/kg) |
| General Pop. Limit: | 1.60 | |

| Maximum *reported* SAR | | |
|---|---|---|
| GMSK BLE | 0.58 | 10g Extremity (W/kg) |
| General Pop. Limit: | 4.00 | |

FCC ID: **IPH-04392**

IC Registration Number:

Product Model Number / HVIN: **A04392**

Product Name / PMN: **A04392**

In Accordance With:

**FCC 47 CFR §2.1093**

Radiofrequency Radiation Exposure Evaluation: Portable Devices

Approved By:

**Ben Hewson, President**
Celltech Labs Inc.
21-364 Lougheed Rd.
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Canada

**Test Lab Certificate: 2470.01**

**IC Registration 3874A**

**FCC Registration: CA3874**

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# 1.0 DOCUMENT CONTROL

| Revision History | | | | |
|---|---|---|---|---|
| **Samples Tested By:** | Ben Hewson/ Trevor Whillock | **Date(s) of Evaluation:** | | 4-6 July 2024 |
| **Report Prepared By:** | Ben Hewson | **Report Reviewed By:** | | Art Voss |
| **Report Revision** | **Description of Revision** | **Revised Section** | **Revised By** | **Revision Date** |
| 0.1 | Draft | n/a | Ben Hewson | 17 July 2024 |
| 1.0 | Initial Release | n/a | Ben Hewson | 23 July 2024 |
| 2.0 | Added File Transfer Mode | - | Art Voss | 28 August 2024 |
| 3.0 | Revised FVIN | 2 | Art Voss | 6 September 2024 |

## 2.0 CLIENT AND DEVICE INFORMATION

| Client Information | |
|---|---|
| **Applicant Name** | **Garmin International Inc.** |
| **Applicant Address** | 1200 East 151 St |
| | Olathe, KS, 66062 |
| | USA |
| **DUT Information** | |
| **Device Identifier(s):** | **FCC ID:** **IPH-04392** |
| **Device Model(s) / HVIN:** | A04392 |
| **Device Marketing Name / PMN:** | A04392 |
| **Test Sample Serial No.:** | 8H1000066 |
| **Software Ver /SVIN:** | 1.14 |
| **Device Type:** | Portable Transceiver |
| **Equipment Class:** | Low Power Communication Device (DXX) |
| **Transmit Frequency Range:** | BT/BLE: 2402-2480MHz |
| **Manuf. Max. Rated Output Power:** | BLE - Low Power Communication Device Transmitter (DXX): 20.0dBm |
| | BLE - Low Power Communication Device Transmitter (DXX) (FTM): 10.0dBm |
| **Antenna Type and Gain:** | -1.29 dBi Max Inverted F Antenna |
| **Modulation:** | BLE: GMSK |
| **DUT Power Source:** | 3.8Vdc; Rate Capacity 158 mAh Rechargeable Li-Ion |
| **DUT Dimensions [LxWxH]** | H x W x D: 45mm dia x 10mm |
| **Deviation(s) from standard/procedure:** | None |
| **Modification of DUT:** | None |

## 3.0 SCOPE OF EVALUATION

This Certification Report was prepared on behalf of:

**Garmin International Inc.**

,(the '*Applicant*"), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 . The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation.

The A04392, operates as a Portable transceiver that is capable of operating in the BLE frequency bands. The device is intended for equine use however may be operational while in the hand or on person of a user and is evaluated in these cases under General Population Use. The product operates from an internal proprietary Li-ion rechargeable battery which can be connected to a compliant USB interface port, AC or DC adapter for charging. Test samples provided by the manufacturer were capable of transmitting at select frequencies and modulations preset by the manufacturer. An additional antenna modification was prepared for one sample allowing the ability to connect test equipment for antenna port conducted power analysis.

**Application:**

This is an application for a new device certification.

**Scope:**

The scope of this evaluation was limited to the evaluation of SAR for intended applications. It will include evaluation of the BLE transmitter for all required RF exposure configurations including Extremity and Body Configuration as the device may be operational while held in the hand or on person.

The Test Plan developed for this evaluation is based on the required test channels and configurations which produced the highest worst case SAR and where applicable, SAR test reduction and/or SAR test exclusion may be utilized. The DUT was evaluated for SAR at the maximum tune up tolerance and conducted output power level, preset by the manufacturer and in accordance with the procedures described in RSS-102, IEC/IEEE 62209-1528, FCC KDB 447498 . As attested by the applicant, the device actual use will operate at a low duty cycle (10%) and in order to measure the SAR the device the test mode software was programmed to provide a continuous wave signal (100%) which was then adjusted to the actual use operating duty cycle of 10%.

## 4.0 NORMATIVE REFERENCES

| Normative References* | |
|---|---|
| ANSI / ISO 17025:2017 | General Requirements for competence of testing and calibration laboratories |
| FCC CFR Title 47 Part 2 | Code of Federal Regulations |
| Title 47: | Telecommunication |
| Part 2.1093: | Radiofrequency Radiation Exposure Evaluation: Portable Devices |
| IEC International Standard /IEEE International Committee on Electromagnetic Safety | |
| IEC/IEEE 62209-1528 | Measurement procudeure for the assessment of sepcific absorption rate of human expoure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528; Human models, insturmentation, and procedures (Frequency range of 4 MHz to 10 GHz) |
| FCC KDB | |
| KDB 865664 D01v01r04 | SAR Measurement Requirements for 100MHz to 6GHz |
| KDB 865664 D02v01r02 | RF Exposure Compliance Reporting and Documentation Considerations |
| FCC KDB | |
| KDB 447498 D04v01 | RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices Interim General RF Exposure Guidance |
| * When the issue number or issue date is omitted, the latest version is assumed. | |

## 5.0 STATEMENT OF COMPLIANCE

This measurement report demonstrates that samples of the product model(s) were evaluated for Specific Absorption Rate (SAR) on the date(s) shown, in accordance with the Measurement Procedures cited and were found to comply with the Standard(s) Applied based on the Exposure Limits of the Use Group indicated for which the product is intended to be used.

| Applicant: | Model / HVIN: | |
|---|---|---|
| Garmin International Inc. | A04392 | |
| **Standard(s) Applied:** | **Measurement Procedure(s):** | |
| FCC 47 CFR §2.1093 | FCC KDB 865664, FCC KDB 447498, FCC KDB 248227<br>IEC/IEEE Standard 62209-1528 | |
| **Reason For Issue:** | **Use Group:** | **Limits Applied:** |
| [x] New Certification | [x] General Population / Uncontrolled | [x] 1.6W/kg - 1g Volume |
| [ ] Class I Permissive Change | | [ ] 8.0W/kg - 1g Volume |
| [ ] Class II Permissive Change | [ ] Occupational / Controlled | [x] 4.0W/kg - 10g Volume |
| **Reason for Change:** | | **Date(s) Evaluated:** |
| | | 4-6 July 2024 |

The results of this investigation are based solely on the test sample(s) provided by the applicant which was not adjusted, modified or altered in any manner whatsoever except as required to carry out specific tests or measurements. A description of the device, operating configuration, detailed summary of the test results, methodologies and procedures used during this evaluation, the equipment used and the various provisions of the rules are included in this test report.

| | |
|---|---|
| I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025. |  <br>Ben Hewson<br>Celltech Labs Inc.<br>11 July 2024<br>Date |

# 6.0 SAR MEASUREMENT SYSTEM

## SAR Measurement System

Celltech Labs Inc. SAR measurement facility employs a Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY6 measurement system is comprised of the measurement server, a robot controller, a computer, a near-field probe, a probe alignment sensor, an Elliptical Planar Phantom (ELI) phantom and a specific anthropomorphic mannequin (SAM) phantom for Head and/or Body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller and a teach pendant (Joystick) to control the robot's servo motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical form the DAE to digital electronic signal and transfers data to the DASY6 measurement server. The DAE4 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter, a command decoder and a control logic unit. Transmission to the DASY6 measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot utilizes a controller with built in VME-bus computer.


DASY 6 SAR System with SAM Phantom


DASY 6 Measurement Controller

## 7.0 RF CONDUCTED POWER MEASUREMENT

Table 7.0 Conducted Power Measurements

| Conducted Power Measurements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Band | Mode | Bandwidth (MHz) | Channel | Frequency (MHz) | Modulation | Bit Rate (Mbps) | Measured Power (dBm) | Rated Power (dBm) | Rated Power (W) | Delta (dB) | SAR Test Channel (Y/-) | Duty Cycle (%) | Crest Factor (1/DC) |
| BT | LE | 1 | 37 | 2402 | GMSK | 1 | 17.76 | 20.00 | 0.100 | -2.24 | - | 10 | 10.000 |
| | | | 17 | 2440 | | | 17.76 | 20.00 | 0.100 | -2.24 | - | 10 | 10.000 |
| | | | 39 | 2480 | | | 18.19 | 20.00 | 0.100 | -1.81 | - | 10 | 10.000 |
| | LE | 2 | 1 | 2404 | GMSK | 2 | 19.03 | 20.00 | 0.100 | -0.97 | - | 10 | 10.000 |
| | | | 17 | 2440 | | | 18.62 | 20.00 | 0.100 | -1.38 | - | 10 | 10.000 |
| | | | 39 | 2480 | | | 19.12 | 20.00 | 0.100 | -0.88 | - | 10 | 10.000 |
| | LE | 0 | 37 | 2402 | CW | - | 18.25 | 20.00 | 0.100 | -1.75 | y | 100 | 1.000 |
| | | | 17 | 2440 | | | 18.03 | 20.00 | 0.100 | -1.97 | y | 100 | 1.000 |
| | | | 39 | 2480 | | | 18.27 | 20.00 | 0.100 | -1.73 | y | 100 | 1.000 |
| BT FTM | LE | 1 | 37 | 2402 | GMSK | 1 | 2.16 | 10.00 | 0.100 | -7.84 | - | 85 | 1.176 |
| | | | 17 | 2440 | | | 6.04 | 10.00 | 0.100 | -3.96 | - | 85 | 1.176 |
| | | | 39 | 2480 | | | 7.23 | 10.00 | 0.100 | -2.77 | - | 85 | 1.176 |
| | LE | 0 | 37 | 2402 | CW | - | 2.38 | 10.00 | 0.100 | -7.62 | - | 100 | 1.000 |
| | | | 17 | 2440 | | | 4.73 | 10.00 | 0.100 | -5.27 | - | 100 | 1.000 |
| | | | 39 | 2480 | | | 7.53 | 10.00 | 0.100 | -2.47 | - | 100 | 1.000 |

The rated power and tolerance are stated for typical transmission modes and data rates. Some modes and data rates may produce lower than rated conducted power levels. Power measurements taken across the various channels, modes and data rates did not produce levels in excess of the Rated Power plus Tolerance. In order to measure SAR, the device was was evaluated using the CW power level setting and as provided by the manufacturer with firmware, and the results were adjusted to the maximum average tune up tolerance output power and to the 10% duty cycle, to produce the most conservative SAR. See section 2.0 Client and Device Information for details. The *reported* SAR was not scaled down.

Note: The DUT has a File Transfer Mode (FTM) whereby file transfers can occur from the DUT to a connected device. The power and duty cycle of this mode is 10dBm at an 85% duty cycle.

# 8.0 MEASUREMENT METHOD

## Table 8.1 Number of Test Channels

The intended use of the device would have it transmit as a portable transceiver near extremity. As such the device was evaluated for both Extremity SAR (10g - 0mm). Also a forseable use of the device would have it transmit in pocket, and was evaluated for Body SAR (1g -5mm) in the worse case position identified in Extremity testing.

The device supports channel 2402 thru 2480 for 2.4 GMSK BLE1 and BLE2 .

The HOPC was selected for SAR evaluation in three positions front, back and left side (closed to position to imbedded antenna) . The worse case SAR position was identified, and the device was evaluated in the channel spread of low, mid, high in accordance with global market requirements.

The device is not exempt from SAR evaluation as Per FCC KDB 447498 D04 Appendix B Exemptions for Single RF Sources - as noted below

B.4 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the available maximum time averaged power may be used if the device antenna or radiating structure does not exceed an electrical length of $\lambda/4$.

The separation distance is the smallest distance from any part of the antenna or radiating structure to all persons, and for portable or mobile devices this is from the device outer housing to the closest antenna.

**$P_{th}$ (mW) = $ERP_{20cm}$(mW) = 2040f** **for 0.3GHz ≤ f < 1.5GHz (B.1)**

**$P_{th}$ (mW) = $ERP_{20cm}$(mW) = 3060** **for 1.5GHz ≤ f ≤ 6GHz (B.1)**

**$P_{th}$ (mW) = ($ERP_{20cm}$)(d/20cm)$^x$** **for d ≤ 20cm (B.2)**

**$P_{th}$ (mW) = ($ERP_{20cm}$)** **for 20cm < d ≤ 40cm (B.2)**

**$x = -\log_{10}(60/(ERP_{20cm})(\sqrt{f})$**

where **f** is in GHz, **d** is separation distance (cm), **$ERP_{20cm}$** is per Formula (B.1).

| Transmitter | Frequency ( f ) (GHz) | Separation Distance (d) (cm) | Average Power (mW) | Antenna Gain (dBi) | ERP or Avg. Power (mW)* | $P_{th}$ (mW) |
|---|---|---|---|---|---|---|
| BLE-CW | 2.48 | 0.2 | 100.0 | -1.29 | 74.30 | 0.47 |
| BLE (10% DC) | 2.48 | 0.2 | 10.0 | -1.29 | 7.43 | 0.47 |

*If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the available maximum time averaged power may be used if the device antenna or radiating structure does not exceed an electrical length of $\lambda/4$.

The BLE transmitters has a maximum frequency of 2480MHz. The BLE power was measured by the client and has a maximum average transmission power of 20dbm with tune up tolerance (100mW) and a minimum antenna separation distance of 2 mm. The device has a duty cycle of 10% and was provided with firmware to allow the lab to measure SAR under continuous wave. The above table indicates that the device will exceed the exempt limits and the device requires SAR evaluation.

# 9.0 ACCESSORIES EVALUATED

**Table 9.0 Accessories Evaluated**

| Accessory List | | | | |
|---|---|---|---|---|
| **Test Report ID Number** | **Manufacturer's Part Number** | **Description** | **SAR Evaluated** | **SAR Tested** |
| **A04392** | 010-06435-00 | A04392 BLE Transceiver | **Y** | **Y** |
| **-** | 320-01602-00 | USB Charging Clip | **N** | **N** |

# 10.0 SAR MEASUREMENT SUMMARY

**Table 10.0: Measured Results -Extremity 10g**

| Measured 10g SAR Results - EXTREMITY Configuration | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Plot ID | Test Frequency (MHz) | DUT Configuration | | | | | Accessories | Spacing | | Measured SAR (W/kg) | SAR Drift (dB) | Delta Power (dB) | Crest Factor (n) | Fluid Sensitivity (n) | Duty Factor (%) | reported SAR (W/kg) |
| | | | Pos | Mode | BW | Mod | BR | | DUT (mm) | Antenna (mm) | | | | | | | |
| Area Scan | | | | | | | | | | | | | | | | | |
| 7/5/2024 | E1 | 2480 | Front | BLE | - | CW | - | n/a | 0 | 2 | 4.100 | 0.010 | -1.730 | 1.000 | 1.000 | 10.000 | 0.611 |
| 7/5/2024 | E1R | 2480 | Front | BLE | - | CW | - | n/a | 0 | 2 | 4.040 | 0.070 | -1.730 | 1.000 | 1.000 | 10.000 | 0.602 |
| 7/5/2024 | E2 | 2480 | Back | BLE | - | CW | - | n/a | 0 | 2 | 2.440 | 0.010 | -1.730 | 1.000 | 1.000 | 10.000 | 0.363 |
| 7/5/2024 | E3 | 2480 | Left | BLE | - | CW | - | n/a | 0 | 2 | 0.910 | -0.080 | -1.730 | 1.000 | 1.000 | 10.000 | 0.138 |
| 7/6/2024 | E6 | 2402 | Front | BLE | - | CW | - | n/a | 0 | 2 | 4.550 | 0.010 | -1.750 | 1.000 | 1.000 | 10.000 | 0.681 |
| 7/6/2024 | E7 | 2440 | Front | BLE | - | CW | - | n/a | 0 | 2 | 4.240 | 0.020 | -1.970 | 1.000 | 1.000 | 10.000 | 0.667 |
| Zoom Scan | | | | | | | | | | | | | | | | | |
| 7/6/2024 | E6Z | 2402 | Front | BLE | - | CW | - | n/a | 0 | 2 | 3.880 | -0.010 | -1.750 | 1.000 | 1.000 | 10.000 | 0.582 |
| Applicable SAR Limit | | | | | | | | Use Group | | | | | Limit | | | | |
| FCC CFR 2.1093 | | | Health Canada Safety Code 6 | | | | | General Population/User Unaware | | | | | 4 W/kg | | | | |

**Table 10.1: Measured Results - Body 1g**

| Measured 1g SAR Results - BODY Configuration | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Plot ID | Test Frequency (MHz) | DUT Configuration | | | | | Accessories | Spacing | | Measured SAR (W/kg) | SAR Drift (dB) | Delta Power (dB) | Crest Factor (n) | Fluid Sensitivity (n) | Duty Factor (%) | reported SAR (W/kg) |
| | | | Pos | Mode | BW | Mod | BR | | DUT (mm) | Antenna (mm) | | | | | | | |
| Area Scan | | | | | | | | | | | | | | | | | |
| 7/5/2024 | B1 | 2480 | Front | BLE | - | CW | - | n/a | 5 | 7 | 6.270 | -0.080 | -1.730 | 1.000 | 1.000 | 10.000 | 0.951 |
| 7/6/2024 | B4 | 2402 | Front | BLE | - | CW | - | n/a | 5 | 7 | 6.840 | -0.020 | -1.750 | 1.000 | 1.000 | 10.000 | 1.028 |
| 7/6/2024 | B5 | 2440 | Front | BLE | - | CW | - | n/a | 5 | 7 | 6.060 | -0.080 | -1.970 | 1.000 | 1.000 | 10.000 | 0.972 |
| Zoom Scan | | | | | | | | n/a | | | | | | | | | |
| 7/6/2024 | B4Z | 2402 | Front | BLE | - | CW | - | n/a | 5 | 7 | 6.540 | -0.060 | -1.750 | 1.000 | 1.000 | 10.000 | 0.992 |
| Applicable SAR Limit | | | | | | | | Use Group | | | | | Limit | | | | |
| FCC CFR 2.1093 | | | Health Canada Safety Code 6 | | | | | General Population/User Unaware | | | | | 1.6 W/kg | | | | |

Note: The calculated File Transfer Mode SAR, based on the worst-case measured SAR, at 10dBm with an 85% duty cycle is given by:
SAR (FTM) = SAR(Meas)X10mW/100mW X 85% = 0.087W/kg, which is lower than the SAR and normal operation.

## 11.0 SCALING OF MAXIMUM MEASURE SAR

**Table 11.0 SAR Scaling – Extremity 10g**

| Scaling of Maximum Measured SAR (10g) | | | | | | |
|---|---|---|---|---|---|---|
| Measured Parameters | | Configuration | | | | |
| | | Extremity | Face | | | |
| Plot ID | | E6Z | | | | |
| Maximum Measured $SAR_M$ | | 3.880 | | | | (W/kg) |
| Frequency | | 2402 | | | | (MHz) |
| Drift | Power Drift | -0.010 | | | | (dB) |
| Conducted Power | | 18.250 | | | | (dBm) |
| DC | Transmiter Duty Cycle | (2) | | | | (%) |
| DF | Use Duty Factor | 10.0 | | | | (%) |
| Fluid Deviation from Target | | | | | | |
| Δe | Permitivity | -8.03% | | | | |
| Δσ | Conductivity | -1.02% | | | | |

| Fluid Sensitivity Calculation (1g) IEC/IEEE 62209-1528 7.8.2 | | | | | | |
|---|---|---|---|---|---|---|
| Delta SAR = Ce * Δe + Cσ * Δσ (8) | | | | | | |
| $Ce = (0.003456*f^3) - (0.03531*f^2) + (0.07675*f) - 0.186$ (11) | | | | | | |
| $Cσ = (0.004479*f^3) - (0.01586*f^2) - (0.1972*f) + 0.7717$ (12) | | | | | | |
| f | Frequency (GHz) | 2.402 | | | | |
| Ce | | -0.157 | | | | |
| Cσ | | 0.269 | | | | |
| Ce * Δe | | 0.013 | | | | |
| Cσ * Δσ | | -0.003 | | | | |
| ΔSAR | | 0.010 (1) | | | | (%) |

| Manufacturer's Tuneup Tolerance | | | | | |
|---|---|---|---|---|---|
| Measured Conducted Power | 18.250 | | | | (dBm) |
| Rated Conducted Power | 20.000 | | | | (dBm) |
| ΔP | -1.750 | | | | (dB) |

| Transmitter Duty Cycle [Crest Factor] | | | | | |
|---|---|---|---|---|---|
| Transmiter Duty Cycle (DC) | 100.0 | | | | (%) |
| CF (1/DC) | 1.00 (2) | | | | |

| SAR Adjustment for Fluid Sensitivity | | | | | |
|---|---|---|---|---|---|
| $SAR_1 = SAR_M$ X [ΔSAR] | 3.880 (1) | | | | (W/kg) |

| SAR Adjustment for Tuneup Tolerance | | | | | |
|---|---|---|---|---|---|
| $SAR_2 = SAR_1$ + [ΔP] | **5.805** | | | | (W/kg) |

| SAR Adjustment for Drift | | | | | |
|---|---|---|---|---|---|
| $SAR_3 = SAR_2$ + [Drift] | **5.819** | | | | (W/kg) |

| SAR Adjustment for Transmitter Duty Cycle [Crest Factor] | | | | | |
|---|---|---|---|---|---|
| $SAR_4 = SAR_3$ x [CF] | 5.819 (2) | | | | (W/kg) |

| SAR Adjustment for Use Duty Factor | | | | | |
|---|---|---|---|---|---|
| $SAR_5 = SAR_4$ x [DF] | **0.582** | | | | (W/kg) |

| *reported* 1g SAR | | | | | |
|---|---|---|---|---|---|
| *reported* SAR | **0.58** | | | | (W/kg) |

## Table 11.1 SAR Scaling – Body – 1g

| Scaling of Maximum Measured SAR (1g) | | | | | | |
|---|---|---|---|---|---|---|
| Measured Parameters | | Configuration | | | | |
| | | Body | Face | | | |
| Plot ID | | B4Z | | | | |
| Maximum Measured $SAR_M$ | | 6.540 | | | | (W/kg) |
| Frequency | | 2402 | | | | (MHz) |
| Drift | Power Drift | -0.060 | | | | (dB) |
| Conducted Power | | 18.250 | | | | (dBm) |
| DC | Transmiter Duty Cycle | (4) | | | | (%) |
| DF | Use Duty Factor | 10.0 | | | | (%) |
| Fluid Deviation from Target | | | | | | |
| Δe | Permitivity | -8.03% | | | | |
| Δσ | Conductivity | -1.02% | | | | |

| Fluid Sensitivity Calculation (1g) | | IEC/IEEE 62209-1528 7.8.2 | | | | |
|---|---|---|---|---|---|---|
| Delta SAR = Ce * Δe + Cσ * Δσ | | | | | | (8) |
| $Ce = (-0.0007854*f^3) + (0.009402*f^2) - (0.02742*f) - 0.2026$ | | | | | | (9) |
| $Cσ = (0.009804*f^3) - (0.08661*f^2) + (0.02981*f) + 0.7829$ | | | | | | (10) |
| f | Frequency (GHz) | 2.402 | | | | |
| Ce | | -0.225 | | | | |
| Cσ | | 0.491 | | | | |
| Ce * Δe | | 0.018 | | | | |
| Cσ * Δσ | | -0.005 | | | | |
| ΔSAR | | 0.013 (3) | | | | (%) |

| Manufacturer's Tuneup Tolerance | | | | | |
|---|---|---|---|---|---|
| Measured Conducted Power | 18.250 | | | | (dBm) |
| Rated Conducted Power | 20.000 | | | | (dBm) |
| ΔP | -1.750 | | | | (dB) |

| Transmitter Duty Cycle [Crest Factor] | | | | | |
|---|---|---|---|---|---|
| Transmiter Duty Cycle (DC) | 100.0 | | | | (%) |
| CF (1/DC) | 1.00 (4) | | | | |

| SAR Adjustment for Fluid Sensitivity | | | | | |
|---|---|---|---|---|---|
| $SAR_1 = SAR_M$ X [ΔSAR] | 6.540 (3) | | | | (W/kg) |

| SAR Adjustment for Tuneup Tolerance | | | | | |
|---|---|---|---|---|---|
| $SAR_2 = SAR_1$ + [ΔP] | 9.785 | | | | (W/kg) |

| SAR Adjustment for Drift | | | | | |
|---|---|---|---|---|---|
| $SAR_3 = SAR_2$ + [Drift] | 9.922 | | | | (W/kg) |

| SAR Adjustment for Transmitter Duty Cycle [Crest Factor] | | | | | |
|---|---|---|---|---|---|
| $SAR_4 = SAR_3$ x [CF] | 9.922 (4) | | | | (W/kg) |

| SAR Adjustment for Use Duty Factor | | | | | |
|---|---|---|---|---|---|
| $SAR_5 = SAR_4$ x [DF] | 0.992 | | | | (W/kg) |

| *reported* 1g SAR | | | | | |
|---|---|---|---|---|---|
| *reported* SAR | 0.99 | | | | (W/kg) |

| NOTES to Table |
|---|
| Scaling of the Maximum Measured SAR is based on the highest Face, Body, Extremity and/or Head SAR measured of ALL test channels, configurations and accessories used during THIS evaluation. The Measured Fluid Deviation parameters, Drift, Conducted Power, Duty Cycle [Crest] and Use Duty Factor apply only to those test frequencies and configurations producing the highest SAR. The *reported* SAR is the accumulation of all SAR Adjustments from the applicable steps above. The Plot ID is for identification of the SAR Measurement Plot(s) in the Annexes of this report.<br><br>NOTE: The above adjustments have been applied to ALL Measured SAR values. In some cases, the highest Measure SAR may not have produced the highest *reported* SAR after all adjustments have been made.<br><br>NOTE: Some of the above adjustments may not be applicable to each configuration. They are identified by grayed fields. |
| **$SAR_1$** |
| Per IEC/IEEE 62209-1528, FCC KDB 865664, ISED RSS-102 and ISED Notice 2012-DRS0529, SAR adjustment is applied when the calculated ΔSAR, resulting from the equations indicated, is negative (-).<br><br>ΔSAR is given as a percentage (%). The SAR is MULTIPLIED by this scaling factor only when the scaling factor is negative (-). |
| **$SAR_2$** |
| Per IEC/IEEE 62209-1528, FCC KDB 865664 and ISED RSS-102, adjustment is required only when the difference (ΔP) between the Measured Conducted Power and the Manufacturer's Rated Conducted Power is (-) Negative.<br><br>ΔP is given in dB. The absolute value of ΔP is ADDED (logarithmically) to the SAR when ΔP is negative (-). |
| **$SAR_3$** |
| Per IEC/IEEE 62209-1528, FCC KDB 865664 and ISED RSS-102, adjustment is required only when Measured Drift is negative (-). The absolute value of Measured Drift is ADDED (logarithmically) to the SAR.<br><br>Drift is given in dB. The absolute value of Drift is ADDED (logarithmically) to the SAR when Drift is negative (-). |
| **$SAR_4$** |
| Per IEC/IEEE 62209-1528, FCC KDB 865664 and ISED RSS-102, when the transmit Duty Cyle (DC) is less than 100%, the *reported* SAR must be scaled to 100% by the Crest Factor (CF). CF = 1/DC where DC is in decimal.<br><br>CF is given as a decimal. The SAR is MULTIPLIED by this scaling factor only when the scaling factor is greater than 1. |
| **$SAR_5$** |
| Use Duty Factor applies to Push-To-Talk (PTT) transceivers or other devices whereby the user has some control of the transmitter on-off period. Per IEC/IEEE 62209-1528, FCC KDB 447498, FCC KDB 643646 and ISED RSS-102, a Duty Factor (DF) of 50% may be applied. In cases where Voice Activated transmit is employed, a DF of 75% may be applied.<br><br>DF is given as a percentage (5). The SAR is MULTIPLIED by this scaling factor only when the scaling factor is less than 100%. |
| ***reported* SAR** |
| The *reported* SAR is the Maximum SAR after all applicable adjustments have been made and is indicated on the cover page of this report. |

Note (1): Delta SAR is Positive, SAR Adjustment for Fluid Sensitivity is not Required, in accordance with ISED Notice 2012-DRS0529
Note (2): Crest Factor = 1 (100% Duty Cycle), Crest Factor Adjustment not Required.
Note (3): Use Duty Factor is 100%. No Duty Factor Correction applied.
Note (4): Delta SAR is Positive, SAR Adjustment for Fluid Sensitivity is not Required, in accordance with ISED Notice 2012-DRS0529
Note (5): Power Drift is Positive, Drift Adjustment not Required.
Note (6): Crest Factor = 1 (100% Duty Cycle), Crest Factor Adjustment not Required.
Note (7): Use Duty Factor is 100%. No Duty Factor Correction applied.

# 12.0 SAR EXPOSURE LIMITS

**Table 12.0 Exposure Limits**

| SAR RF EXPOSURE LIMITS | | | |
|---|---|---|---|
| FCC 47 CFR§2.1093 | Health Canada Safety Code 6 | General Population / Uncontrolled Exposure(4) | Occupational / Controlled Exposure(5) |
| Spatial Average(1) (averaged over the whole body) | | 0.08 W/kg | 0.4 W/kg |
| Spatial Peak(2) (Head and Trunk averaged over any 1 g of tissue) | | **1.6 W/kg** | 8.0 W/kg |
| Spatial Peak(3) (Hands/Wrists/Feet/Ankles averaged over 10 g) | | **4.0 W/kg** | 20.0 W/kg |
| (1) The Spatial Average value of the SAR averaged over the whole body. | | | |
| (2) 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. | | | |
| (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. | | | |
| (4) Uncontrolled environments are defined as locations where there is potential exposure to individuals who have no knowledge or control of their potential exposure. | | | |

# 13.0 DETAILS OF SAR EVALUATION

## 13.0 Day Log

| DAY LOG | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Ambient Temp (°C) | Fluid Temp (°C) | Relative Humidity (%) | Barometric Pressure (kPa) | Fluid Dielectric | SPC | Test | Task |
| 7/4/2024 | 24.4 | 23.2 | 38% | 101.4 | X | | | 2450MHz |
| 7/5/2024 | 22.5 | 23.0 | 39% | 102.2 | | X | X | 2450MHz |
| 7/6/2024 | 23.8 | 23.2 | 40% | 101.4 | | | X | 2450MHz |

*Per IEC/IEEE 62209-1528, test series was started within 24 hours of Fluid Parameter Measurement

### 13.1 DUT Setup and Configuration

| DUT Setup and Configuration | |
|---|---|
| 1 | The device was evaluated for Extremity (held in hand) and Body, from a flat phantom filled with head tissue-equivalent medium. The DUT was evaluated for SAR in accordance with the procedures described in RSS-102, IEC/IEEE 62209-1528, FCC KDB 447498, 865664, 248227. |
| 2 | The Device is capable of transmitting at a particular GMSK data rates and duty cycle in the BLE1 and BLE2 frequencies. The duty cycle as set for by the OEM for the device in use is 10% . For testing the device was provided with software to control the transmitter functions, and was capable of changing between different pre-sets established by the OEM. |
| 3 | Bluetooth was evaluated for SAR in BLE (GMSK) mode with a transmit duty cycle of 100% for Extremity (0mm) in all positions - Front, Back and Left ( nearest location of imbedded antenna ) and a worst-case configuration was derived and used in testing the Body position. The DUT was evaluated for SAR at the maximum conducted output power level, preset by the manufacturer. The SAR results were corrected to to the 10% duty cycle. |
| 4 | Each SAR evaluation was performed with a fully charged battery. |

### 13.2 DUT Positioning

| DUT Positioning |
|---|
| **Positioning** |
| The DUT Positioner was securely fastened to the Phantom Platform. Where appropriate registration marks are placed on the DUT and the Positioner to ensure consistent positioning of the DUT for each test evaluation. |
| **FACE Configuration** |
| Head SAR - (held- to-face).This device is not intended to be held to the Face and was not tested in the FACE configuration. |
| **BODY Configuration** |
| Devices that are designed to be worn on the Body are positioned on the device holder with the surface of the DUT being 5mm from bottom of the phantom in the Body configuration. |
| **HEAD Configuration** |
| This device is not intended to be held to the ear and was not tested in the HEAD configuration. |
| **Extremity Configuration** |
| Extremity SAR - ( held in hand) Devices that are designed to be near extremity are positioned with the device side directly against the phantom surface. The device is positioned on a foam backing. |

## 13.3 General Procedures and Report

a

| General Procedures and Reporting |
|---|
| **General Procedures** |
| The fluid dielectric parameters of the Active Tissue Simulating Liquid (TSL) were measured as described in this Section, recorded and entered into the DASY Measurement Server. Active meaning the TSL used during the SAR evaluation of the DUT. The temperature of the Active TSL was measured and recorded prior to performing a System Performance Check (SPC). An SPC was performed with the Active TSL prior to the start of the test series. The temperature of the Active TSL was measured throughout the day and the Active TSL temperature was maintained to ± 0.5°C. The Active TSL temperature was maintained to within ±1.0°C throughout the test series. TSL analysis and SPC were repeated when the Active TSL use exceeded 84 hours.<br><br>An Area Scan exceeding the length and width of the DUT projection was performed and the locations of all maximas within 2dB of the Peak SAR recorded. A Zoom Scan centered over the Peak SAR location(s) was performed and the 1g and 10g SAR values recorded. The resolutions of the Area Scan and Zoom Scan are described in the Scan Resolution table(s) in this Section. A Power Reference Measurement was taken at the phantom reference point immediately prior to the Area Scan. A Power Drift measurement was taken at the phantom reference point immediately following the Zoom Scan to determine the power drift. A Z-Scan from the *Maximum Distance to Phantom Surface* to the fluid surface was performed following the power drift measurement. |
| **Reporting** |
| Where appropriate the 1g SAR, 10g SAR and power drift measurements are recorded in the SAR Measurement Summary tables in the SAR Measurement Summary Section of this report. The SAR values shown in the 100% DC (Duty Cycle) column are the SAR values reported by the SAR Measurement Server with the DUT operating at or compensated for a 100% transmit duty cycle. A duty cycle compensation (crest factor) and fluid sensitivy scaling factor is shown, as well as other information such as transmit channel and frequency, modulation, accessories tested and DUT-phantom separation distance.<br><br>In the Scaling of Maximum Measured SAR Section of this report, the highest measured SAR in the BODY and/or FACE and/or EXTREMITY (limb-worn) configurations, within the entire scope of this assessment, are, when applicable, scaled for Fluid Sensitivity, Manufacturer's Tune-Up Tolerance, Simultaneous Transmission and Drift. With the exception of Duty Cycle correction/compensation, SAR values are ONLY scaled up, not down. The final results of this scaling is the *reported SAR* which appears on the Cover Page of this report. |

## 13.4 Fluid Dielectric and Systems Performance Check

| Fluid Dielectric and Systems Performance Check |
|---|
| **Fluid Dielectric Measurement Procedure** |
| The fluid dielectric parameters of the Tissue Simulating Liquid (TSL) are measured using the Open-Ended Coax Method connected to an Agilent 8753ET Network Analyzer connected to a measurement server running Aprel Dielectric Property Measurement System. A frequency range of ± 100MHz for frequencies > 300MHz and ± 50MHz for frequencies ≤ 300MHz with frequency step size of 10MHz is used. The center frequency is centered around the SAR measurement probe's calibration point for that TSL frequency range. A calibration of the setup is performed using a short-open-deionized water (at 23°C in a 300ml beaker) method. A sample of the TSL is placed in a 300ml beaker and the open-ended coax is submerged approximately 8mm below the fluid surface in the approximate center of the beaker. A check of the setup is made to ensure no air is trapped under the open-ended coax. The sample of TSL is measured and compared to the FCC KDB 865664 targets for HEAD or BODY for the entire fluid measurement range. Fluid adjustment are made if the dielectric parameters are > 5% in range that the DUT is to be tested. If the adjustments fail to bring the parameters to ≤ 5% but are < 10%, the SAR Fluid Sensitivity as per IEC\IEE 62209-1528 and FCC KDB 865664 are applied to the highest measured SAR. A TSL with dielectric parameters > 10% in the DUT test frequency range are not used. |
| **Systems Performance Check** |
| The fluid dielectric parameters of the Active TSL are entered into the DASY Measurement Server at each of the 10MHz step size intervals. Active meaning the TSL used during the SAR evaluation of the DUT. The DASY Measurement System will automatically interpolate the dielectric parameters for DUT test frequencies that fall between the 10MHz step intervals.<br>A Systems Performance Check (SPC) is performed in accordance with IEC\IEEE 62209-1528 "System Check" and FCC KDB 865664 "System Verification". A validation source, dipole or Confined Loop Antenna (CLA), is placed under the geometric center of the phantom and separated from the phantom in accordance to the validation source's Calibration Certificate data. A CW signal set to the frequency of the validate source's and SAR measurement probe's calibration frequency with a forward power set to the validation source's Calibration Certificate data power setting is applied to the validation source. An Area Scan is centered over the projection of the validation source's feed point and an Area Scan is taken. A Zoom Scan centered over the Peak SAR measurement of the Area Scan and the 1g and 10g SAR is measured. The measured 1g and 10g SAR is compared to the 1g and 10g SAR measurements from the validation source's Calibration Certificate. When required, the measured SAR is normalized to 1.0W and compared to the normalized SAR indicated on the validation source's Calibration Certificate. The SPC is considered valid when the measured and normalized SAR is ≤ 10% of the measured and normalize SAR of the validation source's Calibration Certificate.<br>The fluid dielectric parameters of the Active TSL and SPC are repeated when the Active TSL has been in use for greater than 84 hours or if the Active TSL temperature has exceed ± 1°C of the initial fluid analysis. |

## 13.5 Scan Resolution 100MHz to 2GHz

| Scan Resolution 100MHz to 2GHz | |
|---|---|
| **Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)** | **4 ± 1 mm** |
| **Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)** | **5° ± 1°** |
| **Area Scan Spatial Resolution ΔX, ΔY** | **15 mm** |
| **Zoom Scan Spatial Resolution ΔX, ΔY** | **7.5 mm** |
| **Zoom Scan Spatial Resolution ΔZ (Uniform Grid)** | **5 mm** |
| **Zoom Scan Volume X, Y, Z** | **30 mm** |
| **Fluid Depth** | **150 ± 5 mm** |
| An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima. | |
| A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR | |

### 13.6 Scan Resolution 2GHz to 3GHz

| Scan Resolution 2GHz to 3GHz | |
|---|---|
| **Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)** | **4 ± 1 mm** |
| **Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)** | **5° ± 1°** |
| **Area Scan Spatial Resolution ΔX, ΔY** | **12 mm** |
| **Zoom Scan Spatial Resolution ΔX, ΔY** | **5 mm** |
| **Zoom Scan Spatial Resolution ΔZ (Uniform Grid)** | **5 mm** |
| **Zoom Scan Volume X, Y, Z** | **30 mm** |
| **Fluid Depth** | **150 ± 5 mm** |
| An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima. | |
| A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR | |

### 13.7 Scan Resolution 5GHz to 6GHz

| Scan Resolution 5GHz to 6GHz | |
|---|---|
| **Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)** | **4 ± 1 mm** |
| **Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)** | **5° ± 1°** |
| **Area Scan Spatial Resolution ΔX, ΔY** | **10 mm** |
| **Zoom Scan Spatial Resolution ΔX, ΔY** | **4 mm** |
| **Zoom Scan Spatial Resolution ΔZ (Uniform Grid)** | **2 mm** |
| **Zoom Scan Volume X, Y, Z** | **22 mm** |
| **Fluid Depth** | **100 ± 5 mm** |
| An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima. | |
| A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR | |

# 14.0 SAR MEASUREMENT VARIABILITY & UNCERTAINTY

**Table 14.1 Measurement Variability**

Per FCC KDB Publication 865664, SAR measurement variability is not required to be assessed for each frequency band where all measured SAR values are <0.8 W/kg for 1g and < 2.0 W/kg for 10g.

**Table 14.2 Measurement Uncertainty**

Per FCC KDB 865664 when the highest measured SAR is <1.5 W/kg for 1 g and < 3.75 W/kg for 10g all frequency bands, the extensive SAR measurement uncertainty analysis tables described in IEEE std 1528-2013 are not required.

## 15.0 FLUID DIELECTRIC PARAMETERS

**Table 15.0 Fluid Dielectric Parameters 2450MHz HEAD TSL**

| 29 FLUID DIELECTRIC PARAMETERS | | | | | | | | Fluid Sensitivity Calculation IEC/IEEE 62209-1528 7.8.2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date: 4-Jul-2024 | | Fluid Temp: 24.4 | | Frequency: 2450MHz | | Tissue: Head | | ΔSAR | ΔSAR | SAR Correction Factor (1) | |
| Freq (MHz) | | Test ε | Test σ (S/m) | Target ε | Target σ (S/m) | Deviation Permittivity | Deviation Conductivity | 1g | 10g | 1g | 10g |
| 2400.0000 | | 36.1600 | 1.7400 | 39.2900 | 1.76 | -7.97% | -1.14% | 0.012 | 0.009 | 1.000 | 1.000 |
| 2402.0000 | * | 36.1300 | 1.7420 | 39.2860 | 1.76 | -8.03% | -1.02% | 0.013 | 0.010 | 1.000 | 1.000 |
| 2410.0000 | | 36.0100 | 1.7500 | 39.2700 | 1.76 | -8.30% | -0.57% | 0.016 | 0.012 | 1.000 | 1.000 |
| 2430.0000 | | 36.2100 | 1.8000 | 39.2400 | 1.78 | -7.72% | 1.12% | 0.023 | 0.015 | 1.000 | 1.000 |
| 2440.0000 | * | 36.1400 | 1.8100 | 39.2200 | 1.79 | -7.85% | 1.12% | 0.023 | 0.015 | 1.000 | 1.000 |
| 2450.0000 | | 36.3200 | 1.8200 | 39.2000 | 1.80 | -7.35% | 1.11% | 0.022 | 0.015 | 1.000 | 1.000 |
| 2470.0000 | | 36.1300 | 1.8100 | 39.1700 | 1.82 | -7.76% | -0.55% | 0.015 | 0.011 | 1.000 | 1.000 |
| 2480.0000 | * | 36.0500 | 1.8400 | 39.1600 | 1.83 | -7.94% | 0.55% | 0.020 | 0.014 | 1.000 | 1.000 |
| 2490.0000 | | 36.0100 | 1.8200 | 39.1500 | 1.84 | -8.02% | -1.09% | 0.013 | 0.010 | 1.000 | 1.000 |

*Channel Frequency Tested

## 16.0 SYSTEM VERIFICATION TEST RESULTS

**Table 16.0 System Verification Results 2450MHz HEAD TSL**

| System Verification Test Results | | | | | |
|---|---|---|---|---|---|
| Date | | Frequency (MHz) | Validation Source | | |
| | | | P/N | | S/N |
| 7/5/2024 | | 2450 | D2450V2 | | 825 |
| Fluid Type | Fluid Temp °C | Ambient Temp °C | Ambient Humidity (%) | Forward Power (mW) | Source Spacing (mm) |
| Head | 23.0 | 23 | 39% | 250 | 10 |
| Fluid Parameters | | | | | |
| Permittivity | | | Conductivity | | |
| Measured | Target | Deviation | Measured | Target | Deviation |
| 36.32 | 39.20 | -7.35% | 1.82 | 1.80 | 1.11% |
| Measured SAR | | | | | |
| 1 gram | | | 10 gram | | |
| Measured | Target | Deviation | Measured | Target | Deviation |
| 14.40 | 13.50 | 6.67% | 6.51 | 6.32 | 3.01% |
| Measured SAR Normalized to 1.0W | | | | | |
| 1 gram | | | 10 gram | | |
| Normalized | Target | Deviation | Normalized | Target | Deviation |
| 57.60 | 52.50 | 9.71% | 26.04 | 24.90 | 4.58% |

Prior to the SAR evaluations, system checks were performed on the planar section of the phantom and a SPEAG validation dipole in accordance with the procedures described in IEC/IEEE 62209-1528 and FCC KDB 865664,

The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using a Dielectric Probe Kit and a Network Analyzer.

The forward power was applied to the dipole and the system was verified to a tolerance of +10% from the system manufacturer's dipole calibration target SAR value.

The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.

## 17.0 SYSTEM VALIDATION SUMMARY

**Table 17.0 System Validation Summary**

| Validation Date | Probe Model | Probe S/N | Validation Source | Frequency (MHz) | Validation Results | | |
|---|---|---|---|---|---|---|---|
| | | | | | Linearity | Isotropy | Extrapolation |
| | ✓ = Complete | | | | ✓ = Not Required | | |
| 30-May-24 | EX3DV4 | 7826 | D2450V2 | 2450 | Pass | Pass | Pass |

## 18.0 MEASUREMENT SYSTEM SPECIFICATIONS

**Table 18.0 Measurement System Specifications**

| Measurement System Specification | |
|---|---|
| **Specifications** | |
| **Positioner** | Stäubli Unimation Corp. Robot Model: TX90XL |
| **Repeatability** | +/- 0.035 mm |
| **No. of axis** | 6.0 |
| **Data Acquisition Electronic (DAE) System** | |
| **Cell Controller** | |
| **Processor** | Intel(R) Core(TM) i7-7700 |
| **Clock Speed** | 3.60 GHz |
| **Operating System** | Windows 10 Professional |
| **Data Converter** | |
| **Features** | Signal Amplifier, multiplexer, A/D converter, and control logic |
| **Software** | Measurement Software: DASY6, V 6.4.0.12171 / DASY52 V10.2(1504) |
| | Postprocessing Software: SEMCAD X, V14.6.12(7470) |
| **Connecting Lines** | Optical downlink for data and status info., Optical uplink for commands and clock |
| **DASY Measurement Server** | |
| **Function** | Real-time data evaluation for field measurements and surface detection |
| **Hardware** | Intel ULV Celeron CPU 400 MHz; 128 MB chip disk; 128 MB RAM |
| **Connections** | COM1, COM2, DAE, Robot, Ethernet, Service Interface |
| **E-Field Probe** | |
| **Model** | EX3DV4 |
| **Serial No.** | 7826 |
| **Construction** | Triangular core fiber optic detection system |
| **Frequency** | 10 MHz to 6 GHz |
| **Linearity** | ±0.2 dB (30 MHz to 3 GHz) |
| **Phantom** | |
| **Type** | MFP V5.1C Planar Phantom |
| **Shell Material** | Fiberglass |
| **Thickness** | 2mm +/- .2mm |
| **Volume** | > 8 Liter |

**Table 18.1**

## Measurement System Specification (Continued)

### Probe Specification

| | |
|---|---|
| Construction: | Symmetrical design with triangular core;<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents (e.g. DGBE) |
| Calibration: | ISO/IEC 17025 |
| Frequency: | 4 MHz - 10 GHz; Linearity: ± 0.2 dB (30 MHz - 10 GHz) |
| Directivity: | ± 0.1 dB in TSL (rotation around probe axis)<br>± 0.3 dB in TSL (rotation normal to probe axis) |
| Dynamic Range: | 10 μW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically <1 mW/g) |
| Dimensions: | Overall length: 337 mm; (tip: 20 mm)<br>Tip diameter: 2.5 mm; Tip (body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm |
| Application: | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better than 30% |

**EX3DV4 E-Field Probe**

### Phantom Specification

The ELI V5.0 phantom is an elliptical planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEC\IEEE 62209-1528.

**ELI Phantom**

### Phantom Specification

The SAM V4.0 phantom is a flat planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEC\IEEE 62209-1528.

**SAM Phantom**

### Phantom Specification

The MFP V5.1C phantom is a flat planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEC\IEEE 62209-1528.

**MFP Phantom**

### Device Positioner Specification

The DASY device positioner has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of $65^{O}$. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.

**Device Positioner**

# 19.0 TEST EQUIPMENT LIST

**Table 19.0 Equipment List and Calibration**

| Test Equipment List | | | | |
|---|---|---|---|---|
| **DESCRIPTION** | **ASSET NO.** | **SERIAL NO.** | **DATE CALIBRATED** | **CALIBRATION DUE** |
| Schmid & Partner DASY 6 System | - | - | - | - |
| -DASY Measurement Server | 00158 | 1078 | CNR | CNR |
| -Robot | 00046 | 599396-01 | CNR | CNR |
| -DAE4 | 00019 | 353 | 13-May-24 | 13-May-25 |
| -EX3DV4 E-Field Probe | 00357 | 7826 | 15-May-24 | 15-May-25 |
| -D2450V2 Validation Dipole | 00219 | 825 | 15-May-24 | 15-May-25 |
| ELI Phantom | 00247 | 1234 | CNR | CNR |
| SAM Phantom | 00154 | 1033 | CNR | CNR |
| MFP Phantom | 00355 | 1177/2 | CNR | CNR |
| HP 85070C Dielectric Probe Kit | 00033 | none | CNR | CNR |
| Gigatronics 8652A Power Meter | 00007 | 1835801 | 10-May-22 | 10-May-25 |
| Gigatronics 80701A Power Sensor | 00186 | 1837002 | COU | COU |
| Gigatronics 80334A Power Sensor | 00237 | 1837001 | 10-May-22 | 10-May-25 |
| HP 8753ET Network Analyzer | 00134 | US39170292 | 6-Jan-24 | 6-Jan-27 |
| Rohde & Schwarz SMR20 Signal Generator | 00006 | 100104 | COU | COU |
| Amplifier Research 10W1000C Power Amplifier | 00041 | 27887 | CNR | CNR |
| Amplifier Research 5S1G4 Power Amplifier | 00106 | 26235 | CNR | CNR |
| Narda Directional Coupler 3020A | 00064 | - | CNR | CNR |
| Bipolar Power Supply 6299A | 00086 | 1144A02155 | CNR | CNR |
| DC-18G 10W 30db Attenuator | 00102 | - | COU | COU |
| R&S FSP40 Spectrum Analyzer | 00241 | 100500 | 9-Aug-21 | 9-Aug-24 |
| HP 8566B Spectrum Analyzer | 00051 | 2747A055100 | 6-Jul-24 | 6-Jul-27 |
| RF Cable-SMA | 00311 | - | CNR | CNR |
| HP Calibration Kit | 00145 | - | CNR | CNR |

CNR = Calibration Not Required
SB=Stand By
COU = Calibrate on Use

Note: Per KDB 865664, Dipoles are evaluated annually for return loss and impedance. The dipole's SAR target can only be assessed by the SAR equipment manufacturer and remains the target until the dipole is recalibrated by the manufacturer. The dipole's SAR is evaluated and compared to this target during each and every System Verification which is performed prior to and/or during each DUT SAR evaluation. The results of these verifications are shown in Section 16.0

## 20.0 FLUID COMPOSITION

**Table 20.0 Fluid Composition 2450MHz HEAD TSL**

| Tissue Simulating Liquid (TSL) Composition | | | | 2450MHz Head |
|---|---|---|---|---|
| Component by Percent Weight | | | | |
| Water | Glycol | Salt(1) | HEC(2) | Bacteriacide(3) |
| 52.0 | 48.0 | 0.0 | 0.0 | 0.0 |

(1) Non-Iodinized
(2) **H**ydroxy**E**thyl-**C**ellulose: Sigma-Aldrich P/N 54290-500g
(3) Dow Chemical Dowicil 75 Antimicrobial Perservative

## END OF REPORT

# APPENDIX A – SYSTEM VERIFICATION PLOTS

**DUT: D2450V2 - SN825; Type: D2450V2; Serial: SN825**
**Procedure Name: SPC 2450H_Input=250mw, 1gTarget=[12.15]13.5][14.85]W/kg 10g Target=[5.68][6.32][6.95]_**

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.82 S/m; $\varepsilon_r$ = 36.32; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Date/Time: 7/5/2024 11:12:29 AM

DASY5 Configuration:

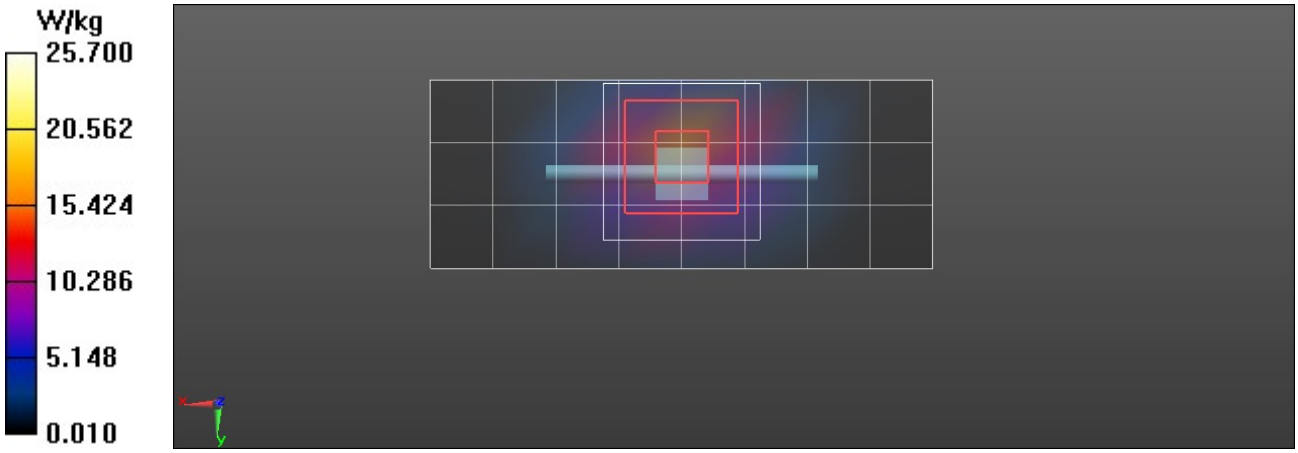
- Probe: EX3DV4 - SN7826; ConvF(7.5, 7.2, 7.38) @ 2450 MHz; Calibrated: 5/15/2024
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 5/13/2024
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

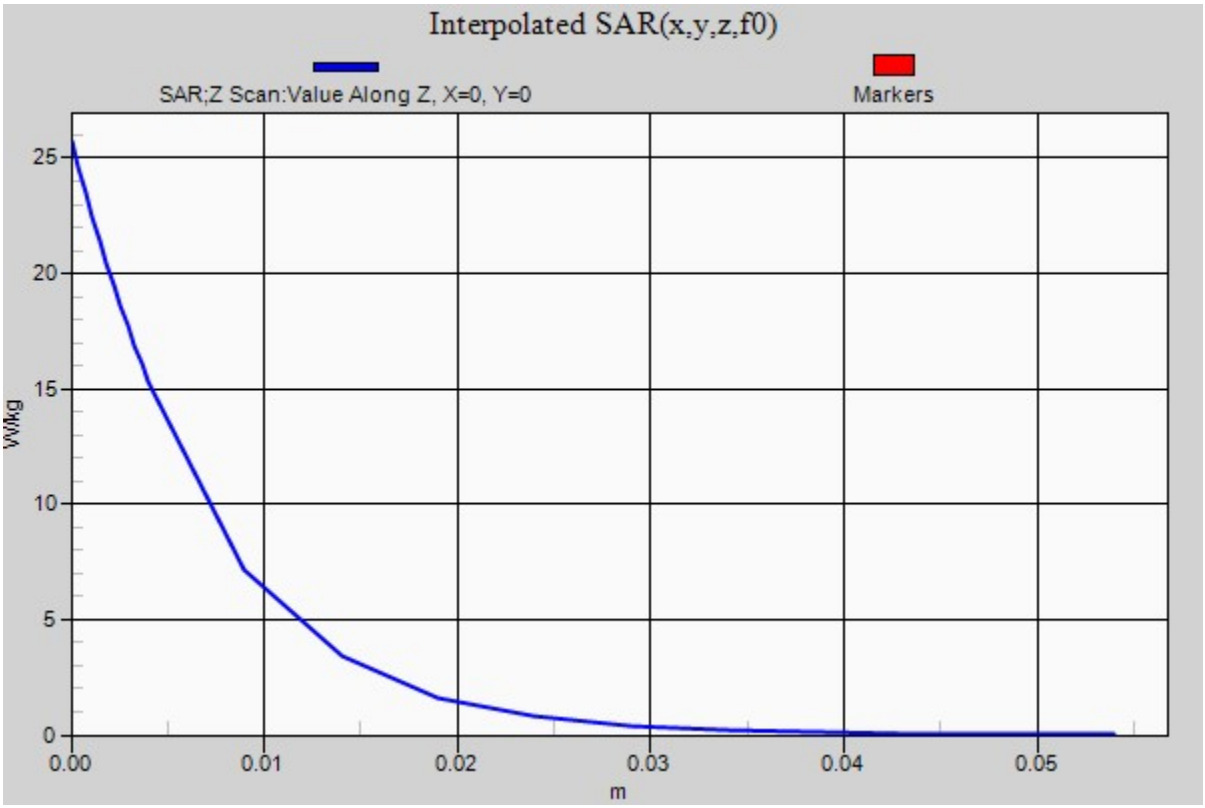
**SPC/SPC 2450H_Input=250mw, 1gTarget=[12.15]13.5][14.85]W/kg 10g Target=[5.68][6.32][6.95]_/Area Scan (9x4x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 15.4 W/kg

**SPC/SPC 2450H_Input=250mw, 1gTarget=[12.15]13.5][14.85]W/kg 10g Target=[5.68][6.32][6.95]_/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.57 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 31.9 W/kg
**SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.51 W/kg**
Smallest distance from peaks to all points 3 dB below = 10.4 mm
Ratio of SAR at M2 to SAR at M1 = 46%
Maximum value of SAR (measured) = 16.4 W/kg

**SPC/SPC 2450H_Input=250mw, 1gTarget=[12.15]13.5][14.85]W/kg 10g Target=[5.68][6.32][6.95]_/Z Scan (1x1x22):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Penetration depth = 6.753 (6.617, 6.804) [mm]
Maximum value of SAR (interpolated) = 25.7 W/kg


W/kg
25.700
20.562
15.424
10.286
5.148
0.010


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
25
20
15
10
5
0
0.00
0.01
0.02
0.03
0.04
0.05
m

# APPENDIX B – MEASUREMENT PLOTS OF MAXIMUM MEASURED SAR

## E6/E6Z

**DUT: A04392; Type: Transmitter; Serial: 8H1000066**
**Procedure Name: E6-A04392, Front 0mm, 2402MHz, BLE-CW**

Communication System: UID 0, CW (0); Frequency: 2402 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2402 MHz; $\sigma$ = 1.742 S/m; $\varepsilon_r$ = 36.13; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Date/Time: 7/6/2024 3:25:22 PM

DASY5 Configuration:

- Probe: EX3DV4 - SN7826; ConvF(7.5, 7.2, 7.38) @ 2402 MHz; Calibrated: 5/15/2024
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 5/13/2024
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1177/2
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**2450H A04392/E6-A04392, Front 0mm, 2402MHz, BLE-CW/Area Scan (7x7x1):** Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 9.20 W/kg

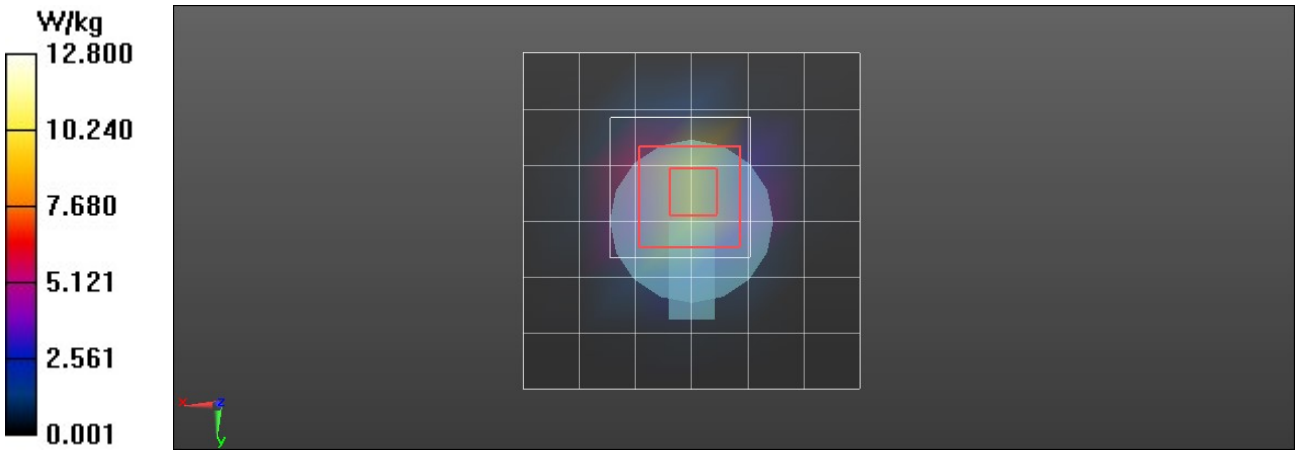
**2450H A04392/E6-A04392, Front 0mm, 2402MHz, BLE-CW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 70.79 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 20.1 W/kg
**SAR(1 g) = 8.63 W/kg; SAR(10 g) = 3.88 W/kg**
Smallest distance from peaks to all points 3 dB below = 10.4 mm
Ratio of SAR at M2 to SAR at M1 = 49.2%

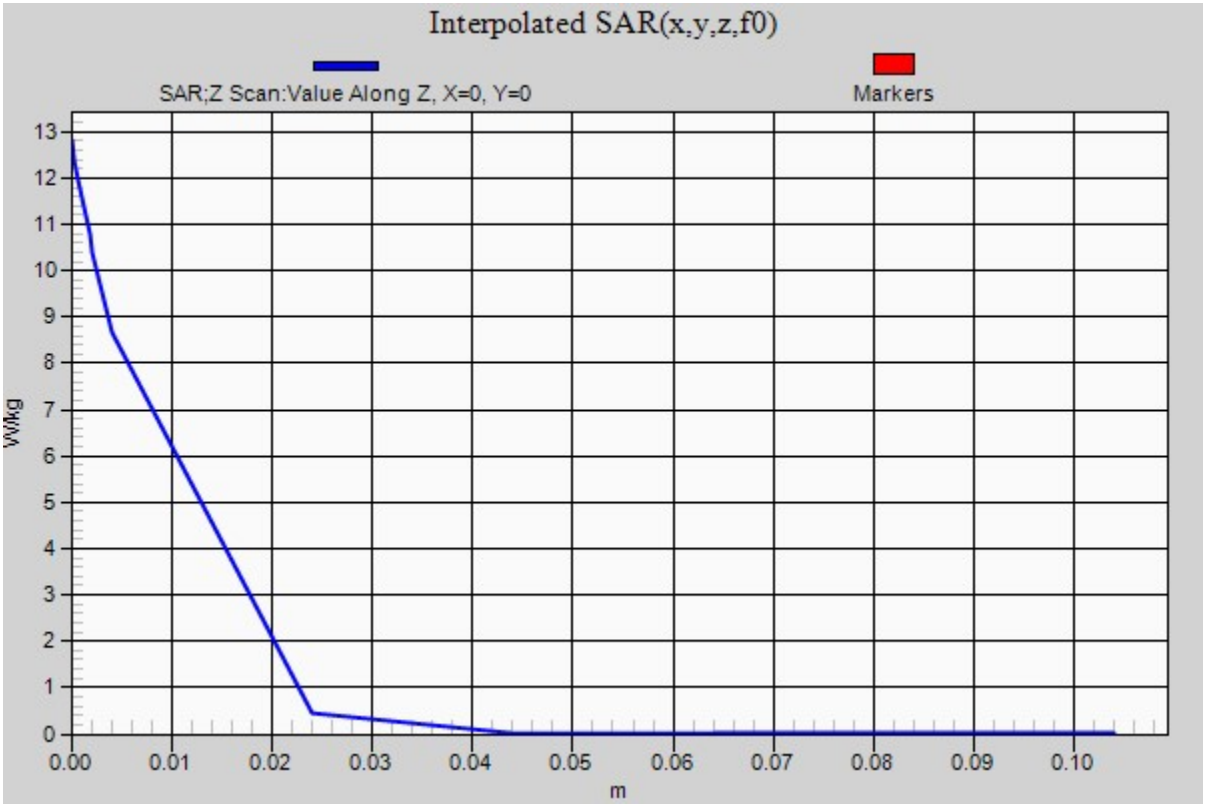
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 9.38 W/kg

**2450H A04392/E6-A04392, Front 0mm, 2402MHz, BLE-CW/Z Scan (1x1x17):** Measurement grid: dx=20mm, dy=20mm, dz=20mm

Info: Interpolated medium parameters used for SAR evaluation.
Penetration depth = n/a (n/a, 6.670) [mm]
Maximum value of SAR (interpolated) = 12.8 W/kg


W/kg
12.800
10.240
7.680
5.121
2.561
0.001


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
m
0
1
2
3
4
5
6
7
8
9
10
11
12
13
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10

## B4/B4Z

**DUT: A04392; Type: Transmitter; Serial: 8H1000066**
**Procedure Name: B4-A04392, Front 5mm, 2402MHz, BLE-CW**

Communication System: UID 0, CW (0); Frequency: 2480 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2480 MHz; $\sigma$ = 1.84 S/m; $\varepsilon_r$ = 36.05; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Date/Time: 7/6/2024 3:41:30 PM

DASY5 Configuration:

- Probe: EX3DV4 - SN7826; ConvF(7.5, 7.2, 7.38) @ 2480 MHz; Calibrated: 5/15/2024
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 5/13/2024
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1177/2
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**2450H A04392/B4-A04392, Front 5mm, 2402MHz, BLE-CW/Area Scan (7x7x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 6.33 W/kg

**2450H A04392/B4-A04392, Front 5mm, 2402MHz, BLE-CW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.22 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 14.4 W/kg
**SAR(1 g) = 6.54 W/kg; SAR(10 g) = 3.05 W/kg**
Smallest distance from peaks to all points 3 dB below = 10.8 mm
Ratio of SAR at M2 to SAR at M1 = 44.8%
Maximum value of SAR (measured) = 7.38 W/kg

**2450H A04392/B4-A04392, Front 5mm, 2402MHz, BLE-CW/Z Scan (1x1x17):** Measurement grid: dx=20mm, dy=20mm, dz=20mm
Penetration depth = n/a (n/a, 7.144) [mm]
Maximum value of SAR (interpolated) = 8.84 W/kg