

Penumbra Inc.

RF Exposure Exhibit

SCOPE OF WORK

EMC TESTING – Real Immersive System; Model: XAVIER 1/XAVIER 2; Part Number: 18284 (WSM, Wireless Sensor Module)

REPORT NUMBER

105041185MPK-009

ISSUE DATE

June 10, 2022

REVISED DATE

April 3, 2023

PAGES

9

DOCUMENT CONTROL NUMBER

Non-Specific Radio Report Shell Rev. December 2017 MPK
© 2017 INTERTEK



RF Exposure Exhibit (portable devices)

Report Number: 105041185MPK-009

Project Number: G105041185

Report Issue Date: June 10, 2022

Report Revision Date: April 3, 2023

Product Designation: Real Immersive System Module

Model Tested: XAVIER 1/XAVIER 2

Part Number: 18284 (WSM, Wireless Sensor Module)

FCC ID: 2AQU7-REAL02S

IC: 24199-REAL02S

to

**47CFR 2.1093
RSS-102 Issue 5**

for

Penumbra Inc.

Tested by:

Intertek
1365 Adams Court
Menlo Park, CA 94025 USA

Client:

Penumbra Inc.
One Penumbra Place
Alameda, CA 94502 USA

Report prepared by:



Aaron Chang / Project Engineer

Report reviewed by:



Minh Ly / EMC Team Lead

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

| Report No. 105041185MPK-009 | |
|------------------------------------|---|
| Equipment Under Test: | Real Immersive System |
| Trade Name: | Penumbra Inc. |
| Model(s) Tested: | XAVIER 1/XAVIER 2 |
| Applicant: | Penumbra Inc. |
| Contact: | Puneet Goyal |
| Address: | Penumbra Inc.. One Penumbra Place Alameda, CA 94502 USA |
| Country: | USA |
| Tel. Number: | 510-440-5598 |
| Email: | pgoyal@penumbrainc.com |
| Applicable Regulation: | 47CFR 2.1093 RSS-102 Issue 5 |

TABLE OF CONTENTS

Penumbra Inc. 1

1.0 RF Exposure Summary.....5

2.0 RF Exposure Limits5

3.0 Test Results (Mobile Configuration).....6

4.0 Document History9

1.0 RF Exposure Summary

| Test | Reference FCC | Reference Industry Canada | Result |
|---|---------------|---------------------------|----------|
| Radio frequency Radiation Exposure Evaluation | 47 CFR§2.1093 | RSS-102 Issue 5 | Complies |

2.0 RF Exposure Limits

2.1 FCC Limits

According to FCC KDB 447498 D01 v06 section 4.3.1, SAR evaluation is not required if below is met:

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \cdot \sqrt{f(\text{GHz})} \right] \leq 3.0 \text{ for 1-g SAR, and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following

- 1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz
- 2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion:

- 1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]
- 2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½
- 3) SAR measurement procedures are not established below 100 MHz

2.2 Industry Canada Limits

According to RSS-102 sec. 2.5.1, at frequency 2479MHz and separation distance of ≤ 5 mm SAR Exemption limit is ≤ 3.94 mW.

3.0 Test Results (Portable Configuration)

3.1 Classification

For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

3.2 EIRP calculations

The Real Immersive System, Model: Xavier 1/Xavier 2 consist of one 2.4GHz radio.

3.3 Maximum RF Power

| Frequency Range (MHz) | RF Output (dBm) | Antenna Gain ¹ (dBi) | Note |
|-----------------------|-------------------|---------------------------------|---|
| 2402-2479 | 7.77dBm or 5.98mW | 1.3 | Conducted power measurements were taken from Report # 105041185MPK-005. |

¹As declared by the manufacturer.

3.4 RF Exposure Calculation

3.4.1 RF Exposure calculation for 2.4GHz radio, Real Immersive System, Model: Xavier 1/Xavier 2:

Duty Cycle calculation based on Operational Description provided by the manufacturer:

There are 244 Frames transmitted per second: $1/244 = 4096 \text{ usec} \Rightarrow$ Each TDMA frame (F) length is 4096 usec
 Each packet sent is composed of 71 bits + payload length.
 (71 bits: 8bit preamble + 40bit address + 7bit length + 16bit CRC)
 Payload length (PNO + IMU mode 2) = 34 bytes
 Total payload length: $34 \times 8 + 71 = 343 \text{ bits}$
 Total payload sent at 1Mbps: $343 / 1000000 = 343 \text{ usec}$
 Duty cycle: $343 / 4096 = 8.37\%$

3.4.2 RF Exposure calculation FCC

Calculations for this report are based on highest power measured.

| Power input to antenna | Source-based Duty Cycle | Numerical Gain | Corrected input power into antenna | EIRP | Frequency |
|------------------------|-------------------------|----------------|------------------------------------|---------|-------------|
| 5.98 mW | 8.37% (0.0837) | 1.35 | 0.5 mW | 0.68 mW | 2402 - 2479 |

Corrected Input Power = Power input * Duty Cycle

EIRP = Corrected Input Power * Antenna Gain

Max Peak Conducted Power measured = 1.0 mW (rounded from 0.5 mW to nearest mW)

Min. test separation distance taken from document "REAL Immersive System Separation Distance REAL02S.pdf"

Per FCC KDB 447498 D01 v06 section 4.3.1 a):

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR

Or

$[1 \text{ mW} / 22\text{mm}] \cdot [\sqrt{2.479\text{GHz}}] = 0.1$

Results: SAR evaluation is not required because at 2.479GHz, the source-based, time averaged output power and the minimum test separation distance calculation is ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR.

3.4.3 RF Exposure calculation ISED

Calculations for this report are based on highest power measured.

| Power input to antenna | Source-based Duty Cycle | Numerical Gain | Corrected input power into antenna | EIRP | Frequency |
|------------------------|-------------------------|----------------|------------------------------------|---------|-------------|
| 5.98 mW | 8.37% (0.0837) | 1.35 | 0.5 mW | 0.68 mW | 2402 - 2479 |

Corrected Input Power = Power input*Duty Cycle

EIRP = Corrected Input Power*Antenna Gain

RF Exposure calculation for FCC KDB 447498 D01 v06

According to RSS-102 sec. 2.5.1, at frequency 2479 MHz and separation distance of ≤ 5 mm SAR Exemption limit is ≤ 3.94 mW.

Max EIRP measured = 0.68 mW

Results: SAR evaluation is not required since the higher of the maximum conducted or equivalent isotropically radiated power (EIRP) source-based, time averaged output power is below the exemption limit.

Note: Antenna gains below 0 are considered as 0dBi

4.0 Document History

| Revision/ Job Number | Writer Initials | Reviewers Initials | Date | Change |
|---------------------------------|----------------------------|-------------------------------|----------------|-------------------------------------|
| 1.0 / G105041185 | AC | ML | June 10, 2022 | Original document |
| 2.0 / G105041185 | AC | ML | April 03, 2023 | Updated FCC limits and calculations |