

RF Exposure Lab

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CERTIFICATE OF COMPLIANCE SAR EVALUATION

Penumbra, Inc.
One Penumbra Place
Alameda, CA 94502

Dates of Test: December 29, 2020
Test Report Number: R&D.20201203
Revision A

FCC ID:	2AQU7-REAL02
IC Certificate:	24199-REAL02
Model(s) Number:	Xavier1 & Xavier2
Model(s) Name:	HMD, All-In-One Head Mounted Display
Test Sample:	Engineering Unit Same as Production
Serial No.:	N/A
Equipment Type:	Wireless VR Headset
Classification:	Portable Transmitter
TX Frequency Range:	2412 – 2462 MHz; 2402 – 2480 MHz; 5180 – 5320 MHz; 5500 – 5700 MHz; 5745 – 5825 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	2450 MHz (b) – 19.0 dBm, 2450 MHz (g) – 19.0 dBm, 2450 MHz (n20) – 17.5 dBm, 2450 MHz (n40) – 12.5 dBm, 2450 MHz (ac/ax) – 17.5 dBm, 5250 MHz (a) – 18.5 dBm, 5250 MHz (n20) – 18.5 dBm, 5250 MHz (n40) – 18.5 dBm, 5250 MHz (ac/ax) – 18.5 dBm, 5600 MHz (a) – 18.5 dBm, 5600 MHz (n20) – 18.5 dBm, 5600 MHz (n40) – 18.5 dBm, 5600 MHz (ac/ax) – 18.5 dBm, 5800 MHz (a) – 18.5 dBm, 5800 MHz (n20) – 18.5 dBm, 5800 MHz (n40) – 18.5 dBm, 5800 MHz (ac/ax) – 18.5 dBm, Bluetooth (Internal to VR Headset) – 7.5 dBm, Proprietary Transmitter (Added to VR Headset) – 10.0 dBm Conducted
Signal Modulation:	DSSS, OFDM, GFSK, 8DPSK, $\pi/4$ DPSK
Antenna Type:	Internal
Application Type:	Certification
FCC Rule Parts:	Part 2, 15C, 15E
KDB Methodology:	KDB 447498 D01 v06
Industry Canada:	RSS-102 Issue 5, Safety Code 6
Maximum SAR Value:	0.42 W/kg (From VR Original Report) 1 gram Average
Maximum SAR Value:	0.51 W/kg (From VR Original Report) 10 gram Average
Maximum Simultaneous SAR:	1.02 W/kg 1 gram Average (Head)
Maximum Simultaneous SAR:	0.75 W/kg 10 gram Average (Extremity)
Separation Distance:	0 mm

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2013 and IEC 62209-2:2010 (See test report).

I attest to the accuracy of the data. All measurements were performed by myself or 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.

RF Exposure Lab, LLC certifies that no party to this application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).



Jay M. Moulton
Vice President



Testing Cert. # 2387.01

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Table of Contents

1.	Introduction	4
2.	Evaluation of Additional Bluetooth Transmitters	4
2.1	Specifications of Additional Bluetooth Transmitters	4
2.2	SAR Values Extracted from Original SAR Report for VR Headset	5
2.3	SAR Test Exclusion Evaluation for Additional Bluetooth Transmitters	5
2.4	Estimated SAR Value for Additional Bluetooth Transmitters	6
2.5	Simultaneous Evaluation with Additional Bluetooth Transmitters	7
3.	Photos of Device	8

Comment/Revision	Date
Original Release	December 29, 2020
Revision A – Correct transmitter name to proprietary, headset on page 1 and frequency of proprietary transmitter to 2479 MHz.	December 30, 2020

1. Introduction

This measurement report shows compliance of the Penumbra, Inc. Model Number Xavier 1 & Xavier 2 Model Name HMD, All-In-One Head Mounted Display FCC ID: 2AQU7-REAL02 with FCC Part 2.1093, ET Docket 93-62 Rules for mobile and portable devices and IC Certificate: 24199-REAL02 with RSS-102 Issue 5 & Safety Code 6. The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices.

The device is a wireless virtual reality headset with the addition of two(2) Proprietary transmitters. The headset by itself is a pre-approved device manufactured by HTC Corporation model number 2Q9R100. The FCC ID for the headset is NM82Q9R100 and the ISED certificate number is 4115A-2Q9R100. The data was extracted from the report dated September 10, 2020 report number FA073116-02.

This analysis report takes the original SAR data from the FCC filing under FCC ID NM82Q9R100 and ISED certificate number 4115A-2Q9R100. Using this data, this report shows the compliance of adding the two(2) proprietary transmitters to the headset. The simultaneous evaluation is calculated and shown to comply within this report.

The two models are identical electrically. The only difference is the Xavier 2 has an extended piece of plastic in the front of the device as shown in the photos in section 3 of this report.

2. Evaluation of Additional Proprietary Transmitters

2.1 Specifications of Additional Proprietary Transmitters

The additional Proprietary transmitters operate in the frequency range of 2402 – 2479 MHz. The maximum tolerance transmit power of each Proprietary transmitter is 10.0 dBm.

2.2 SAR Values Extracted from Original SAR Report for VR Headset

The following table indicated the maximum SAR values for the VR Headset for each transmitter located within the headset. The table also shows the maximum simultaneous evaluated SAR values for the filed VR headset report.

Band	Configuration	SAR Value
2450 MHz	Head	0.13 W/kg
2450 MHz	Extremity	0.46 W/kg
5 GHz	Head	0.42 W/kg
5 GHz	Extremity	0.51 W/kg
Internal Bluetooth	Head	0.24 W/kg
Internal Bluetooth	Extremity	0.10 W/kg
Simultaneous	Head	0.66 W/kg
Simultaneous	Extremity	0.61 W/kg

2.3 SAR Test Exclusion Evaluation for Additional Proprietary Transmitters

The two(2) additional Proprietary transmitters are excluded from SAR testing per KDB447498 D01 v06 section 4.3.1 a) on page 12 and RSS-102 Issue 5 section 2.5.1 Table 1 on page 4. The maximum transmit power of the additional Proprietary transmitters is 10 dBm which equates to 10 mW of power.

Per KDB 447498 D01 v06, the following equation is used to determine SAR test exclusion.

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

- $f_{(\text{GHz})}$ 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

Using the calculation in KDB 447498 D01 v06 section 4.3.1 a) on page 12, the following evaluation shows the additional Proprietary transmitters are excluded from SAR testing.

Max. power of channel, including tune-up tolerance = 10 mW

Min. test separation distance = 12 mm

$F_{(\text{GHz})} = 2.48 \text{ GHz}$

$[10 \text{ mW} / 12 \text{ mm}] * \sqrt{2.48} = 1.31 \text{ rounded to } 1.3$

Therefore, the Proprietary transmitters are each excluded from SAR testing since 1.3 is less than 3.0 for Head and 7.5 for extremity.

Per RSS-102 Issue 5 section 2.5.1 Table 1 on page 4, the separation distance of 12 mm at 2450 MHz yields an exclusion of any transmitter which is 10.2 mW or less in maximum transmit power. Since the additional Proprietary transmitters are a maximum of 10 mW transmit power, the additional Proprietary transmitters are excluded from SAR testing per RSS-102 Issue 5 section 2.5.1 Table 1 on page 4.

2.4 Estimated SAR Value for Additional Proprietary Transmitters

When an antenna qualifies for the standalone SAR test exclusion of KDB 447498 D01 v06 section 4.3.1 a) on page 12 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to KDB 447498 D01 v06 section 4.3.2 b) 1). The following is the formula used to estimate the standalone SAR value.

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f_{(\text{GHz})}}/x] \text{ W/kg, for test separation distances } \leq 50 \text{ mm, where } x = 7.5 \text{ for 1-g SAR and } x = 18.75 \text{ for 10-g SAR.}$$

Max. power of channel, including tune-up tolerance = 10 mW

Min. test separation distance = 12 mm

$F_{(\text{GHz})} = 2.48 \text{ GHz}$

$[10 \text{ mW} / 12 \text{ mm}] * [\sqrt{2.48}/7.5] = 0.175 \text{ W/kg rounded to } 0.18 \text{ W/kg for 1-g SAR}$

$[10 \text{ mW} / 12 \text{ mm}] * [\sqrt{2.48}/18.75] = 0.0699 \text{ W/kg rounded to } 0.07 \text{ W/kg for 10-g SAR}$

2.5 Simultaneous Evaluation with Additional Proprietary Transmitters

Per KDB 447498 D01 v06 section 4.3.2 on page 13, simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

For the two(2) additional Proprietary transmitters being added, the sum of the two(2) transmitters estimated SAR value is used to determine simultaneous SAR test exclusion. The estimated SAR value for each Proprietary transmitter is 0.18 W/kg for the 1-g SAR value and 0.07 W/kg for the 10-g SAR value. Therefore, for the two(2) transmitters summed up the maximum simultaneous SAR value would be 0.36 W/kg for 1-g SAR and 0.14 W/kg for 10-g.

For the Head SAR configuration, the highest simultaneous SAR value is 0.66 W/kg from the table listed above on page 3 of this report. Using the summed estimated SAR for the two(2) additional Proprietary transmitters, the total SAR value for simultaneous transmission SAR test exclusion is 1.02 W/kg. Since this value is less than the limit of 1.6 W/kg, the Head SAR configuration is excluded from simultaneous SAR testing.

For the Extremity SAR configuration, the highest simultaneous SAR value is 0.61 W/kg from the table listed above on page 3 of this report. Using the summed estimated SAR for the two(2) additional Proprietary transmitters, the total SAR value for simultaneous transmission SAR test exclusion is 0.75 W/kg. Since this value is less than the limit of 4.0 W/kg, the Extremity SAR configuration is excluded from simultaneous SAR testing.

3. Photos of Device



Xavier 1 Front of Device



Xavier 1 Back of Device



Xavier 1 Top of Device



Xavier 1 Bottom of Device



Xavier 1 Right Side of Device



Xavier 1 Left Side of Device



Xavier 2 Front of Device



Xavier 2 Back of Device



Xavier 2 Top of Device



Xavier 2 Bottom of Device



Xavier 2 Right Side of Device



Xavier 2 Left Side of Device