RF Exposure Analysis
Revision 2

FCC ID	**2APZQ- ZYGO2H**
IC ID	**23961- ZYGO2H**
Description:	**Zygo Underwater Communication Radio**
Model Name:	**Zygo2H**
Model Number:	**ZY700 (regular), ZY701 (large)**

Swimmersive Co.
2447 Pacific Coast Highway, 2nd Fl.
Hermosa Beach, CA 90254

By

TEM Consulting, LP
140 River Rd.
Georgetown, TX 78628

September 2024

TYPE CERTIFICATION

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Introduction

This memo evaluates the Zygo system headset for RF exposure testing exclusion to the FCC USA and ISED Canada Requirements.

Product Description

The Swimmersive Zygo is a communication system for swimmers and swimming coaches. The Zygo system has 2 components. A transmitter to stream music to swimmers or for a coach to talk to his swimmers, called the Zygo Transmitter. A headset, worn by the swimmers, called the Zygo Headset.

It's primary use is to stream music to swimmers as they work out. It also allows a coach to give instructions to swimmers as they work out. When coach's use the unit to give instructions the unit operates push-to-talk (PTT) and the Bluetooth link is not active. In this mode the unit is handheld.

The Zygo transmitter operates in the 174-216 MHz VHF band and 2.4 GHz ISM bands.

The Zygo headset operates in the 174-216 MHz.

The unit is battery powered.

Zygo Radios

The Zygo system headset has a low frequency transmitter, that operates in the 174-216 MHz band.

The measured powers were:

Frequency (MHz)	Power (dBm)
175.0	**15.736**
194.5	**15.314**
209.5	**14.565**

The highest measured power was with the low frequency radio channel. The low channel is at 175.0 MHz with a measured power of 37.46 mW (15.736 dBm).

The low frequency radio has a duty cycle of transmission for 3.4 mS followed by a 1.0 mS off time. This calculates to a duty cycle of 5.3 dB.

FCC Requirements

FCC KDB 447498 D01 V06 section 4.3 gives SAR test exclusion guidance:

> **4.3. General SAR test exclusion guidance**
> 4.3.1. Standalone SAR test exclusion considerations
>
> ....
>
> 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:
>
> [(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,[30] where
>
> - $f_{(GHz)}$ is the RF channel transmit frequency in GHz

- Power and distance are rounded to the nearest mW and mm before calculation[31]
- 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 (also illustrated in Appendix B):

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

The formula can be used to calculate the maximum allowable power. The power of interest is the source-based time-averaged maximum conducted output power of the RF channel.

The formula for the maximum allowable power, based on the guidance of section 4.3 in the KDB, is:

$$P = T \cdot D/\sqrt{f}$$

- P is the source-based time-averaged maximum conducted output power in W
- T is the numeric thresholds of 3.0 and 7.5
- D is the minimum separation distance in m
- f is the RF channel transmit frequency in GHz

For the highest frequency used, 216 MHz:

- for a numeric threshold of 3.0 the maximum power is 32.3 mW
- for a numeric threshold of 7.5 the maximum power is 80.7 mW

ISED Canada Requirements

Canadian regulation for RF exposure are contained in Spectrum Management and **Telecommunications Radio Standards Specification RSS-102 Issue 5, March 2015, Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)**. Section 2.5.1, Exemption Limits for Routine Evaluation – SAR Evaluation, provides the following exclusion limits:

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

The values listed are for a 1 gram tissue value. If a device is worn on a limb and subject to the 10 gram value the values in the table are multiplied by 2.5:

> For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

Hence for the headset the limit is 71 mW.

Product Analysis

VHF Radio

The low frequency radio has a 5.3 dB duty cycle

It meets both the FCC and ISED test exclusion criterion.

Conclusion

This analysis concludes that the radio in the Zygo2H headset is below the test exemption threshold and does not require SAR testing.