

RF Exposure Analysis

Revision 4

FCC ID 2APZQ-ZYGO2T
IC ID 23961-ZYGO2T
Description: Zygo Underwater Communication Radio Transmitter
Model Name: Zygo2
Model Number: ZY600

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TYPE CERTIFICATION

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Introduction

This memo evaluates the Zygo2T, Zygo Underwater Communication Radio Transmitter, for RF exposure testing exclusion to the FCC USA and ISED Canada Requirements.

Product Description

The Swimmersive Zygo2 is a communication system for swimmers and swimming coaches. The Zygo2 system has 2 components. A transmitter to stream music to swimmers or for a coach to talk to his swimmers, called the Zygo Underwater Communication Radio Transmitter (Zygo transmitter or transmitter). A headset, worn by the swimmers, called the Zygo Underwater Communication Radio 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.

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

The unit is battery powered.

Zygo Radios

The Zygo transmitter has two radios, a Bluetooth radio, operating in the 2.4 GHz ISM band, and the VHF transmitter to the headset, that operates in the 174-216 MHz band.

For the Bluetooth radio the measured powers were:

| Frequency (MHz) | Power (dBm) |
|-----------------|-------------|
| 2402 | 6.41 |
| 2441 | 6.21 |
| 2480 | 6.46 |

The Bluetooth channel with the highest measured power is the high channel at 2480 MHz with a measured power of 4.43 mW (6.46 dBm).

The low frequency transmitter measured powers were:

| Frequency (MHz) | Power (dBm) |
|-----------------|-------------|
| 175.0 | 18.861 |
| 194.5 | 11.328 |
| 209.5 | 10.785 |

The low frequency radio channel with the highest measured power is its low channel at 175.0 MHz with a measured power of 76.93 mW (18.861 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:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{\text{(GHz)}}}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where

- $f_{\text{(GHz)}}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation³¹
- 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) $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot (f_{\text{(MHz)}}/150)]\}$ mW, for 100 MHz to 1500 MHz
 - 2) $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot 10]\}$ 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 mW
- 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

For the highest frequency used, 2.48 GHz:

- for a numeric threshold of 3.0 the maximum power is 9.6 mW
- for a numeric threshold of 7.5 the maximum power is 23.8 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:

Product Analysis

Bluetooth Radio

The Bluetooth maximum power was measured at 4.43 mW (6.46 dBm).

This power is well below the limit of 9.6 mW.

VHF Radio

The low frequency radio channel with the highest measured power is its low channel at 175.0 MHz with a measured power of 76.93 mW (18.861 dBm). The low frequency radio has a 5.3 dB duty cycle. The device is hand held or resting on a flat surface.

It meets both the FCC and ISED test exclusion criterion.

Simultaneous Transmission

Simultaneous transmission of both radios is dominated by the larger power of the low frequency radio and remains under the test exemption threshold.

Conclusion

This analysis concludes that both radios in the Zygo2 transmitter are below the test exemption threshold and do not require SAR testing.