

# Vesper Cortex

## RF Exposure Evaluation

FCC: YJD-VESPM1, YJD-VESPH1  
IC: 9118A-M1, 9118A-H1

| Version | Date       | Comment                        | Author |
|---------|------------|--------------------------------|--------|
| 1       | 01/06/2020 | First Release                  | CBO    |
| 2       | 09/06/2020 | ISED update                    | CBO    |
| 3       | 17/06/2020 | Include FCC and IC identifiers | CBO    |

## Introduction

This document evaluates the Vesper Marine Cortex System against the international requirements for RF exposure to the general public.



Cortex V1 System with Cortex M1 (left) and H1 Handset (right)

## Overview

The RF Exposure for the M1 and H1 have been treated independently. Since the handset is designed to be held in the hand and operated close to the face (~25cm) SAR testing was performed on the H1. An RF exposure assessment for the general public in the US, Canada and Europe was performed for the M1.

## Cortex Hub M1

FCC: YJD-VESPM1

IC: 9118A-M1

### VHF Limits

The Cortex VHF, DSC and AIS System must operate in Europe under the reference levels as outlined by the Council Recommendation 1999/519/EC and in the US under the FCC limits which can be summarized as follows:

Table 1 – International VHF Exposure Limits

| Region   | Frequency Range (MHz) | E-Field Strength (V/m) | H-Field Strength (A/m) |
|----------|-----------------------|------------------------|------------------------|
| Europe   | 30 – 300              | 28                     | 0.07                   |
| FCC / IC | 30 – 300              | 27.5                   | 0.07                   |

Furthermore EN 50385 stipulates that if the average power emitted by the system is less than 20mW, the system is deemed to comply with the standard without testing, since one could argue that the average time the device spends transmitting is very small relative to typical system up times.

### VHF Exposure Evaluation

The compliance boundary was examined. The compliance boundary can be determined from the following with the results shown in Table 2 below,

$$D = \sqrt{30 \times G \times P} / E$$

where,

D = distance from the antenna (m)

G = numerical antenna gain

P = power at the antenna (W)

E = E-Field strength (V / m)

The assumptions are as follows,

- The far field model applies
- The antenna gain is typically 3dBi
- The antenna length is typically equal to half a wavelength
- Nominal operating frequency of 162MHz

Table 2 – Evaluation Results for 25W VHF operation

|                               |           |
|-------------------------------|-----------|
| Radiating Far Field boundary* | 0.962 m   |
| E-Field at Far Field boundary | 40.31 V/m |
| H-Field at Far Field boundary | 0.11 A/m  |
| EU / IC Compliance Boundary   | 1.39 m    |
| US Compliance Boundary        | 1.41 m    |

*\* The boundary between the Near and Far Fields for which at distances greater than this the Far Field model can be applied*

A maximum permissible exposure (MPE) radius of **2m** is practical for system installation and will ensure the limits are never breached.

## UHF Limits and Exposure Evaluation

In accordance with the test reports covering EN 300 328 and FCC 15.247 compliance the maximum summed output power of the 802.11b/g/n transmitter is 17dBm. Exposure at a typical operating distance **0.5m** is well below the limits for both FCC, IC and EU as can be seen in Table 4 below.

Table 3 – WiFi Exposure Limits

| Region | Frequency Range (MHz) | Power Density (mW/cm <sup>2</sup> ) |
|--------|-----------------------|-------------------------------------|
| FCC    | 1500 – 100000         | 1                                   |
| EU     | 2000 - 300000         | 1                                   |
| IC     | 300 - 6000            | 0.5                                 |

Table 4 – WiFi Evaluation Results\*

|                               |                          |
|-------------------------------|--------------------------|
| Radiating Far Field boundary  | 0.06 m                   |
| E-Field at Far Field boundary | 26.81 V/m                |
| Power Density at boundary     | 0.191 mW/cm <sup>2</sup> |
| Power Density at 0.5m         | 0.003 mW/cm <sup>2</sup> |

\*Results were calculated using the same equations as specified in VHF Exposure evaluation with the following differences:

- Average Antenna gain of 2.5dBi used
- Nominal operating frequency 2462MHz

For cellular uplinks the maximum transmitter is 23dBm. Exposure at a typical operating distance of **0.5m** is well below the limits for both FCC, IC and EU as can be seen in Table 4 below on two commonly used global bands.

Table 5 – LTE / 3G Exposure Limits

| Region | Frequency Range (MHz) | Power Density (mW/cm <sup>2</sup> ) |
|--------|-----------------------|-------------------------------------|
| FCC    | 400 - 1500            | f / 300                             |
|        | 1500 – 100000         | 5                                   |
| EU     | 400 - 1500            | f / 200                             |
|        | 1500 - 2000           | f / 200                             |
|        | 2000 - 300000         | 10                                  |
| IC     | 300 - 6000            | 0.5                                 |

Table 4 – LTE/3G Evaluation Results\*

|                               | B2 (1900)                | B5 (850)                 |
|-------------------------------|--------------------------|--------------------------|
| Radiating Far Field boundary  | 0.08 m                   | 0.179 m                  |
| E-Field at Far Field boundary | 40.78 V/m                | 18.23 V/m                |
| Power Density at boundary     | 0.441 mW/cm <sup>2</sup> | 0.088 mW/cm <sup>2</sup> |
| Power Density at 0.5m         | 0.011 mW/cm <sup>2</sup> | 0.011 mW/cm <sup>2</sup> |

\*Results were calculated using the same equations as specified in VHF Exposure evaluation with the following differences:

- Average Antenna gain of 2.5dBi used
- Nominal operating frequency B2 1880MHz, B5 837MHz

## Cortex Handset (H1 / H1P)

FCC: YJD-VESPH1

IC: 9118A-H1

Since the handset is designed to be held in the hand and operated close to the face (~25cm front of face) SAR testing was performed.

### SAR Testing Summary

| Report Name         | Test Standards                        | Description                             |
|---------------------|---------------------------------------|-----------------------------------------|
| 75943820-03 Issue 1 | FCC 47 CFR 2.1093,<br>RSS 102 Issue 5 | Specific Absorption Rate on H1 Handsets |
| 75943820-06 Issue 1 | IEC 62209-2                           | Specific Absorption Rate on H1 Handsets |

The highest SAR value recorded was 0.01 W/kg (1 g) when tested for use Front of Face (25mm) and 0.07 W/kg (10 g) for Extremities (0mm).

## Conclusion

The Cortex system complies with the international standards for general public exposure to electromagnetic fields.