

## **RF Exposure Analysis – Minimum Separation Distance for the VEGAPULS 6X, Level Probing Radar and Tank Level Probing Radar**

### **FCC ID: O6QPS6XW**

The level probing radar operates in the 76GHz to 84GHz band.

### **The following FCC Rule Parts are applicable:**

Part 2.1091 - Radiofrequency radiation exposure evaluation: Mobile devices

Part 1.1307(b)(3)(i)(C) - SAR test exemption (ii)

### **VEGAPULS 6x Maximum Transmit Power Consideration:**

The VEGAPULS 6X has a further three different antenna types:

Horn Antenna

Horn Antenna for high temperatures

PVDF Thread with integrated Horn Antenna

Each antenna has a maximum gain.

For the horn antenna, the maximum conducted output power is set to -0.2dBm (including tune-up tolerance).

For the horn antenna for high temperatures and for the PVDF thread with integrated horn antenna, the maximum conducted output power is set to +3.0dBm (including tune-up tolerance).

### Horn Antenna

Antenna Gain: +33.0dBi

$EIRP = -0.2\text{dBm} + 33.0\text{dBi} = +32.8\text{dBm}$

$ERP = EIRP - 2.15\text{dBm} = 30.65\text{ dBm} (1.16\text{ W})$

### Horn Antenna for high temperatures

Antenna Gain: +28.8dBi

$EIRP = +3.0\text{dBm} + 28.8\text{dBi} = +31.8\text{dBm}$

$ERP = EIRP - 2.15\text{dBm} = 29.65\text{ dBm} (0.923\text{ W})$

PVDF Thread with integrated Horn Antenna

Antenna Gain: +24.9dBi

EIRP = +3.0dBm + 24.9dBi = +27.9dBm

ERP = EIRP - 2.15dBm = 25.75 dBm (0.376 W)

Evaluation

From Part 2.1093(c)(1). RF exemption applies if the maximum transmitted power is less than the maximum of the following criteria:

- i) Less than 1 mW Blanket exemption.  $P_{TH} = 0.001 \text{ W}$   
(VEGAPULS 6X is not compliant)
- ii) Determination of exemption under the MPE-based §1.1307(b)(3)(i)(C),

Determination of threshold power ( $P_{TH}$ ) under the MPE-based §1.1307(b)(3)(i)(C) exemption.

This is only applicable at a separation distance greater than  $\lambda/2\pi$

For the VEGAPULS 6X

80GHz operation  $\Rightarrow \lambda/2\pi = 0.0006\text{m}$  (0.06cm)

The VEGAPULS 6X will need to have a separation distance greater than 0.06cm for this clause to be applicable for demonstrating exemption in accordance with §1.1307(b)(3)(i)(C)

To demonstrate this, the applicable equation in Table 1 of §1.1307(b)(3)(i)(C) will need to be re-arranged for the minimum separation distance (R).

$$\text{Threshold ERP (watts) } P_{TH(1,500 - 100,000\text{MHz})} = 19.2 * R^2$$

$$R^2 = \text{Threshold ERP (watts) } P_{TH} / 19.2$$

$$R = (\text{Threshold ERP (watts) } P_{TH} / 19.2)^{1/2}$$

## Calculations

### Horn Antenna

$$P_{TH} = 1.16 \text{ W}$$

$$R = (1.16 / 19.2)^{1/2}$$

$$R = 0.246\text{m} \text{ (24.6cm)}$$

### Horn Antenna for high temperatures

$$P_{TH} = 0.923 \text{ W}$$

$$R = (0.923 / 19.2)^{1/2}$$

$$R = 0.219\text{m} \text{ (21.9cm)}$$

### PVDF Thread with integrated Horn Antenna

$$P_{TH} = 0.376 \text{ W}$$

$$R = (0.376 / 19.2)^{1/2}$$

$$R = 0.140\text{m} \text{ (14.0cm)}$$

## Conclusion:

The VEGAPULS 6X will be exempt from routine environmental (RF exposure) evaluation providing the VEGAPULS 6X is installed with a separation distance of 25cm to comply with FCC rule part §1.1307(b)(3)(i)(C):

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