RF Exposure Evaluation Report

1. Product Information

Manufacturer	Furuno Electric Co., Ltd.
	9-52 Ashihara-cho, Nishinomiya city, Hyogo, 662-8580 Japan
Trade name	Furuno
Type	RTR-112A
Model	Transceiver for RADAR SENSOR DRS6A X-Class
Product Description	Marine Radar operating in the band of 9300-9500 MHz
FCC ID	ADB9ZWRTR112A
Frequency Range	9380MHz ~ 9440MHz
Peak Envelope Power (PEP)	6kW
Antenna Gain (G_p)	XN10A : 27.5dBi / XN12A : 28.0dBi / XN13A : 29.5dBi
Beam Width (θ)	XN10A : 2.3° / XN12A : 1.9° / XN13A : 1.35°
Maximum Pulse Width (τ)	1.2μs
Pulse Repetition Frequency (PRF)	600Hz
Minimum separation distance	XN10A : 2.45m / XN12A : 2.2m / XN13A : 1.75m

2. Evaluation method and Limit

FCC requirements

According to FCC CFR 47 part1 1.1307 (b)(3)(i)(C): The criteria listed in the following table shall be used to determine the exemption of further evaluation.

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1{,}920\,R^2$.
1.34-30	$3{,}450\,R^2/f^2$.
30-300	$3.83\,R^2$.
300-1,500	$0.0128\,R^2 f$.
1,500-100,000	$19.2 R^2$.

R is the separation distance and is XN10A : 2.45m / XN12A : 2.2m / XN13A : 1.75m instructed in the installation manual.

Threshold ERP* is

$$\mathrm{ERP_{TH}}(XN10A) = 19.2 \times 2.45^2 = 115.25 \ [W]$$

$$\mathrm{ERP_{TH}}(XN12A) = 19.2 \times 2.2^2 = 92.93 \ [W]$$

$$\mathrm{ERP_{TH}}(XN13A) = 19.2 \times 1.75^2 = 58.8 \ [W]$$

* ERP: refer to FCC CFR 47 part1 1.1307 (b)(2)

3. Evaluation Results

Calculated ERP

$$\text{ERP} = \text{PEP} \times 10\text{^}\left(\frac{G_p - 2.15}{10}\right) \times (\tau \times \text{PRF}) \times \frac{\theta}{360}$$

$$\text{ERP(XN10A)} = 6000 \times 10\text{^}\left(\frac{27.5 - 2.15}{10}\right) \times (1.2 \times 10^{-6} \times 600) \times \frac{2.3}{360} = 9.46 \ [\text{W}] \leq 115.25 \ [\text{W}]$$

$$\text{ERP(XN12A)} = 6000 \times 10\text{^}\left(\frac{28.0 - 2.15}{10}\right) \times (1.2 \times 10^{-6} \times 600) \times \frac{1.9}{360} = 8.77 \ [\text{W}] \leq 92.93 \ [\text{W}]$$

$$\text{ERP(XN13A)} = 6000 \times 10\text{^}\left(\frac{29.5 - 2.15}{10}\right) \times (1.2 \times 10^{-6} \times 600) \times \frac{1.35}{360} = 8.80 \ [\text{W}] \leq 58.8 \ [\text{W}]$$

where:

PEP is converted to the mean power using the pulse width and the pulse repetition frequency.

G_p is converted to a gain relative to a dipole.

The antenna rotates continuously over 360 degrees in the horizontal plane and illuminates the subjects only by its main lobe. Therefore, time-averaged power is derated by the beamwidth and the angle of rotation..
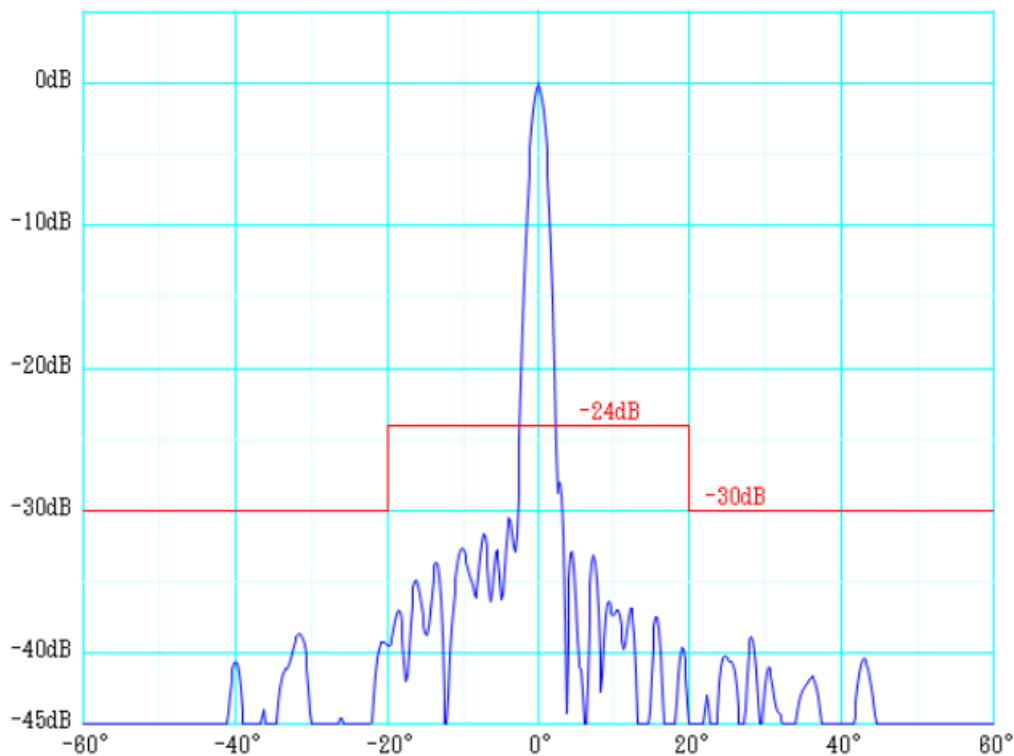
Annex.1

RTR-112A radiation pattern (normalized)

Main beam width XN10A : 2.3° / XN12A : 1.9° / XN13A : 1.35° / (Horizontal polarization)
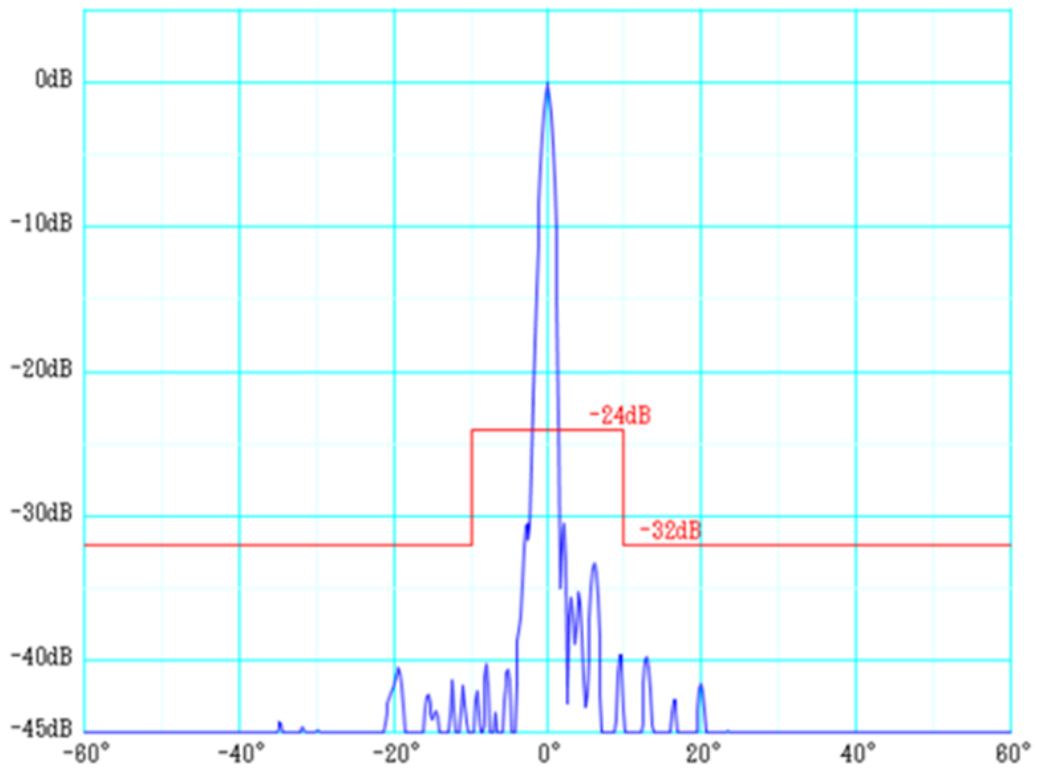
Any other radiation is 20dB, almost 30dB, below than mainlobe
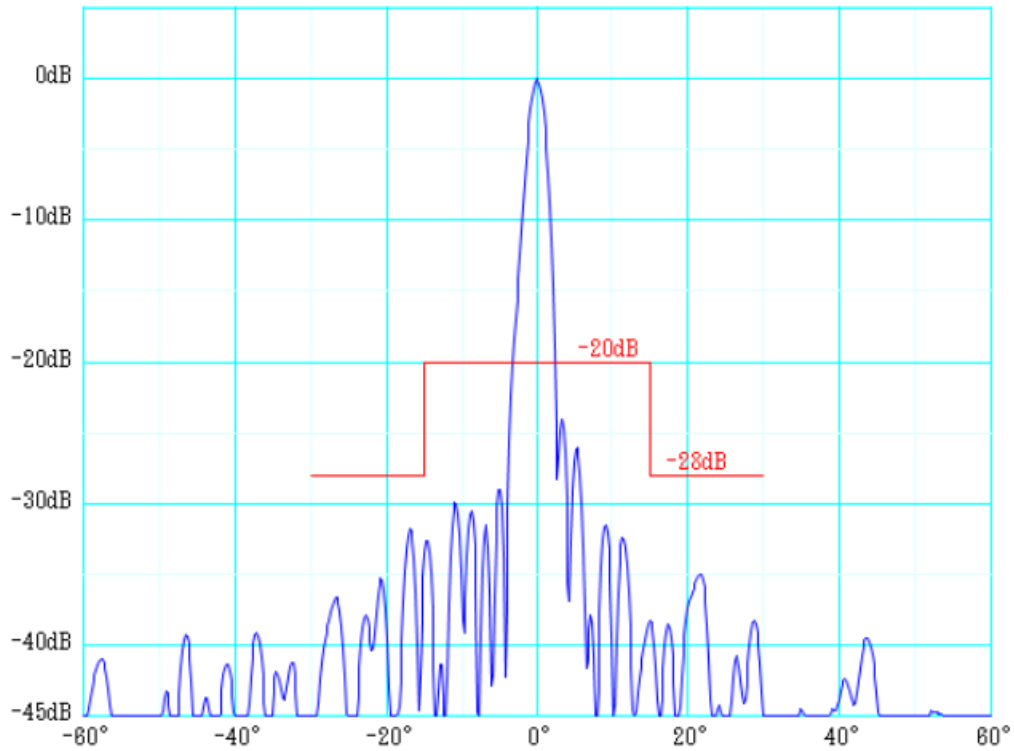
XN10A radiation pattern

XN12A radiation pattern

XN13A radiation pattern