1. RF Exposure Requirements

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

With the signal booster not being delivered with a standard antenna the assessment will be based on the maximum output power of the signal booster and the power density limits for the operating frequency. Thereby the maximum antenna gain can be derived and will be the determine factor for the RF safety compliance of the signal booster.

1.1. Limits

The limits for the exposure calculations are used from FCC OET65 Appendix A, Table 1

Table 1 Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength E (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5.0	6

Table 2 Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength E (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	842/f	2.19/f	($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1	30

f = frequency in MHz * Plane-wave equivalent power density

1.2. Equations

The equation used to predict the maximum antenna gain allowed in the system is from FCC OET65 equation 3.

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to antenna (in appropriate units e.g. mW)
G = power gain of the antenna in the direction of interest to an isotropic antenna
R = distance to the center of radiation of the antenna (appropriate units e.g. cm)

The maximum antenna gain is the unit of interest and by re-arranging the equation the following is obtained:

$$G = \frac{4 \cdot \pi \cdot R^2 \cdot S}{P}$$

With the gain in the above equation being expressed as a numeric gain it will be more common to show the gain as dBi, hence the below equation for converting the gain into dBi

$$G_{dBi} = 10 \cdot Log\left(\frac{4 \cdot \pi \cdot R^2 \cdot S}{P}\right)$$

2. Assessment of BRTS33-US-Lx

The signal booster range from Semco Maritime, BRTS33-US-Lx, covers the 450-460MHz range. Below are the details for the assessment of the system.

- Frequency 455MHz
- Output power: 17dBm
- Power Density Limit: $\mathrm{S} = 455/1500 \approx 0.3\mathrm{mW/cm^2}$
- Distance: 20cm

$$G_{dBi} = 10 \cdot \mathrm{Log}\left(\frac{4 \cdot \pi \cdot 20^2 \cdot 0.3}{10^{17/10}}\right) = 14.78dBi$$

From the above it is safe to use an antenna with an isotropic gain of 14dBi or less. The above does not include any cable or connector losses that will add to the safety of the system.