Compliance Notes for the FCC Guidelines for Human Exposure to Radio-Frequency Electromagnetic Fields

The following demonstrates that FCC ID 0270000-30-30 qualifies for certification under the FCC guidelines for human exposure to RF fields. This evaluation is demonstrated based on OET Bulletin 65, Edition 97-01, hereafter referred as "the Bulletin".

To qualify under Part 15.255, the peak power density of an RF device must be less than 18 μW/cm^2 at 3 meters and the average power density must be less than 9 μW/cm^2 at 3 meters.

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

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

The Equivalent Isotropic Radiation Power (EIRP) is evaluated as 20.35 W for peak and 10.17 W for temporal average power density, based on the equation (3) provided by the Bulletin.

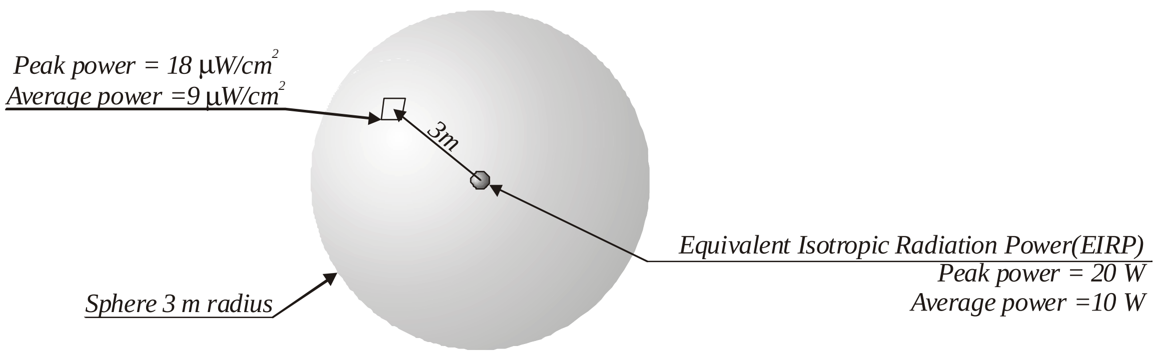

Figure 1. Part 15.255 Device

Maximum Permissible Exposure (MPE) levels of Part 15 device are set for occupational / controlled exposure is 5 mW/cm^2 over a six-minute average. and general public / uncontrolled exposure is 1 mW/cm^2 over a 30-minute average. When the radiation source is at 3 meters or further away from exposed subject, it is evident that safety limit is met since the PART15.255 limits power density at 3 meters to 18 μW/cm^2. Let us consider the worse-case scenario, with a point-like RF source, the power density increases as the subject approaches to the source as a square function of distance and eventually becomes the infinite. Even under this condition, the MPE are always met farther than 28.4 cm from the radiation source.

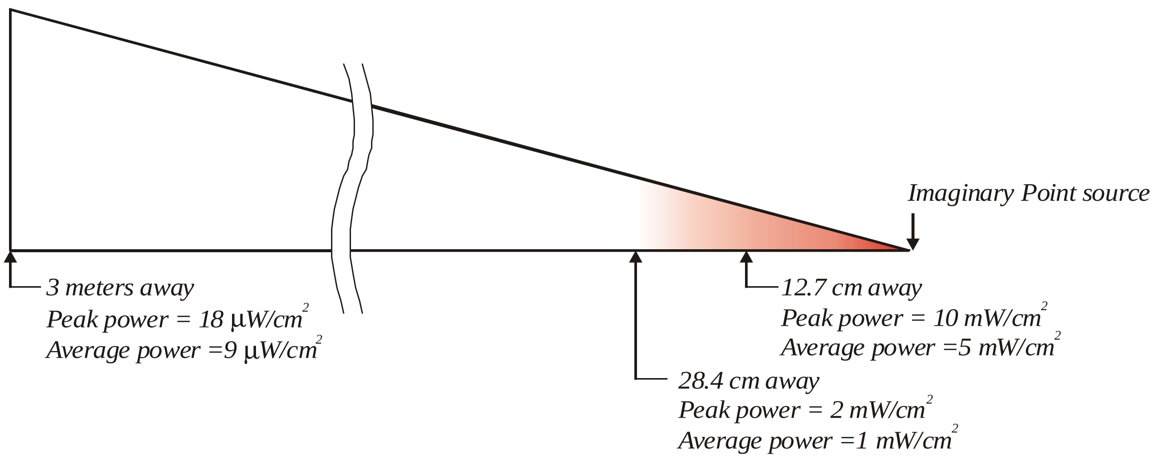

Figure 2. Estimated Maximum Permissible Exposure for Part 15.255 Device

<u>Therefore the safety question arises only within 28.4 cm from the source.</u>

The approximation method for the power density of the antennae surface is specified as Equation (11) of the Bulletin.

$$S_{surface} = \frac{4P}{A}$$

where: S *surface* = maximum power density at the antenna surface
P = power fed to the antenna
A = physical area of the aperture antenna

The equipment under the test has antennae with apertures that are 105 cm^2 (for a 3.1" x 5.3" patch array), and are 804 cm^2 (for ϕ13" Cassegrain).

Radio	Type	Aperture (A)	Gain (*G*)	Near Field	Efficiency (η)	Antennae Injection Power (*P*)
#1	Patch Array	105 cm^2	29 dBi	90 cm	0.28	15 dBm Peak (30mW max.) 11 dBm Average (12mW max.)
#2	Cassegrain	804 cm^2	43 dBi	545 cm	0.49	10 dBm Peak (10 mW max.) 6 dBm Average (4 mW max.)

Table 1. The Specification of the Antenna and Power as the worst case.

Radio #1: The power density of the antenna surface = 1.1 mW/cm^2 (peak)
and 0.45 mW/cm^2 (Average)

Radio #2: The power density of the antenna surface = 0.049 mW/cm^2 (peak)
and 0.020 mW/cm^2 (Average)

Therefore, the surface of the antenna meets the requirement. Furthermore, the equipment under test has antennas that are covered and sealed with a plastic (ABS) radome at least 1.25 *cm* away from the surface of the antennae and it is not accessible.

The near field is defined as the Fresnel region provided by the Equation (12) of the Bulletin.

$$R_{nf} = \frac{D^2}{4\lambda}$$

where: R_{nf} = extent of near-field
D = maximum dimensions of antenna (diameter if circular)
λ = wavelength

The region of the question (less than 28 cm) falls into the defined near field based on the Bulletin.

The method for estimating the power density in the near field of antennae is specified as Equation (13) of the bulletin.

$$S_{nf} = \frac{16\eta P}{\pi D^2}$$

where: S_{nf} = maximum near-field power density
η = aperture efficiency, typically 0.5-0.75
P = power fed to the antenna
D = antenna diameter

For rectangular aperture, instead of $\pi D^2/4$, aperture area (A) is used.

Radio #1: The power density at the near field	=	0.32 mW/cm^2 (peak)
	and	0.13 mW/cm^2 (average)
Radio #2: The Power density at the near field	=	0.024 mW/cm^2 (peak)
	and	0.096 mW/cm^2 (average)

Therefore, as long as the device has a radome, and the distribution point of the radiation is covered and is inaccessible to the general public, the device clearly meets MPE requirements.