Power Spectral Density Analysis Mars Outpost Experiment

Altitude = 525 km
Power = 2 Watts
Gain = 6 dBi
So, EIRP = 9 dBW, = 8 Watts
Bandwidth = 16 MHz
Frequency = 8045 MHz

Maximum Power Spectral Density
Considering the total power of the transmitting signal to be approximately uniformly distributed over the operating bandwidth of 16 MHz, this results in a Power Spectral Density (PSD) calculated as:

$$PSD = \frac{EIRP}{BW} = \frac{9\ W}{16 * 10^6\ Hz} = 5.6 * 10^{-7}\ W/Hz$$

The calculated PSD at the spacecraft is $5.6*10^{-7}$ W/Hz **or -62.5 dBW/Hz.**

Atmospheric Attenuation / Propagation Pathloss to Earth Surface
The transmitted signal will be further attenuated by propagation pathloss from the CubeSat orbiting in low Earth orbit at 525 km, to Earth surface The minimum value of the corresponding pathloss for 8045 MHz with a wavelength of 0.036 m, through the atmosphere to the nadir point if the centerline of the antenna is pointed to nadir, is **159 dB.**

PSD at Earth Surface
So allowing for attenuation, the in band PSD at the nadir point on Earth Surface will be no greater than -63 – 159 = **-222 dBW/Hz.**

PSD at GEO Orbit
The closest path to GEO (altitude 35,786 km) will be in the unlikely case that the spacecraft becomes flipped and the antenna center beam points at zenith rather than Earth surface, while at the same time the spacecraft is crossing the equatorial plane. The path loss attenuation from propagation for distance will be over a minimum of (35,786 – 525) km, or 35,261 km. This provides a path loss of 195 db.

So the in band PSD at the closest GEO point will be no greater than -63 – 195 = **-258 dBW/Hz.**

This is the maximum value under extreme conditions, and is expected to be below a level that can interfere at that range.