**Interference and Electromagnetic Compatibility Study**
**Rev. 14 September 2018**

**Introduction:**

The Orbital Reflector Satellite is a visually observed and tracked satellite that is also flying a small experimental Simplex Radio Transceiver at 922MHz. The Radio can be interrogated from a similar ground station. It can respond with some scientific data and also act as a backup for the on-board payload deployment timer. The Spacecraft will not transmit without proper, coded, interrogation from the temporary ground station. The initial orbit is planned on 575 km and When atmospheric decay lowers the orbit, the radio will not be used. Radio experiments are planned to include vehicle temperature, battery state of charge, and ground station received power.

**Location Usage:**

Since the System only responds to properly coded sequester, and those requests will only come when the spacecraft is over ITU Region 2. This means that the operations will be in the ITU Region 2s Amateur and ICM 33cm band.

**Earth Surface Power Flux Density**

The maximum antenna input power is supply limited to 0.5 Watts (-3dBW). With a peak antenna gain of +3dB and a minimal orbital range (zenith) of 575km, this produces a maximum earth surface power of -121.4 dBW (-126 dBW/m^2). With a GFSK bandwidth of 10 kHz, our density is -161dBW/Hz only slightly (3dB) higher than the -164 dBW thermal background radiation. Alternately, the total power radiated by the satellite over its own bandwidth has a field intensity at the Earth's surface of 0.025 uV/m^2.

**GSM and LTE Systems Interference in 902-928MHz Band.**

The protection criteria of Interference / (Thermal) Noise for GSM and LTE services is -6 dB and for GSM-R, -9 dB. These have receive center frequencies or 880-915 MHz (base station) and 925-950MHz (mobile) with bandwidths of 200 kHz (GSM/GSM-R) and 5MHz (LTE). Orbital Reflector satellite with a 922MHz center frequency, 10 kHz bandwidth, and 100dB of attenuation at +/- 100khz has no discernible overlap with these services whatsoever. The I/N is therefor much,much less than -9dB.

**Other spacecraft:**

The Space Network List Online (https://www.itu.int/snl/freqtab_snl.html) provides a list of licensed satellites operating in orbit. Searching the lists for the frequency range of 900-950MHZ we find No geostationary nor ground stations listed. The Non-Geo satellites listed were:

PROMETHIUS-B1 (915.0MHz, BW 26 MHz type ET)
AEROCUBE (914.7MHz, BW 1.25MHz )
AEROCUBE-8CD AEROCUBE-11 AEROCUBE-12 (Same)

There is no possible interference to/from the Aerocube satellites since their frequencies are never coincident with ours. The Promethius-B1 satellite uses a software defined radio and may use any portion or all of the 905-928 33cm band for experimental voice, video, and digital communications demonstrations. It is nominally supposed to use a direct sequence spread spectrum link with a bandwidth of the entire band (23MHz BW = 11.5MHz chipping rate). As a spread spectrum system any interference we could conceivably put into it will be attenuated by the direct sequence process gain (10khz/26MHz = -34dB) plus a reasonable range (at least 575km or -121 dB) which would limit our detectable power to something below -155 dBW. The puts our interference power at more than 30dB below the Noise background (I/N -30dB). The Promethius Satellite also has downward pointed antenna gain which we do not have specifications for, which will further limit our interference. While we can not guarantee that this is not detectable, the Promethius satellite does need to meet the same expectations of an experimental radio system and reject any

interference we could conceivably supply.

**ITU Radio Regulations:**

APPENDIX 2 Table of Transmitter Frequency Tolerances has the Transmitter tolerance in 470MHz to 2454MHz band for space stations is 20 parts in 10^6 ( 1 in 2x10^5 ). Our frequency is digitally derived from a 30MHz crystal oscillator with capacitive tuning. This is better than 1 part in 10^6, easily exceeding this requirement.

APPENDIX 3 Spurious transmission levels for the range of 30MHz to 1GHz the spurious transmissions shall be narrower than 100kHz. Our necessary bandwidth, out of band domain and spurious domain are combined less than this width. Our 60dB attenuation bandwidth is only 80kHz, meeting the 60dB requirement in 100khz.

**Conclusion:**

The ORSat (ORBITAL REFLECTOR) satellite will pose no interference when it is requested to operate its radio transmitter.