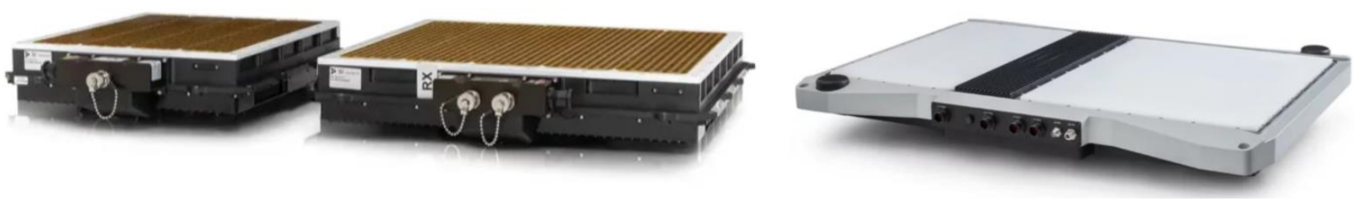

Radiation Hazard Assessments TX (RHATX)

GetSAT SlingBlade LEO Tx Antenna assembly

Document # SlingBlade_RHATX-040326 Version 1.2

04/03/26

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1. ABSTRACT

This document is a summary of calculations determining the radiation exposure at varying elevation angles of the SlingBlade LW / LM Getsat Transmit Antenna PN SBKU-LW/LM-TX-V2 for the purpose of documenting the minimum safe distance from the Tx Antenna at which the occupational power density of 5 mW/cm2, and the general public power density of 1 mW/cm2, is expected under worst case conditions. Power density safe exposure thresholds and time limits are determined using Health Canada (HC) and Federal Communications Commission (FCC) guidelines.

1.1 REVISION HISTORY

Table 1: Revision history

Release	Date	Author	Description
Ver 1.0	July 2nd, 2025	Oleg Roitberg	Version 1.0
Ver 1.1	March 4th, 2026	Oleg Roitberg	Version 1.1 Rolling LEO Power density

1.1 APPROVALS

Table 2: Approvals

Approved by	Date	Name	Signature
CTO	July 2nd, 2025	Oleg Roitberg	
CTO	March 4th, 2026	Oleg Roitberg	

2. General

2.1 Scope

This document covers the radiation hazard analysis for the SlingBlade LW/LM Getsat Transmit Antenna PN SBKU-LW/LM-TX-V2, where 'V2' refers to antenna version.

The maximum power levels of the TX panel adopted to the maximum allowed for OneWeb network. Maximum EIRP analyzed in this document 33.6dBW.

Any PN numbered configuration as defined in Table 3.

Part Number	Description
SBKU-LW/LM-TX-V1	SlingBlade LW/LM KU Tx Antenna ver 1
SBKU-LW/LM-TX-V2	SlingBlade LW/LM KU Tx Antenna ver 2
SBKU-LW/LM-TX-V3	SlingBlade LW/LM KU Tx Antenna ver 3

Table 3: Tx antenna Configurations

3. Reference Documents

Documents in Table 4 form a part of this document to the extent specified herein.

Document Number	Title
Health Canada, Safety Code 6, 2015	Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 2 kHz to 300 GHz
FCC OET Bulletin 65, Edition 97-01, August 1997	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
ICNIRP Guidelines– 1998	ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (Up to 300 GHz), 1998

Table 4: Tx antenna Configurations

4. Maximum Permissible Exposure Limits

Maximum Permissible Exposure (MPE) is defined in terms of power density (S), electric field strength (E) and magnetic field strength (H) where these quantities are related by equation (1).

$$S = EH = E_2/3770 = 37.7H_2$$

Table 3.0-1 lists time exposure limits and power density limits defined in FCC OET Bulletin 65, Health Canada Safety Code 6 and ICNIRP Guidelines

FCC Guidelines		
Category	**Time Limit (min)**	**Power Density Limit (mW/cm2)**
Occupational/Controlled Environment	6	5
General Population/Uncontrolled Environment	30	1
HC Guidelines		
Category	**Time Limit (min)**	**Power Density Limit (mW/cm2)**
Occupational/Controlled Environment	2.6	5
General Population/Uncontrolled Environment	2.6	1
ICNIRP Guidelines		
Category	**Time Limit (min)**	**Power Density Limit (mW/cm2)**
Occupational/Controlled Environment	N/A	5
General Population/Uncontrolled Environment	N/A	1

Table 5: Maximum Permissible Exposure Limits

Occupational exposure limits are considered for maintenance crew, any crew member standing on top of the aircraft fuselage, adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions or for any other controlled situation. General population exposure limits are considered for individuals of all ages and of varying health status, all bystanders beneath the aircraft, bystanders in the aircraft terminal, members of the public unaware of their exposure to EMF who cannot reasonably take precautions to minimize or avoid exposure or for any other uncontrolled situation.

5. Analysis

5.1 Scope

The On-Axis Power density analysis employs a high-fidelity Fresnel zone model and assumes a 100% duty cycle. The Fresnel zone is the 3D elliptical region between the transmit antenna and the receive antenna, Figure 1, where R is the distance from the Tx Antenna along the LOS.

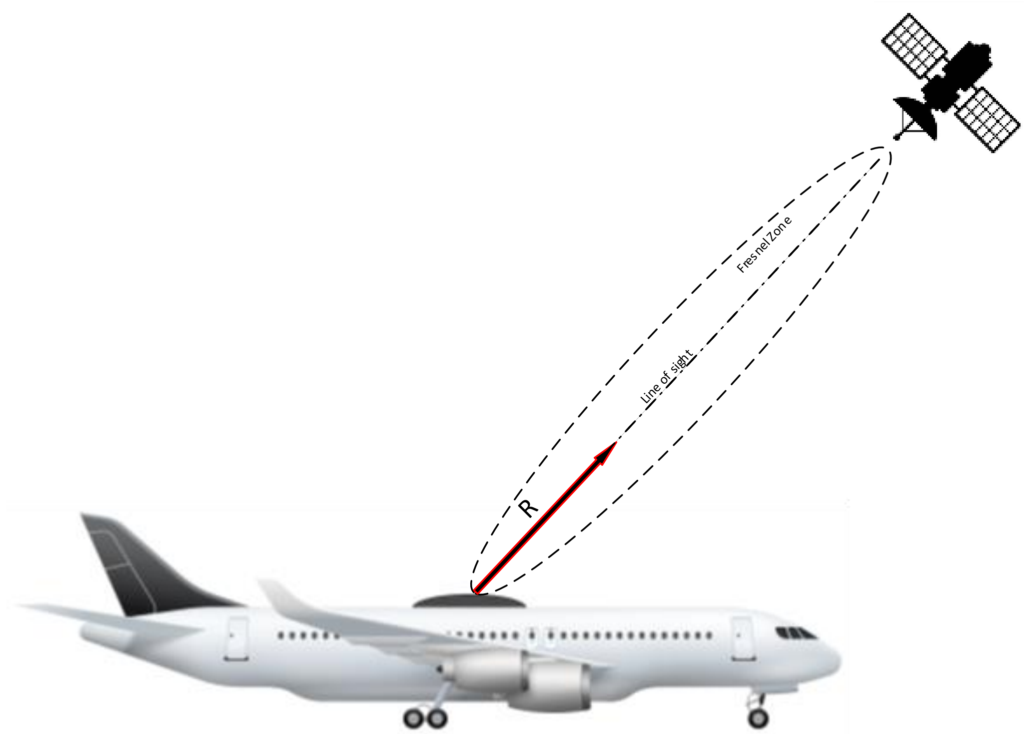

Figure 1: Fresnel Zone, Reference Only

The parameters in Table 4.1-1 are used to calculate power-density for an elevation range of 0°-90°.

Parameter	Value	Unit
Azimuth Beamwidth	2.8	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	33.6	dbW

Table 6: Parameters for Power-Density Calculations

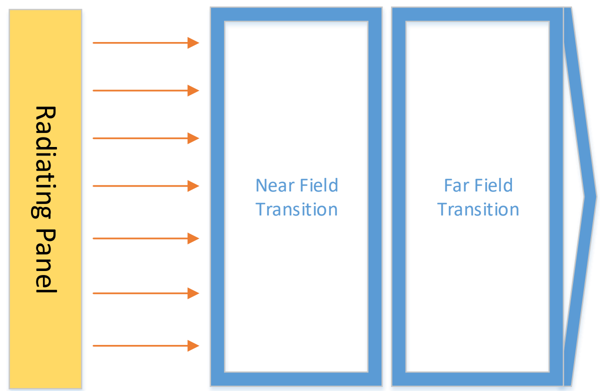

Figure 2: Analyzed zones

Next figures representing the maximum power density vs distance at various elevation angle.

Elevation is calculated for 90°,75°,60°,45°,30°,15° and 0° scenarios with PSAT max power transition.

5.2 ON AXIS ELEVATION 90° @ EIRP OF 33.6 DBW

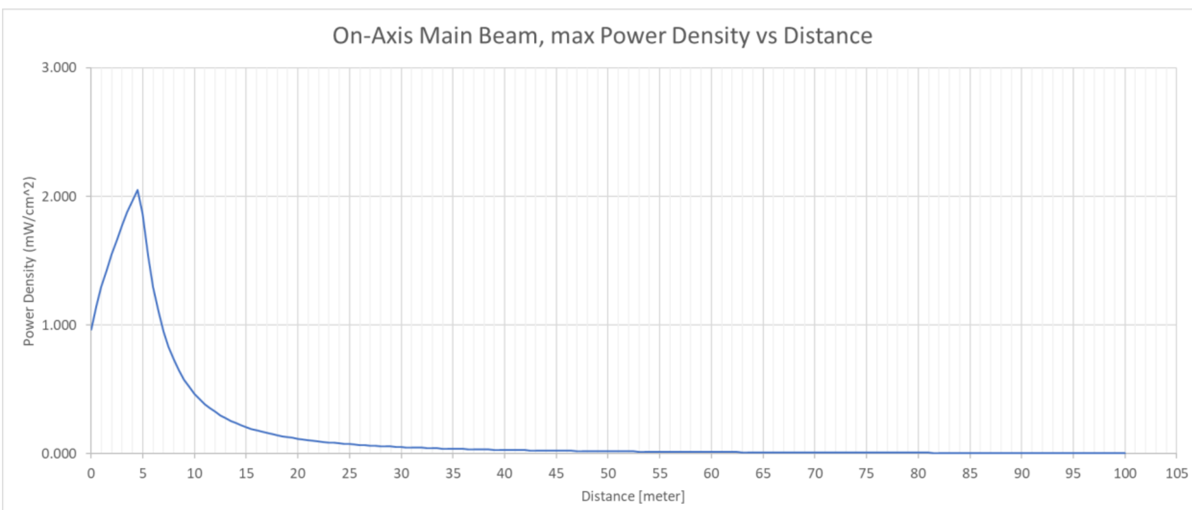

Figure 3: Power Density vs Distance at 90° Elevation

5.3 ON AXIS ELEVATION 75° @ EIRP OF 33.0 DBW

Analyzed data:

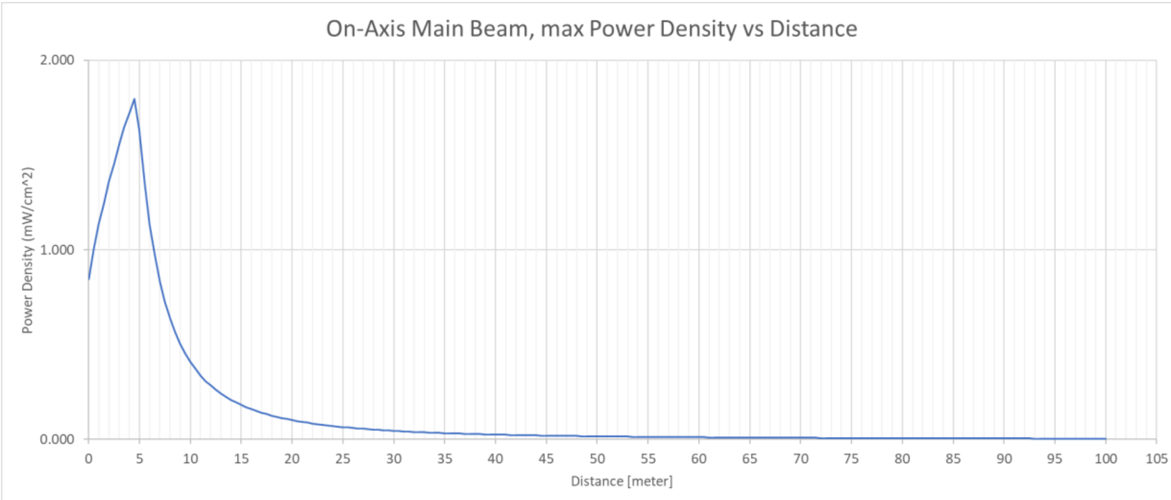

Figure 4: Power Density vs Distance at 75° Elevation

5.4 ON AXIS ELEVATION 60° @ EIRP OF 32.4 DBW

Analyzed data:

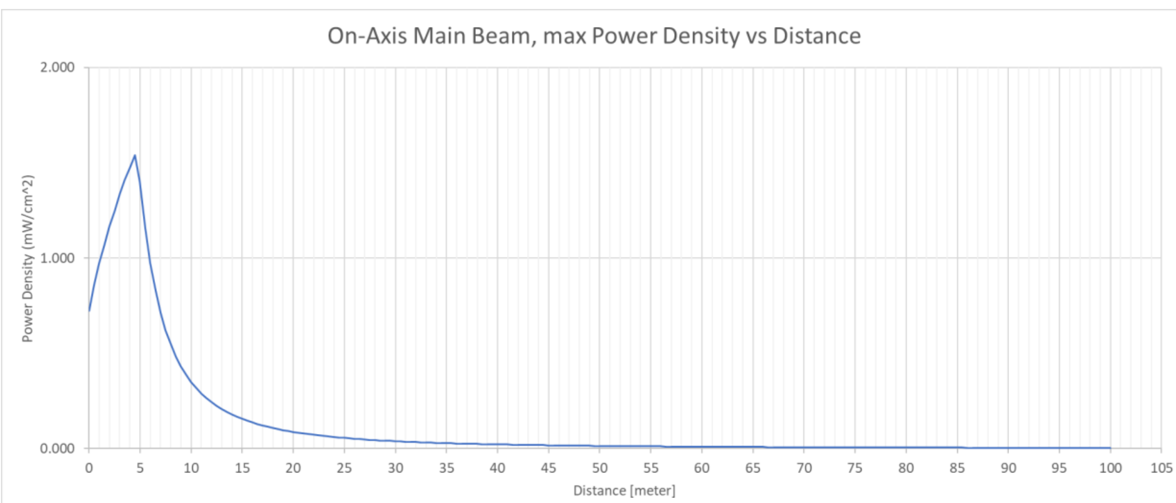

Figure 5: Power Density vs Distance at 60° Elevation

5.5 ON AXIS ELEVATION 45° @ EIRP OF 31.7 DBW

Analyzed data:

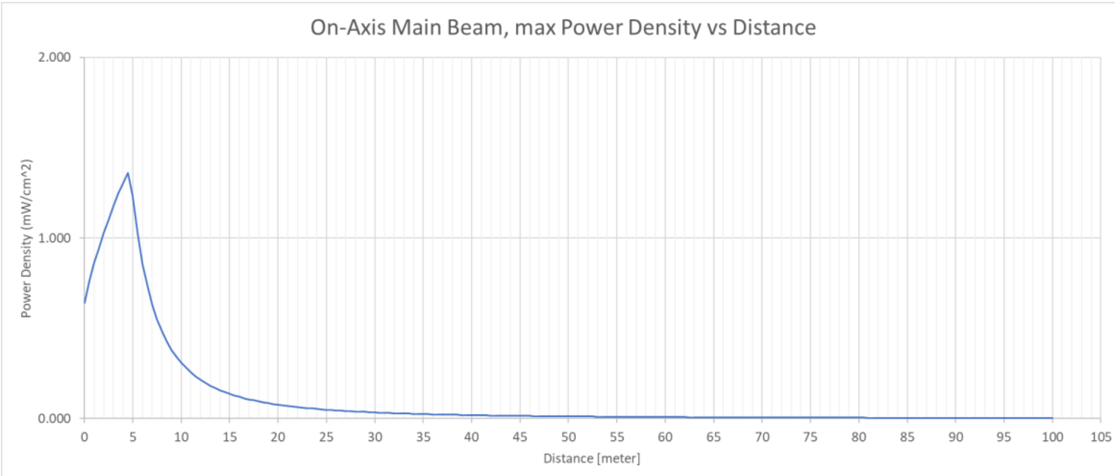

Figure 6: Power Density vs Distance at 45° Elevation

5.6 ON AXIS ELEVATION 30° @ EIRP OF 30.0 DBW

Analyzed data:

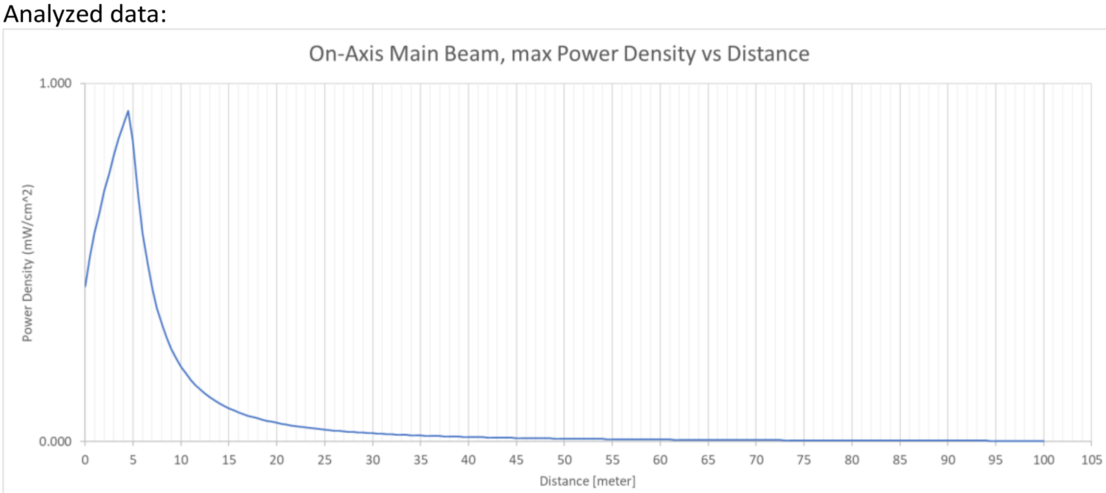

Figure 7: Power Density vs Distance at 30° Elevation

5.7 On Axis Elevation 15° @ EIRP of 27.5 dBW

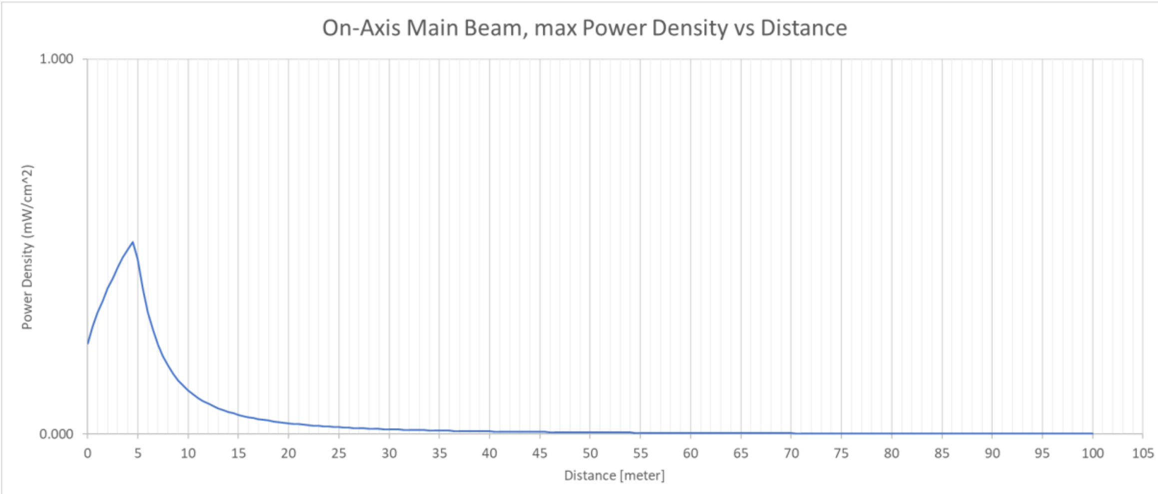

Figure 8: Power Density vs Distance at 15° Elevation

5.8 On Axis Elevation 0° @ EIRP of 15 dBW

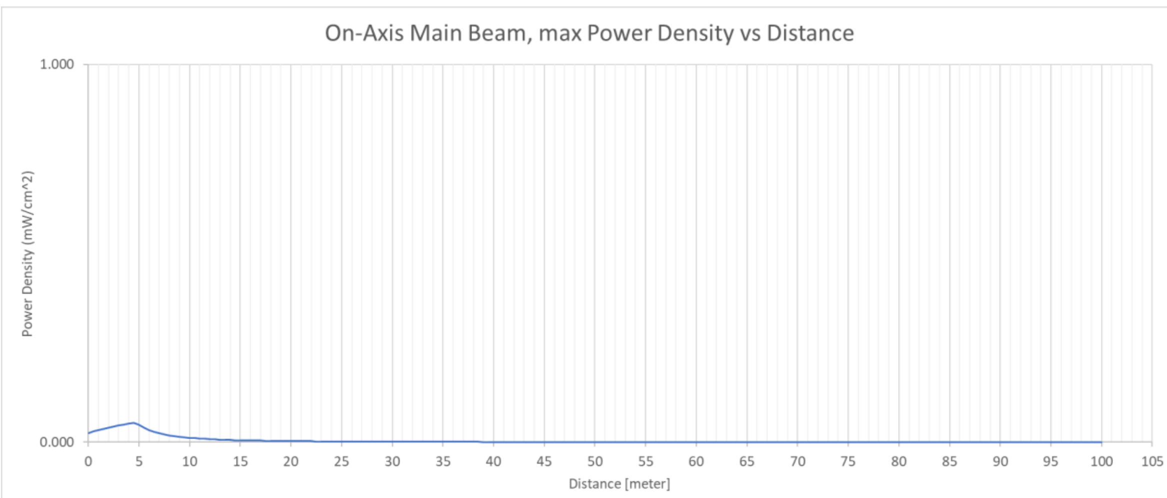

Figure 9: Power Density vs Distance at 0° Elevation

5.9 Scope

Minimum safe distance from the antenna is defined in terms of vertical proximity and horizontal proximity, parameters are shown in Figure 10.

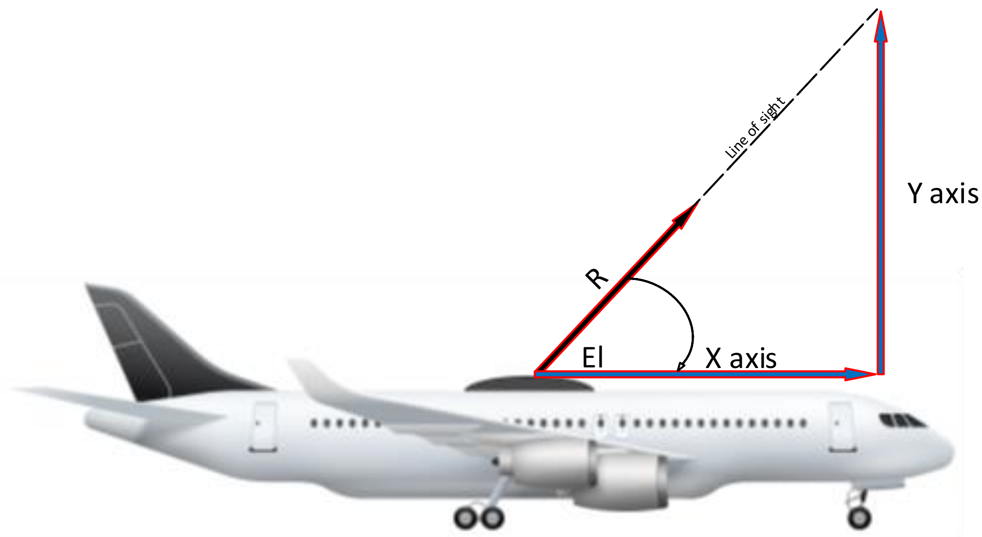

Figure 10: Minimum Safe Distance

Analyzing the power density plots, R values for the distance from the Tx Antenna where power density is 5 mw/cm2 and 1 mw/cm2 are listed in Table 7 and Table 8, respectively.

X axis Proximity of the Power density equals to Rmax * Cos (El)
Y axis Proximity of the Power density equals to Rmax * Sin (El)

El (°)	**Elevation Beam Width BW (°)**	**EIRP (dBW)**	**R @5 mw/cm2 (meters)**	**Y axis, Vertical Proximity @5 mw/cm2 (meters)**	**X axis, Horizontal Proximity @5 mw/cm2 (meters)**
90	2.8	33.6	0	0	0
75	2.9	33.0	0	0	0
60	3.2	32.4	0	0	0
45	4	31.7	0	0	0
30	6	30	0	0	0
15	11	27.5	0	0	0
0	22	15	0	0	0

Table 7: Safe Distances with 5 mw/cm2 On-Axis Power-Density, FCC Occupational Exposure

El (°)	Elevation Beam Width BW (°)	EIRP (dBW)	R @1 mw/cm2 (meters)	Y axis, Vertical Proximity @1 mw/cm2 (meters)	X axis, Horizontal Proximity @1 mw/cm2 (meters)
90	2.8	33.6	7	7	0.0
75	2.9	33.0	6.5	6.27	1.6
60	3.2	32.4	5.5	4.7	2.75
45	4	31.7	5.3	3.7	3.7
30	6	30	0.0	0.0	0.0
15	11	27.5	0.0	0.0	0.0
0	22	15	0.0	0.0	0.0

Table 8: Safe Distances with 1 mw/cm2 On-Axis Power-Density, FCC General Population Exposure

6. Discussion

6.1 Occupational Exposure

Occupational exposure safe distances for all elevation angles are defined in Table 4.2-1. The following real life “controlled” situations were evaluated and discussed:

1) A maintenance member standing on top of the aircraft fuselage.
2) A maintenance member directly above the antenna, for situations such as de-icing.

6.1.1 Maintenance Member Standing on top of the Aircraft Fuselage

Presuming that the system is transmitting at 100% duty factor, at its worst case possible the TX antenna power level up to 33.6dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and pointed in elevation 45° at a 1.8 m tall crewmember standing on top of the aircraft fuselage, the safe vertical proximity is 1.8 m from the center of the transmitting antenna and the safe horizontal proximity is 1.8m from the center of the transmitting antenna. Calculations are based on the parameters outlined in Table 9.

Parameter	**Value**	**Unit**
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	3.0	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	33.6 (inc radome)	dbW
Maximum Safe Exposure	5	mW/cm2

Table 9: Safe Power Density and Safe Distance Calculation Parameters @ 15° El, Occupational Exposure

It should be noted that, as an additional interlock safety feature and for practical scenarios in which the antenna is powered on but the line-of-sight to the intended satellite is blocked by objects or personnel, RF emissions are proactively inhibited. The transmit panel will automatically mute in the absence of a reliable receive signal from the satellite therefore disabling all transmission from the antenna.

6.1.2 Maintenance Member Directly Above the Antenna

Presuming that the system is transmitting at 100% duty factor, at its worst case possible the TX antenna power level up to 33.6dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and pointed in elevation 90° at a crewmember above the antenna, the safe vertical proximity is 0.0m (according Table 7) from the center of the transmitting antenna and the safe horizontal proximity is 0.0 m (0.0 ft) from the center of the transmitting antenna. Calculations are based on the parameters outlined in Table 10.

Parameter	Value	Unit
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	2.8	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	33.6 (inc radome)	dbW
Maximum Safe Exposure	5	mW/cm2

Table 10: Power Density and Safe Distance Calculation Parameters @ 90° El, Occupational Exposure

It should be noted that, as an additional interlock safety feature and for practical scenarios in which the antenna is powered on but the line-of-sight to the intended satellite is blocked by objects or personnel during situations like de-icing, RF emissions are proactively inhibited. The transmit panel will automatically mute in the absence of a reliable receive signal from the satellite therefore disabling all transmission from the antenna.

6.2 Bystander Standing Below the Crown of the Aircraft Fuselage

General population exposure safe distances for all elevation angles are defined in Table 8. The following real life “un-controlled” situations were evaluated and discussed:

1) A bystander standing below the crown of the aircraft fuselage.
2) A bystander standing in the aircraft terminal.

6.2.1 Maintenance Member Directly Above the Antenna

The Tx Antenna will not (cannot) scan below the crown of the fuselage due to mechanical constraints. Presuming that the system is transmitting at 100% duty factor, at its worst case possible TX antenna power level up to 33.6dbW (including 1db radome loss), with the antenna beam pointed in azimuth and pointed in the supposed lowest elevation of 0° towards a bystander standing below the crown the aircraft fuselage, the safe vertical proximity is 0.0m from the center of the transmitting antenna and the safe horizontal proximity is less than 0.0 m. Calculations are based on the parameters outlined in Table 11.

Parameter	Value	Unit
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	22	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	15.0 (inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 11: Power-Density and Safe Distance Calculation Parameters @ 0° El, General Population Exposure

6.2.2 Maintenance Bystander Standing in the Aircraft Terminal, 15° El

Presuming that the system is transmitting at 100% duty factor, at its worst-case possible TX antenna power level up to 27.5 (including 1db radome loss), with the antenna beam directly pointed in azimuth and in elevation 15° at a bystander standing in the aircraft terminal, the safe vertical proximity is 0.0 m from the center of the transmitting antenna and the safe horizontal proximity is 0.0 m. Calculations are based on the parameters outlined in Table 12.

Parameter	Value	Unit
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	11	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	27.5(inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 12: Power-Density and Safe Distance Calculation Parameters @ 15° El, General Population Exposure

It should be noted that, as an additional interlock safety feature and for practical scenarios in which the antenna is powered on but the line-of-sight to the intended satellite is blocked by objects like aircraft terminal buildings, RF emissions are proactively inhibited. The Tx antenna will automatically mute in the absence of a reliable receive signal from the satellite therefore disabling all transmission from the antenna.

6.2.3 Maintenance Bystander Standing in the Aircraft Terminal, 30° El

Presuming that the system is transmitting at 100% duty factor, at its worst-case possible TX antenna power level up to 30.0dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and in elevation 30° at a bystander standing in the aircraft terminal, the safe vertical proximity is 0.0 m from the center of the transmitting antenna and the safe horizontal proximity is 0.0 m. Calculations are based on the parameters outlined in Table 13.

Parameter	**Value**	**Unit**
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	6	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	30 (inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 13: Power-Density and Safe Distance Calculation Parameters @ 30° El, General Population Exposure

6.2.4 Maintenance Bystander Standing in the Aircraft Terminal, 45° El

Presuming that the system is transmitting at 100% duty factor, at its worst-case possible TX antenna power level up to 31.7 dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and in elevation 45° at a bystander standing in the aircraft terminal, the safe vertical proximity is 3.7 m from the center of the transmitting antenna and the safe horizontal proximity is 3.7 m. Calculations are based on the parameters outlined in Table 14.

Parameter	**Value**	**Unit**
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	4	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	31.7(inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 14: Power-Density and Safe Distance Calculation Parameters @ 45° El, General Population Exposure

6.2.5 Maintenance Bystander Standing in the Aircraft Terminal, 60° El

Presuming that the system is transmitting at 100% duty factor, at its worst-case possible TX antenna power level up to 32.4 dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and in elevation 60° at a bystander standing in the aircraft terminal, the safe vertical proximity is 4.7 m from the center of the transmitting antenna and the safe horizontal proximity is 2.75 m. Calculations are based on the parameters outlined in Table 14.

Parameter	**Value**	**Unit**
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	3.2	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	32.4 (inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 15: Power-Density and Safe Distance Calculation Parameters @ 60° El, General Population Exposure

6.2.6 Maintenance Bystander Standing in the Aircraft Terminal, 75° El

Presuming that the system is transmitting at 100% duty factor, at its worst-case possible TX antenna power level up to 33.0dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and in elevation 75° at a bystander standing in the aircraft terminal, the safe vertical proximity is 6.27 m from the center of the transmitting antenna and the safe horizontal proximity is 1.6 m. Calculations are based on the parameters outlined in Table 14.

Parameter	**Value**	**Unit**
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	3.0	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	33.0 (inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 16: Power-Density and Safe Distance Calculation Parameters @ 75° El, General Population Exposure

6.2.7 Maintenance Bystander Standing in the Aircraft Terminal, 90° El

Presuming that the system is transmitting at 100% duty factor, at its worst-case possible TX antenna power level up to 33.6dbW (including 1db radome loss), with the antenna beam directly pointed in azimuth and in elevation 90° at a bystander standing in the aircraft terminal, the safe vertical proximity is 7 m from the center of the transmitting antenna and the safe horizontal proximity is 0 m. Calculations are based on the parameters outlined in Table 14.

Parameter	Value	Unit
Azimuth Beamwidth	2.8	°
Elevation Beamwidth	3.0	°
Frequency	14.25	GHz
Antenna I2R Power loss	Radome Loss – 1	dB
Antenna Power (EIRP max)	33.6 (inc radome)	dbW
Maximum Safe Exposure	1	mW/cm2

Table 17: Power-Density and Safe Distance Calculation Parameters @ 90° El, General Population Exposure

7. Conclusion for Fixed beam worst case

Considering all real-life situations for occupational and general population RF emission exposure, minimum RF exposure time limits, power density limits and minimum safe distances are defined in Table 6.0-1.

Category	Time Limit	Power Density Limit	Elevation	Safe Vertical Proximity	Safe Horizontal Proximity
Occupational/Controlled	2.6 min	5 mW/cm2	**15**	**0.0 m**	**0.0 m**
			90	**0.0 m**	**0.0 m**
General Population/Uncontrolled	2.6 min	1 mW/cm2	**0**	**0.0 m**	**0.0 m**
			15	**0.0 m**	**0.0 m**
			45	**3.7 m**	**3.7 m**
			90	**7.0 m**	**0.0 m**

Table 18: Minimum Safe RF Exposure Parameters

8. Beam movement scenario while LEO tracking

8.1 Scope

Additionally, to fix beam max exposure at 100% duty cycle this paragraph focuses on the actual scenario to calculate worst case 30 minutes rolling average exposure using LEO constellation.

The methodology was taken from some moving samples of LEO constellation:

a. The calculation using beam occupancy with highest mean count over long time of few weeks

b. Calculated 15 seconds peak count over time for all beams around the long time

c. The calculated Rolling Average Spectral density based on the following calculations

Equitation 1

$$DT_{rolling-average-spatial-dc} = \frac{(N_{count} * Time_{count})}{T_{period}}$$

N count - is the number of unique hits in the target slot for time window
T Period - is the 30 minutes min average period in second

Equitation 2:

$$S_{rolling-average} = (S_{\text{static-distance}}) * (DT_{rolling-average-spatial-dc})$$

Equitation 3:

$$S_{max-rolling-average} = Max(S_{rolling-average})$$

The table below represents the final product of combining static beam measurements according max EIRP and distance to meet 30 minutes exposure:

Power Density at 33.6dBw		
	Max Slot at 15 sec peaks [mW/cm2]	Mean Slot 15 sec peaks [mW/cm2]
Same distance from panel	0.083771623	0.011557895

Table 19: Max 30-Min Rolling Average Power Density

In the calculation from static exposure (fixed beam) at 1 mW/cm2 with EIRP of 33dBw we can see reduced to 0.083mW/cm2. This means that the reduce is by more than 10 times from fix beam scenario.

Bottom line to pass the FCC requirements of 1 mW/cm2 for 30 minutes power density with rolling average power density there is no distance limitation as every distance providing < 1mw/cm2 power density