System Orbit Characteristics:

Alpha CubeSat | 2016 February 05 | Version: 2.5.3

Orbit Option to be Used in Link Model (LEO, HEO, GEO, Deep Space)

Select Orbit Option: 4 Deep Space

Slant Range: 3,999,000 km Used in Path Loss Calculation

Option No.:	Orbit Type:	Slant Range:	
1	LEO	2783.9	km
2	HEO	41126.8	km
3	GEO	38097.0	km
4	Deep Space	3.999E+06	km

Element Reference Epoch: 2005, 87.50000

Blue = User Data Entry Values
Black = Computed Values (**No Data Entry**)

Red = Key Results
Blue = Critical User Data Entry Values

NOTE: Cells Not Yet Protected

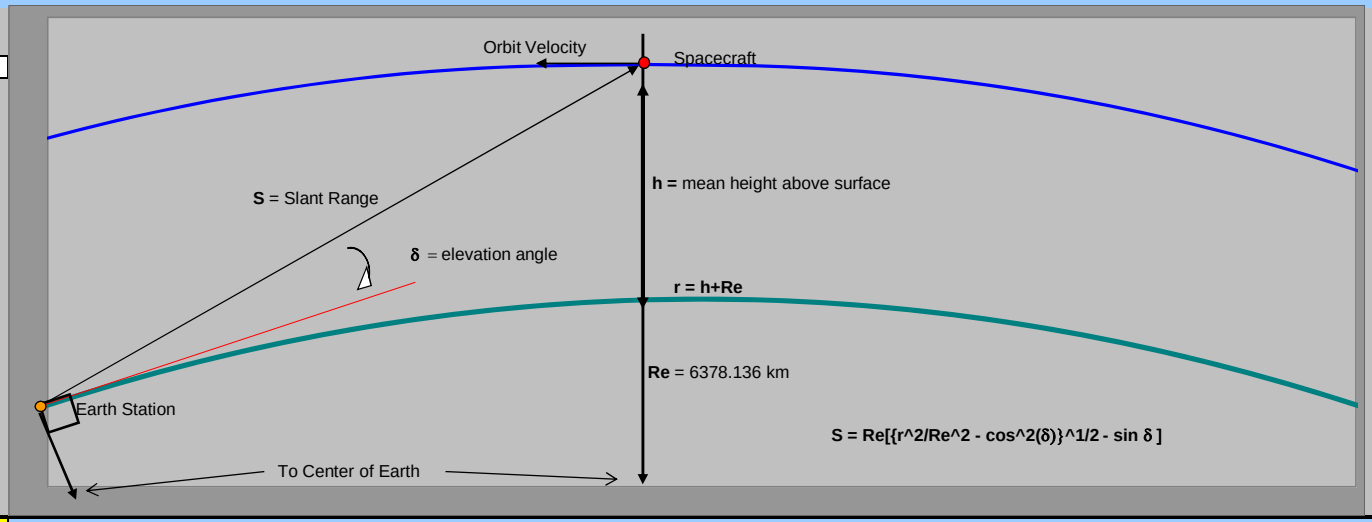
LEO Orbit - Option #1

NOTE:

Low Earth Orbit Properties

Slant Range to Spacecraft vs. Elevation Angle

Parameter:	*Value:*	*Unit:*
Earth Radius:	6,378.14	km
Height of Apogee (ha):	805.0	km
Height of Perigee (hp):	795.0	km
Semi-Major Axis (a):	7,178.1	km
Eccentricity (e):	0.000697	
Inclination (I):	98.61	°
Argument of Perigee (ω):	180.0	°
R.A.A.N. (Ω):	123.70	°
Mean Anomaly (M):	0.00	°
Period:	100.874	minutes
dω/dt:	-2.9241	deg./day
dΩ/dt:	0.9860	deg./day
dM/dt:	Not Implemented	deg./day
Mean Orbit Altitude:	800.00	km
Mean Orbit Radius:	7,178.14	km
Sun Synchronous Inclination:	98.61	°
Elevation Angle (**δ**):	5.0	°
Slant Range (**S**):	2,783.9	km.



LEO Orbit Geometry

High Earth Orbit (HEO) - Option #2

NOTE:

HEO Orbit Properties

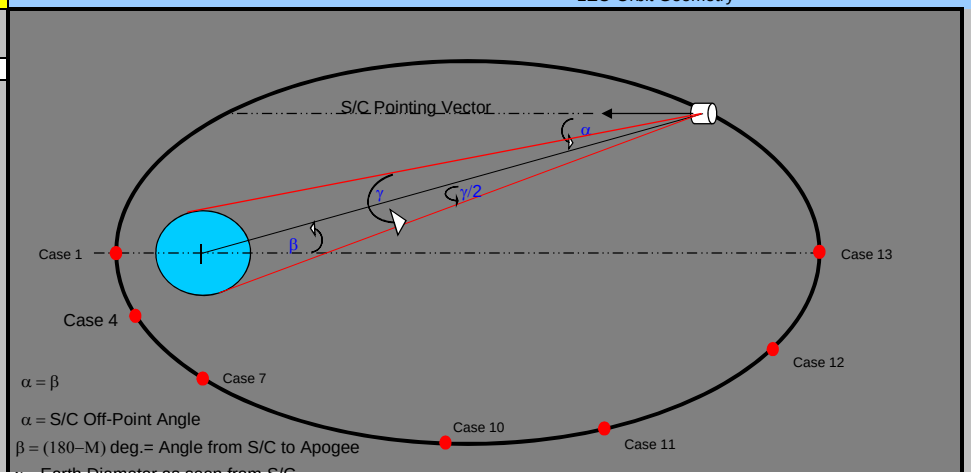
S/C Spinning and NADIR-Pointing at Apogee

Parameter:	*Value:*	*Unit:*
Earth Radius:	6,378.14	km
Height of Apogee:	35,786	km
Height of Perigee:	500	km
Semi-Major Axis (a):	24,521.14	km
Eccentricity (e):	0.719502	
Inclination (I):	7.00	degrees
Argument of Perigee (ω):	180.0	degrees
R.A.A.N. (Ω):	0.00	degrees
Mean Anomaly (M):	180.00	degrees
Period:	636.90	minutes
dω/dt:	0.7542	deg./day
dΩ/dt:	-0.3814	deg./day

1) To Change Orbit Keplarians Modify **ONLY** Blue Values Above.

2) Choose Case No. and Enter Here. Proceed to "Uplink & Downlink

HEO Orbit



Choices" Below.

Geometry

γ = Earth Diameter as seen from S/C
α + γ/2 = Worst Case Squint Angle

CASE NO. SELECTED:	13	35,786.0 km Altitude	Elevation Angle:	5.0 °	Slant Range (S):	41,126.8 km

CASE:		R(km):	M(deg.):	altitude (km):	S/C off-point angle:	S/C rcvr. ant. temp.(K)
1	perigee	6878.1	0	500.0	180.0 deg.	35
2		6977.6	15	599.5	165.0 deg.	35
3		7286.6	30	908.5	150.0 deg.	35
4		7838.8	45	1,460.7	135.0 deg.	35
5		8697.9	60	2,319.8	120.0 deg.	35
6		9970.3	75	3,592.2	105.0 deg.	35
7		11827.0	90	5,448.8	90.0 deg.	35
8		14533.4	105	8,155.2	75.0 deg.	35
9		18472.4	120	12,094.3	60.0 deg.	35
10		24076.0	135	17,697.8	45.0 deg.	40
11		31380.2	150	25,002.0	30.0 deg.	50
12		38775.1	165	32,396.9	15.0 deg.	90
13	apogee	42164.1	180	35,786.0	0.0 deg.	170
14		41756.6	175	35,378.4	5.0 deg.	160 ← User Defined Case:

SOME KEY ORBIT & LINK PARAMETERS	
EARTH ANGULAR DIAMETER (γ):	17.4 °
S/C POINTING VECTOR (α):	10.0 °
WORST CASE SQUINT ANGLE:	18.7 °
RX ANTENNA POINTING LOSS:	0.00 dB
TX ANTENNA POINTING LOSS:	0.00 dB
GROUND RCVR Eb/No:	10.1 dB
S/C RCVR Eb/No	36.5 dB

3) If CASE No. 14 is Selected, Choose Mean Anomaly Value and S/C Rcvr Antenna Temp. and Enter Here.

Geostationary Earth Orbit (GEO) - Option #3

NOTE:

Path Length to User Terminal from Spacecraft

Parameter:	Value:	Unit:	Comment(s):
Geostationary Altitude:	35,786.019	km	Height Above Geoid
Equatorial Radius of Earth (Re):	6,378.137	km	
Geostationary semi major axis	42,164.156	km	Accurate to 1/10 meter
Typical Path Length:	37,410.000	km	User at typical Longitude difference from satellite and at mean latitude.
Shortest Path Length:	35,786.019	km	User at same longitude as satellite and at the equator
Longest Path Length:	41,678.957	km	User at max. longitude difference from satellite and at max. latitude (0.0° User Elevation Angle).

	UPLINK: → S/C → DOWNLINK:	User #1:			User #2: NOTE:
User Latitude:		40.000	°	+ = North Latitude; - = South Latitude	40.000 °
User Longitude:		-105.000	°	+ = East Longitude; - = West Longitude	-116.000 °
Spacecraft Slot (Longitude):		-132.000	°	Enter Slot Postion in Degrees East Longitude (NOTE: Δ Longitude ≤ 81.3°) [- = W. Long.; + = E. Long.]	-132.000 °
Slant Range to User:		38097.0	km	← The distance from the GEO satellite to the user. This Value used in Link Budget Path Loss Calculation.	37715.2 km
User Elevation Angle:		36.015	°	This is the Elevation Angle to the GEO spacecraft from the User (latitude and longitude) site.	40.853 °
User Azimuth Angle:		218.403	°	This is the azimuth angle to the GEO spacecraft from the User (latitude and longitude) site.	204.041 °
Earth Central Angle:		46.957	°	The angle measured from Earth center between the sub-satellite point and the ground station location.	42.577 °

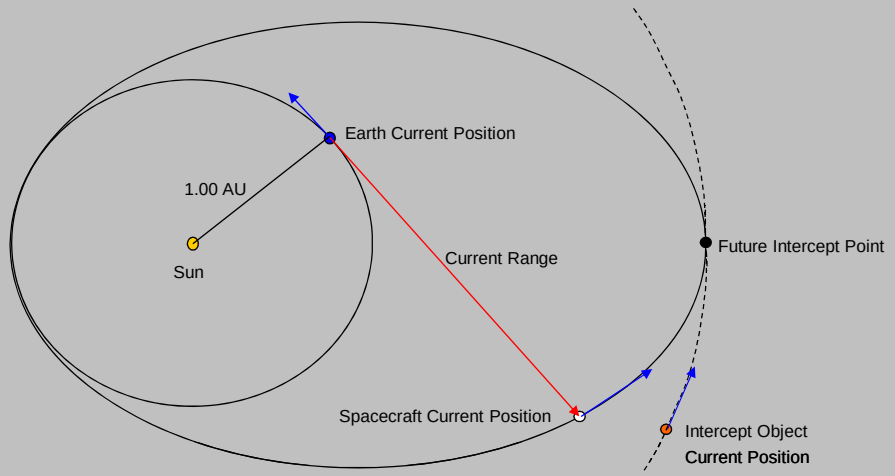
Deep Space Mission - Option #4: Range Expressed in Astronomical Units (AU)

NOTE:

Mission Target Object: 4 Million KM

Current Range to S/C: 0.027 AU

Current Range to S/C: 3.999E+06 km



Heliocentric Transfer Mission (Example)