Cornell University SSDS KickSat Bus Spreadsheet

NOAA APT Reception

Link Budget

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Sat data from http://noaasis.noaa.gov/NOAASIS/pubs/Users_Guide-Building_Receive_Stations_March_2009.pdf

*Boxes with black outlines are inputs

Constants	**Standard**		**Decibels**		
Boltzmann Constant, k	1.381E-23	J/K	-228.60	dB	
Speed of Light in Vacuum, c	3.00E+08	m/s			
Earth Radius, RE	6378.14	km			
Earth Mu	3.99E+05	km^3/s^2			
Frequency					
Frequency of Signal, f	138	MHz			
Wavelength of Signal, λ	2.182	m			
Orbit					
Altitude, h	845	km			Average altitude for NOAA APT birds
Minimum Elevation Angle, φ	60	deg			<- Minimum Elevation Angle Goes Here
Line of Sight Range, S	957.4	km			
Orbital Period, T	101.8	min			
S/C Velocity in Circular Orbit, v	7.4	km/s			
S/C Velocity Relative to Ground Station, vr	3.7	km/s			
Maximum Estimated Doppler Shift, df	1.7	kHz			
Path Losses					
Link Loss (or free-space loss), Ls	3.3E-14		-134.8	dB	
Atmospheric Attenuation, La	0.832		-0.8	dB	Based upon standard model and 114.25km slant range in atmosphere
Receiver					
Gain of Receiving Antenna, Gr	3.40		5.3	dB	1/4 wave monopole over ground pland as described in http://www.jocet.org/papers/151-L020.pdf 88% efficiency
Receiver System Temperature, Ts	290.00	K	27.5	dBK	Assumed to be night time, day time figure is 332.033K
Receiver Noise Factor/Figure	2.239		3.5	dB	from http://superkuh.com/gnuradio/R820T_datasheet-Non_R-20111130_unlocked.pdf, measured figures tend higher, closer to 5.4dB.
Polarization Losses, Lp	0.50		-3.0	dB	Loss from right hand circular polarization (RHCP) to vertical =-3dB under ideal conditions
Bandwidth, B	17.0	kHz	42.3	dBHz	From NOAA document referenced above
System Noise, N	1.52E-16	W	-158.78	dBW	
Transmitter					
Transmitting Antenna Gain, Gt	2.00		3.00	dB	Assumed to be NOAA-19 since remaining birds are in tumble
Transmitter Power, P	5.000	W	6.989700043	dbW	<- Transmitter power goes here
EIRP, W	9.976	W	9.99	dbW	
Signal Encoding / Convolution					
Baud Rate, R	9600.00	bps			
Link Quality					
Received Power, Carrier Power, C	**4.65E-13**	**W**	**-123.35**	**dBW**	
Carrier to Noise, C/N	**3048.474**		**34.84**	**dB**	
Eb/N0	**5398.3**		**37.32**	**dB**	
Minimum Eb/N0	**10.0**		**10.00**	**dB**	
Margin, M	**4858.51**		**27.32**	**dB**	

References:

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