

**10. IS-14**

**Coverage Map**



## Satellite Operator Certification Letter



12 September 2016

Federal Communications Commission  
International Bureau  
445 12th Street, SW  
Washington, D.C. 20554

Re: Engineering Certification of Intelsat

To Whom It May Concern:

This letter certifies that Intelsat is aware that Astronics AeroSat ("Astronics") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the IS-14 satellite located at 45° W.L., the IS-15 satellite located at 85° E.L., the IS-19 satellite located at 166° E.L., the IS-22 satellite located at 72.1° E.L., the IS-29e satellite located at 50° W.L. and the Galaxy 3C satellite located at 95.05° W.L.. Specifically, we understand that in addition to the previously authorized antenna systems, Astronics seeks to operate the AeroSat HR129 antenna system with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR129 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19, IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

A handwritten signature in blue ink that reads "Dick Evans".

Dick Evans  
Senior Principal Regulatory Engineer, Spectrum Engineering  
Intelsat

# Link Budget

## Forward Link Budget

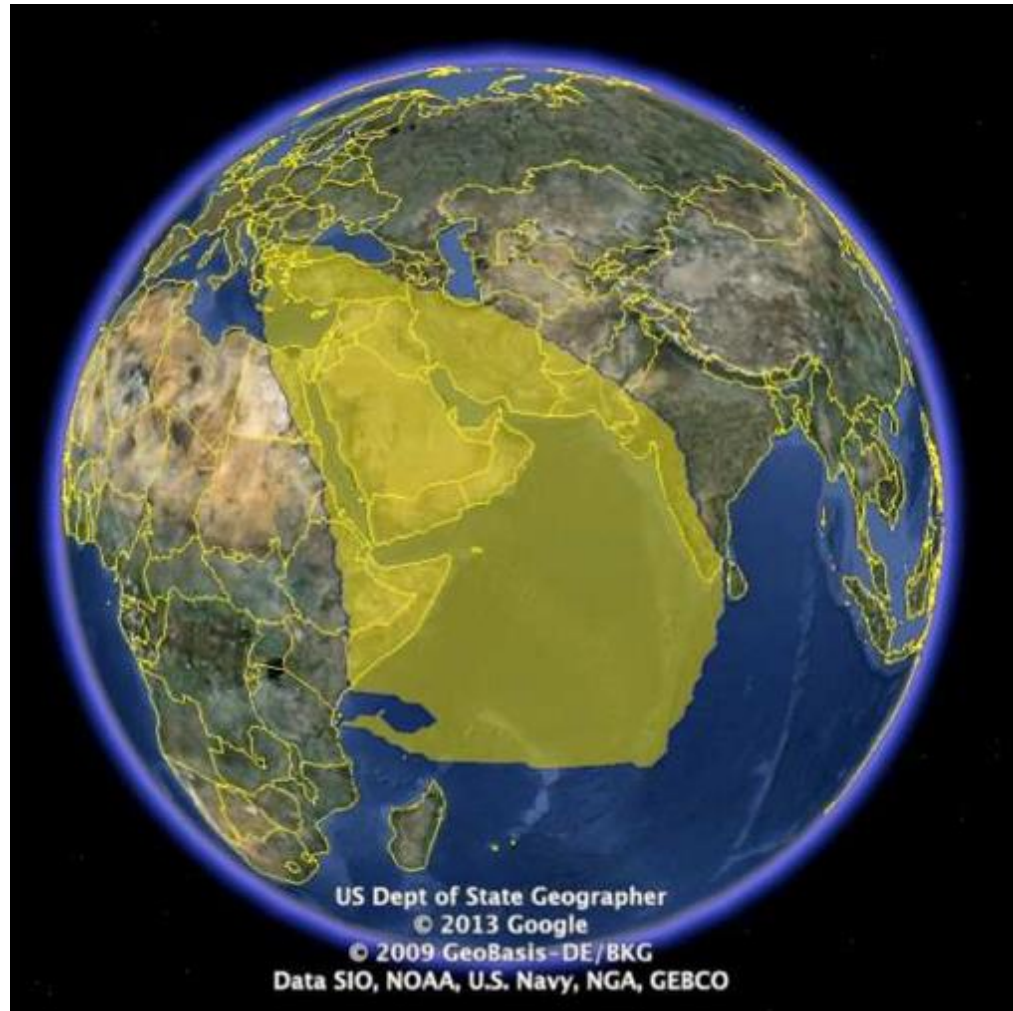
eXConnect Terminal	
Antenna Type	HR129
Lat	11.8 deg
Lon	6.8 deg
EIRP max	41.6 dBW
G/T	11.0 dB/K
Satellite	
Name	IS-14
Longitude	-45.0 deg
Hub Earth Station	
Site	Cologne
Lat	50.94 deg
Lon	6.96 deg
EIRP max	80.0 dBW
G/T	37.4 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.75
Overhead Rate	0.92
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.39 bps/Hz
Data Rate	3.62E+07 bps
Information Rate (Data + Overhead)	3.92E+07 bps
Symbol Rate	2.61E+07 Hz
Chip Rate (Noise Bandwidth)	2.61E+07 Hz
Occupied Bandwidth	3.13E+07 Hz
Power Equivalent Bandwidth	3.60E+07 Hz
C/N Threshold	4.4 dB
Uplink	
Frequency	14.100 GHz
Back off	8.1 dB
EIRP Spectral Density	33.7 dBW/4kHz
Slant Range	40122 km
Space Loss, Ls	207.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.9 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.2 dB/K
Thermal Noise, C/No	90.3 dBHz
C/(No+Io)	89.8 dBHz
Satellite	
Flux Density	-95.1 dBW/m2
SFD @ Hub	-92.1 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	1.0 dB
Downlink	
Frequency	11.550 GHz
Transponder Sat. EIRP @ Beam Peak	54.0 dBW
Transponder Sat. EIRP @ Terminal	53.0 dBW
DL PSD Limit	15.0 dBW/4kHz
DL PSD @ Beam Peak	14.8 dBW/4kHz
Carrier EIRP @ Beam Peak	53.0 dBW
Carrier EIRP @ Terminal	52.0 dBW
Slant Range	38644 km
Space Loss, Ls	205.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	85.7 dBHz
C/(No+Io)	80.0 dBHz
End to End	
End to End C/(No+Io)	79.6 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.4 dB
Link Margin	0.0 dB

## Return Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	11.8 deg
Lon	6.8 deg
EIRP max	41.6 dBW
G/T	11.0 dB/K
Satellite	
Name	IS-14
Longitude	-45.0 deg
Hub Earth Station	
Site	Cologne
Lat	50.94 deg
Lon	6.96 deg
EIRP max	80.0 dBW
G/T	37.4 dB/K
Signal	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.50
Overhead Rate	0.74
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.18 bps/Hz
Data Rate	1.23E+06 bps
Information Rate (Data + Overhead)	1.67E+06 bps
Symbol Rate	3.34E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	1.88E+05 Hz
C/N Threshold	-2.3 dB
Uplink	
Frequency	14.202 GHz
Back off	0.0 dB
EIRP Spectral Density	9.4 dBW/4kHz
Slant Range	38644 km
Space Loss, Ls	207.2 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	7.2 dB/K
Thermal Noise, C/No	69.6 dBHz
C/(No+Io)	69.1 dBHz
Satellite	
Flux Density	-121.7 dBW/m2
SFD @ Terminal	-89.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	29.9 dB
Downlink	
Frequency	11.652 GHz
Transponder Sat. EIRP @ Beam Peak	54.0 dBW
Transponder Sat. EIRP @ Hub	47.0 dBW
DL PSD Limit	15.0 dBW/4kHz
DL PSD @ Beam Peak	-8.2 dBW/4kHz
Carrier EIRP @ Beam Peak	24.1 dBW
Carrier EIRP @ Hub	17.1 dBW
Slant Range	40122 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.3 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	72.9 dBHz
C/(No+Io)	69.5637 dBHz
End to End	
End to End C/(No+Io)	66.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-1.9 dB
Link Margin	0.4 dB

*11. IS-15*

Coverage Map



## Satellite Operator Certification Letter



12 September 2016

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International Bureau  
445 12th Street, SW  
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Re: Engineering Certification of Intelsat

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This letter certifies that Intelsat is aware that Astronics AeroSat ("Astronics") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the IS-14 satellite located at 45° W.L., the IS-15 satellite located at 85° E.L., the IS-19 satellite located at 166° E.L., the IS-22 satellite located at 72.1° E.L., the IS-29e satellite located at 50° W.L. and the Galaxy 3C satellite located at 95.05° W.L.. Specifically, we understand that in addition to the previously authorized antenna systems, Astronics seeks to operate the AeroSat HR129 antenna system with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR129 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19, IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

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Dick Evans  
Senior Principal Regulatory Engineer, Spectrum Engineering  
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Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR6400 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19, IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

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Senior Principal Regulatory Engineer, Spectrum Engineering  
Intelsat

# Link Budgets

## Forward Link Budget

Flitestream Terminal	
Site	Jordan
Antenna Type	HR6400
Lat	29.5 deg
Lon	35.4 deg
G/T	12.3 dB/K
Satellite	
Name	IS-15
Transponder	K12
Longitude	85.2 deg
Hub Earth Station	
Site	Cyprus
Lat	34.859 deg
Lon	33.383 deg
EIRP max	80.0 dBW
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.66670
Overhead Rate	0.93986
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.25 bps/Hz
Data Rate	2.10E+06 bps
Information Rate (Data + Overhead)	2.23E+06 bps
Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	1.67E+06 Hz
Occupied Bandwidth	2.00E+06 Hz
C/N Threshold	3.5 dB
Uplink	
Frequency	14.110000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	24.6 dB
EIRP Spectral Density	29.2 dBW/4kHz
Slant Range	39315 km
Space Loss, Ls	207.3 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.4 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.0 dB/K
Thermal Noise, C/No	75.3 dBHz
C/(No+Io)	74.8 dBHz
Satellite	
Flux Density	-109.9 dBW/m2
SFD @ Hub	-95.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.1 dB
OBO	12.0 dB
Downlink	
Frequency	12.600000 GHz
Transponder Sat. EIRP @ Beam Peak	50.8 dBW
Transponder Sat. EIRP @ Terminal	46.8 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	12.6 dBW/4kHz
Carrier EIRP @ Beam Peak	38.8 dBW
Carrier EIRP @ Terminal	34.8 dBW
Slant Range	38944 km
Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	69.3 dBHz
C/(No+Io)	69.0 dBHz
End to End	
End to End C/(No+Io)	68.0 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.8 dB
Link Margin	1.3 dB

## Return Link Budget (Link 1)

Flitestream Terminal	
Site	Armenia
Antenna Type	HR6400
Lat	29.5 deg
Lon	35.4 deg
EIRP max	45.0 dBW
Satellite	
Name	IS-15
Transponder	K12
Longitude	85.2 deg
Hub Earth Station	
Site	Cyprus
Lat	34.859 deg
Lon	33.383 deg
G/T	39.0 dB/K
Signal	
Waveform	iDirectRL-SF4
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.43
Overhead Rate	0.68
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.07 bps/Hz
Data Rate	4.86E+05 bps
Information Rate (Data + Overhead)	7.18E+05 bps
Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	-5.0 dB
Uplink	
Frequency	14.110000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	12.8 dBW/4kHz
Slant Range	38944 km
Space Loss, Ls	207.2 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	2.0 dB/K
Thermal Noise, C/No	68.3 dBHz
C/(No+Io)	67.8 dBHz
Satellite	
Flux Density	-117.0 dBW/m2
SFD @ Terminal	-96.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.1 dB
OBO	18.1 dB
Downlink	
Frequency	12.600000 GHz
Transponder Sat. EIRP @ Beam Peak	50.8 dBW
Transponder Sat. EIRP @ Hub	46.8 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	-0.4 dBW/4kHz
Carrier EIRP @ Beam Peak	31.8 dBW
Carrier EIRP @ Hub	27.8 dBW
Slant Range	39315 km
Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	85.6 dBHz
C/(No+Io)	85.1 dBHz
End to End	
End to End C/(No+Io)	67.7 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-0.5 dB
Link Margin	4.5 dB

**Forward Link Budget**

<b>Flitestream Terminal</b>	
Site	Jordan
Antenna Type	HR6400
Lat	29.5 deg
Lon	35.4 deg
G/T	12.5 dB/K
<b>Satellite</b>	
Name	IS-15
Transponder	K12
Longitude	85.2 deg
<b>Hub Earth Station</b>	
Site	Cyprus
Lat	34.859 deg
Lon	33.383 deg
EIRP max	80.0 dBW
<b>Signal</b>	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.33
Overhead Rate	0.92
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.61 bps/Hz
Data Rate	2.80E+06 bps
Information Rate (Data + Overhead)	3.06E+06 bps
Symbol Rate	4.58E+06 Hz
Chip Rate (Noise Bandwidth)	4.58E+06 Hz
Occupied Bandwidth	5.50E+06 Hz
C/N Threshold	-0.8 dB
<b>Uplink</b>	
Frequency	14.160000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	24.6 dB
EIRP Spectral Density	24.8 dBW/4kHz
Slant Range	39315 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.4 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.0 dB/K
Thermal Noise, C/No	75.3 dBHz
C/(No+Io)	74.8 dBHz
<b>Satellite</b>	
Flux Density	-109.9 dBW/m2
SFD @ Hub	-95.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.1 dB
OBO	12.0 dB
<b>Downlink</b>	
Frequency	12.600000 GHz
Transponder Sat. EIRP @ Beam Pe	50.8 dBW
Transponder Sat. EIRP @ Terminal	46.8 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	8.2 dBW/4kHz
Carrier EIRP @ Beam Peak	38.8 dBW
Carrier EIRP @ Terminal	34.8 dBW
Slant Range	38939 km
Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	69.6 dBHz
C/(No+Io)	69.5 dBHz
<b>End to End</b>	
End to End C/(No+Io)	68.4 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	0.8 dB
Link Margin	1.6 dB

**Return Link Budget (Link 2)**

<b>Flitestream Terminal</b>	
Site	Armenia
Antenna Type	HR6400
Lat	29.5 deg
Lon	35.4 deg
EIRP max	45.0 dBW
<b>Satellite</b>	
Name	IS-15
Transponder	K12
Longitude	85.2 deg
<b>Hub Earth Station</b>	
Site	Cyprus
Lat	34.859 deg
Lon	33.383 deg
G/T	39.0 dB/K
<b>Signal</b>	
Waveform	iDirectRL-SF4
Modulation	BPSK
Bits per symbol	1
Spread Factor	1
Coding Rate	0.53
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.38 bps/Hz
Data Rate	1.91E+06 bps
Information Rate (Data + Overhead)	2.67E+06 bps
Symbol Rate	5.00E+06 Hz
Chip Rate (Noise Bandwidth)	5.00E+06 Hz
Occupied Bandwidth	6.00E+06 Hz
C/N Threshold	1.1 dB
<b>Uplink</b>	
Frequency	14.160000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	14.0 dBW/4kHz
Slant Range	38939 km
Space Loss, Ls	207.3 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	2.0 dB/K
Thermal Noise, C/No	68.2 dBHz
C/(No+Io)	68.1 dBHz
<b>Satellite</b>	
Flux Density	-117.0 dBW/m2
SFD @ Terminal	-96.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.1 dB
OBO	18.1 dB
<b>Downlink</b>	
Frequency	12.642750 GHz
Transponder Sat. EIRP @ Beam Pe	50.8 dBW
Transponder Sat. EIRP @ Hub	46.8 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	0.8 dBW/4kHz
Carrier EIRP @ Beam Peak	31.8 dBW
Carrier EIRP @ Hub	27.8 dBW
Slant Range	39315 km
Space Loss, Ls	206.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	85.5 dBHz
C/(No+Io)	84.9 dBHz
<b>End to End</b>	
End to End C/(No+Io)	68.1 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	1.1 dB
Link Margin	0.0 dB



**Forward Link Budget**

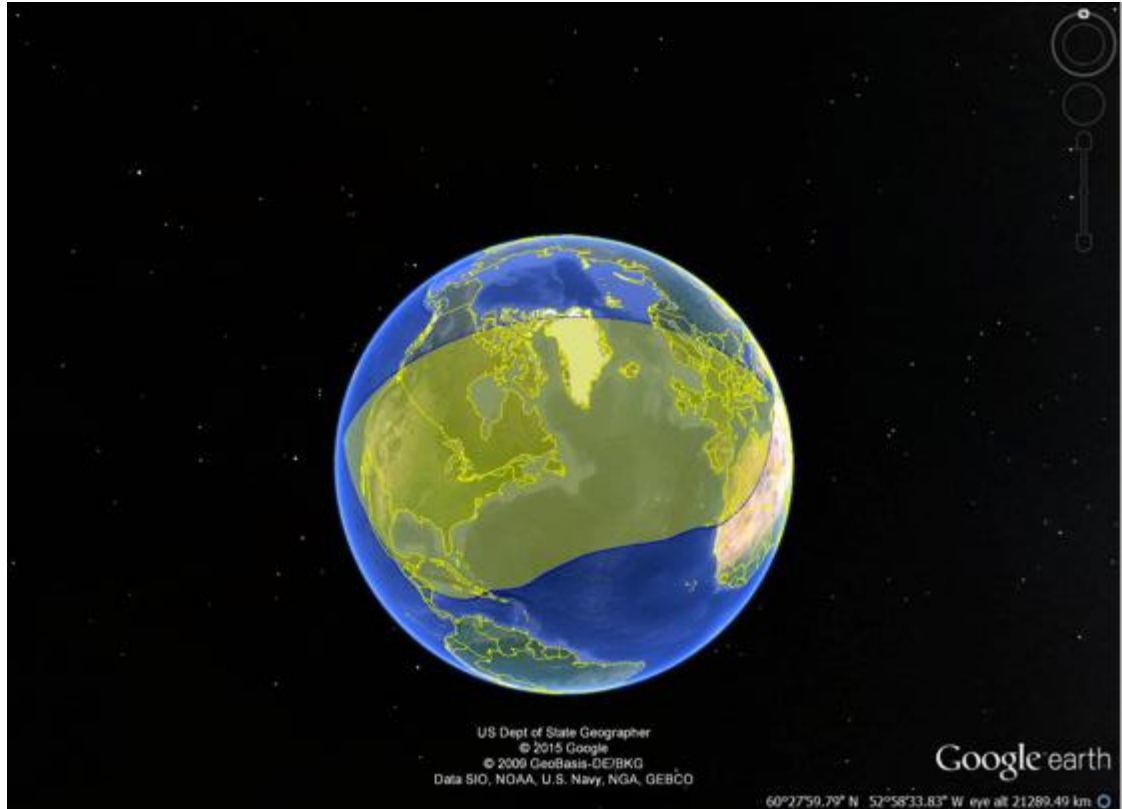
<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	14.9 deg
Lon	53.0 deg
EIRP max	42.5 dBW
G/T	11.3 dB/K
<b>Satellite</b>	
Name	IS-15
Longitude	85.2 deg
<b>Hub Earth Station</b>	
Site	Cyprus
Lat	34.92 deg
Lon	33.64 deg
EIRP max	80.0 dBW
G/T	37.3 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50
Overhead Rate	0.83
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz
Data Rate	1.38E+07 bps
Information Rate (Data + Overhead)	1.67E+07 bps
Symbol Rate	1.67E+07 Hz
Chip Rate (Noise Bandwidth)	1.67E+07 Hz
Occupied Bandwidth	2.00E+07 Hz
Power Equivalent Bandwidth	3.28E+07 Hz
C/N Threshold	0.9 dB
<b>Uplink</b>	
Frequency	14.048 GHz
Back off	14.8 dB
EIRP Spectral Density	29.0 dBW/4kHz
Slant Range	39297 km
Space Loss, Ls	207.3 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.4 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.7 dB/K
Thermal Noise, C/No	84.8 dBHz
C/(No+Io)	84.3 dBHz
<b>Satellite</b>	
Flux Density	-101.1 dBW/m2
SFD @ Hub	-92.7 dBW/m2
Small Signal Gain (IBO/OBO)	1.5 dB
OBO	6.9 dB
<b>Downlink</b>	
Frequency	12.538 GHz
Transponder Sat. EIRP @ Beam Peak	52.7 dBW
Transponder Sat. EIRP @ Terminal	51.7 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	9.6 dBW/4kHz
Carrier EIRP @ Beam Peak	45.8 dBW
Carrier EIRP @ Terminal	44.8 dBW
Slant Range	37136 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	78.4 dBHz
C/(No+Io)	76.2 dBHz
<b>End to End</b>	
End to End C/(No+Io)	75.6 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	2.3 dB
Link Margin	1.4 dB

**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	14.9 deg
Lon	53.0 deg
EIRP max	42.5 dBW
G/T	11.3 dB/K
<b>Satellite</b>	
Name	IS-15
Longitude	85.2 deg
<b>Hub Earth Station</b>	
Site	Cyprus
Lat	34.92 deg
Lon	33.64 deg
EIRP max	80.0 dBW
G/T	37.3 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.34E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	7.62E+05 Hz
C/N Threshold	-1.2 dB
<b>Uplink</b>	
Frequency	14.048 GHz
Back off	0.0 dB
EIRP Spectral Density	10.2 dBW/4kHz
Slant Range	37136 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	4.7 dB/K
Thermal Noise, C/No	68.4 dBHz
C/(No+Io)	67.9 dBHz
<b>Satellite</b>	
Flux Density	-120.5 dBW/m2
SFD @ Terminal	-95.7 dBW/m2
Small Signal Gain (IBO/OBO)	1.5 dB
OBO	23.3 dB
<b>Downlink</b>	
Frequency	12.538 GHz
Transponder Sat. EIRP @ Beam Peak	52.7 dBW
Transponder Sat. EIRP @ Hub	48.7 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	-2.8 dBW/4kHz
Carrier EIRP @ Beam Peak	29.4 dBW
Carrier EIRP @ Hub	25.4 dBW
Slant Range	39297 km
Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.6 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	80.4 dBHz
C/(No+Io)	76.3218 dBHz
<b>End to End</b>	
End to End C/(No+Io)	67.4 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-0.9 dB
Link Margin	0.3 dB

**12. IS-29E**

**Coverage Map**



## Satellite Operator Certification Letter



12 September 2016

Federal Communications Commission  
International Bureau  
445 12th Street, SW  
Washington, D.C. 20554

Re: Engineering Certification of Intelsat

To Whom It May Concern:

This letter certifies that Intelsat is aware that Astronics AeroSat ("Astronics") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the IS-14 satellite located at 45° W.L., the IS-15 satellite located at 85° E.L., the IS-19 satellite located at 166° E.L., the IS-22 satellite located at 72.1° E.L., the IS-29e satellite located at 50° W.L. and the Galaxy 3C satellite located at 95.05° W.L.. Specifically, we understand that in addition to the previously authorized antenna systems, Astronics seeks to operate the AeroSat HR129 antenna system with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR129 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19, IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

A handwritten signature in blue ink that reads "Dick Evans".

Dick Evans  
Senior Principal Regulatory Engineer, Spectrum Engineering  
Intelsat



12 September 2016

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445 12th Street, SW  
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This letter certifies that Intelsat is aware that Astronics AeroSat ("Astronics") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the IS-14 satellite located at 45° W.L., the IS-15 satellite located at 85° E.L., the IS-19 satellite located at 166° E.L., the IS-22 satellite located at 72.1° E.L., the IS-29e satellite located at 50° W.L. and the Galaxy 3C satellite located at 95.05° W.L.. Specifically, we understand that in addition to the previously authorized antenna systems, Astronics seeks to operate the AeroSat HR6400 antenna system with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR6400 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19, IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

A handwritten signature in blue ink that reads "Dick Evans".

Dick Evans  
Senior Principal Regulatory Engineer, Spectrum Engineering  
Intelsat

# Link Budgets

## Forward Link Budget

Flitestream Terminal	
Site	
Antenna Type	HR6400
Lat	37.4 deg
Lon	-97.2 deg
G/T	12.1 dB/K
Satellite	
Name	IS-29
Longitude	-50.0 deg
Hub Earth Station	
Site	mountainside
Lat	39.599 deg
Lon	-77.757 deg
EIRP max	80.0 dBW
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.89
Overhead Rate	0.95
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B)	1.69 bps/Hz
Data Rate	7.59E+07 bps
Information Rate (Data + Overhead)	8.00E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07
C/N Threshold	6.6 dB
Uplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	14.0 dB
EIRP Spectral Density	25.5 dBW/4kHz
Slant Range	38102 km
Space Loss, Ls	207.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	16.0 dB/K
Thermal Noise, C/No	100.5 dBHz
C/(No+Io)	100.0 dBHz
Satellite	
Flux Density	-99.7 dBW/m2
SFD @ Hub	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	8.7 dB
Downlink	
Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Peak	62.2 dBW
Transponder Sat. EIRP @ Terminal	61.2 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	13.0 dBW/4kHz
Carrier EIRP @ Beam Peak	53.5 dBW
Carrier EIRP @ Terminal	52.5 dBW
Slant Range	39091 km
Space Loss, Ls	205.9 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	87.2 dBHz
C/(No+Io)	85.7 dBHz
End to End	
End to End C/(No+Io)	85.5 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	8.0 dB
Link Margin	1.4 dB

## Return Link Budget (Link 1)

Flitestream Terminal	
Site	
Antenna Type	HR6400
Lat	37.4 deg
Lon	-97.2 deg
EIRP max	44.9 dBW
Satellite	
Name	IS-29
Longitude	-50.0 deg
Hub Earth Station	
Site	Mountainside
Lat	39.599 deg
Lon	-77.757 deg
G/T	40.4 dB/K
Signal	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.86
Overhead Rate	0.87
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B)	1.49 bps/Hz
Data Rate	9.93E+06 bps
Information Rate (Data + Overhead)	1.14E+06 bps
Symbol Rate	6.66E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
C/N Threshold	7.5 dB
Uplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	2.6 dB
EIRP Spectral Density	10.1 dBW/4kHz
Slant Range	39091 km
Space Loss, Ls	207.2 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	15.4 dB/K
Thermal Noise, C/No	79.0 dBHz
C/(No+Io)	78.7 dBHz
Satellite	
Flux Density	-117.8 dBW/m2
SFD @ Terminal	-103.4 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	12.5 dB
Downlink	
Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Peak	60.0 dBW
Transponder Sat. EIRP @ Hub	60.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	12.5 dBW/4kHz
Carrier EIRP @ Beam Peak	44.8 dBW
Carrier EIRP @ Hub	44.8 dBW
Slant Range	38102 km
Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.9 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	104.2 dBHz
C/(No+Io)	85.0 dBHz
End to End	
End to End C/(No+Io)	77.8 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	9.5 dB
Link Margin	2.0 dB

**Forward Link Budget**

**Flitestream Terminal**

Site	
Antenna Type	HR6400
Lat	52.0 deg
Lon	-35.0 deg
G/T	12.1 dB/K

**Satellite**

Name	IS-29
Longitude	-50.0 deg

**Hub Earth Station**

Site	mountainside
Lat	39.599 deg
Lon	-77.757 deg
EIRP max	80.0 dBW

**Signal**

Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B)	1.26 bps/Hz
Data Rate	5.66E+06 bps
Information Rate (Data + Overhead)	6.00E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07
C/N Threshold	3.5 dB

**Uplink**

Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	12.5 dB
EIRP Spectral Density	27.0 dBW/4kHz
Slant Range	38102 km
Space Loss, Ls	207.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	16.0 dB/K
Thermal Noise, C/No	102.0 dBHz
C/(No+Io)	101.3 dBHz

**Satellite**

Flux Density	-99.7 dBW/m2
SFD @ Hub	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	7.2 dB

**Downlink**

Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Peak	56.1 dBW
Transponder Sat. EIRP @ Terminal	55.1 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	8.4 dBW/4kHz
Carrier EIRP @ Beam Peak	48.9 dBW
Carrier EIRP @ Terminal	47.9 dBW
Slant Range	38711 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	82.7 dBHz
C/(No+Io)	82.2 dBHz

**End to End**

End to End C/(No+Io)	82.1 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.6 dB
Link Margin	1.1 dB

**Return Link Budget (Link 1)**

**Flitestream Terminal**

Site	
Antenna Type	HR6400
Lat	52.0 deg
Lon	-35.0 deg
EIRP max	44.9 dBW

**Satellite**

Name	IS-29
Longitude	-50.0 deg

**Hub Earth Station**

Site	mountainside
Lat	39.599 deg
Lon	-77.757 deg
G/T	40.4 dB/K

**Signal**

Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.23E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
C/N Threshold	-1.2 dB

**Uplink**

Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	14.7 dBW/4kHz
Slant Range	37390 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	0.2 dB/K
Thermal Noise, C/No	68.8 dBHz
C/(No+Io)	68.7 dBHz

**Satellite**

Flux Density	-117.8 dBW/m2
SFD @ Terminal	-88.2 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	25.5 dB

**Downlink**

Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Peak	60.0 dBW
Transponder Sat. EIRP @ Hub	60.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	2.3 dBW/4kHz
Carrier EIRP @ Beam Peak	34.6 dBW
Carrier EIRP @ Hub	34.6 dBW
Slant Range	38102 km
Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.9 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	94.0 dBHz
C/(No+Io)	84.5 dBHz

**End to End**

End to End C/(No+Io)	68.6 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	0.4 dB
Link Margin	1.6 dB

**Forward Link Budget**

**Flitestream Terminal**

Site	
Antenna Type	HR6400
Lat	25.4 deg
Lon	-80.1 deg
G/T	12.1 dB/K

**Satellite**

Name	IS-29
Longitude	-50.0 deg

**Hub Earth Station**

Site	mountainside
Lat	39.599 deg
Lon	-77.757 deg
EIRP max	80.0 dBW

**Signal**

Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B)	1.13 bps/Hz
Data Rate	5.08E+06 bps
Information Rate (Data + Overhead)	5.40E+06 bps
Symbol Rate	4.50E+06 Hz
Chip Rate (Noise Bandwidth)	4.50E+06 Hz
Occupied Bandwidth	5.40E+07
C/N Threshold	2.7 dB

**Uplink**

Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	6.3 dB
EIRP Spectral Density	33.2 dBW/4kHz
Slant Range	38102 km
Space Loss, Ls	207.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	16.0 dB/K
Thermal Noise, C/No	108.2 dBHz
C/(No+Io)	105.8 dBHz

**Satellite**

Flux Density	-99.7 dBW/m2
SFD @ Hub	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	1.0 dB

**Downlink**

Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Peak	48.1 dBW
Transponder Sat. EIRP @ Terminal	47.1 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	6.6 dBW/4kHz
Carrier EIRP @ Beam Peak	47.1 dBW
Carrier EIRP @ Terminal	46.1 dBW
Slant Range	37390 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	81.2 dBHz
C/(No+Io)	80.8 dBHz

**End to End**

End to End C/(No+Io)	80.8 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.3 dB
Link Margin	59.0 dB

**Return Link Budget (Link 1)**

**Flitestream Terminal**

Site	
Antenna Type	HR6400
Lat	52.0 deg
Lon	-35.0 deg
EIRP max	44.9 dBW

**Satellite**

Name	IS-29
Longitude	-50.0 deg

**Hub Earth Station**

Site	mountainside
Lat	39.599 deg
Lon	-77.757 deg
G/T	40.4 dB/K

**Signal**

Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.86
Overhead Rate	0.87
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B)	1.49 bps/Hz
Data Rate	9.93E+06 bps
Information Rate (Data + Overhead)	1.14E+07 bps
Symbol Rate	6.66E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
C/N Threshold	7.5 dB

**Uplink**

Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	2.0 dB
EIRP Spectral Density	10.7 dBW/4kHz
Slant Range	38711 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	14.8 dB/K
Thermal Noise, C/No	79.1 dBHz
C/(No+Io)	78.7 dBHz

**Satellite**

Flux Density	-117.8 dBW/m2
SFD @ Terminal	-102.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	12.5 dB

**Downlink**

Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Peak	60.0 dBW
Transponder Sat. EIRP @ Hub	60.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	12.6 dBW/4kHz
Carrier EIRP @ Beam Peak	44.8 dBW
Carrier EIRP @ Hub	44.8 dBW
Slant Range	38102 km
Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.9 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	104.3 dBHz
C/(No+Io)	85.0 dBHz

**End to End**

End to End C/(No+Io)	77.8 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	9.6 dB
Link Margin	2.1 dB

**Forward Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	31.0 deg
Lon	-104.2 deg
EIRP max	41.8 dBW
G/T	11.4 dB/K
<b>Satellite</b>	
Name	IS29e
Longitude	-50.0 deg
<b>Hub Earth Station</b>	
Site	Mountainside
Lat	39.6 deg
Lon	-77.76 deg
EIRP max	80.0 dBW
G/T	37.5 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	5.08E+07 bps
Information Rate (Data + Overhead)	5.40E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07 Hz
Power Equivalent Bandwidth	2.65E+07 Hz
C/N Threshold	2.7 dB
<b>Uplink</b>	
Frequency	6.131 GHz
Back off	5.7 dB
EIRP Spectral Density	33.8 dBW/4kHz
Slant Range	38106 km
Space Loss, Ls	199.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.5 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	4.0 dB/K
Thermal Noise, C/No	106.6 dBHz
C/(No+Io)	106.1 dBHz
<b>Satellite</b>	
Flux Density	-88.8 dBW/m2
SFD @ Hub	-77.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	9.8 dB
<b>Downlink</b>	
Frequency	12.106 GHz
Transponder Sat. EIRP @ Beam Peak	64.3 dBW
Transponder Sat. EIRP @ Terminal	63.3 dBW
DL PSD Limit	14.0 dBW/4kHz
DL PSD @ Beam Peak	14.0 dBW/4kHz
Carrier EIRP @ Beam Peak	54.5 dBW
Carrier EIRP @ Terminal	53.5 dBW
Slant Range	39358 km
Space Loss, Ls	206.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	87.0 dBHz
C/(No+Io)	80.5 dBHz
<b>End to End</b>	
End to End C/(No+Io)	80.5 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.0 dB
Link Margin	0.3 dB

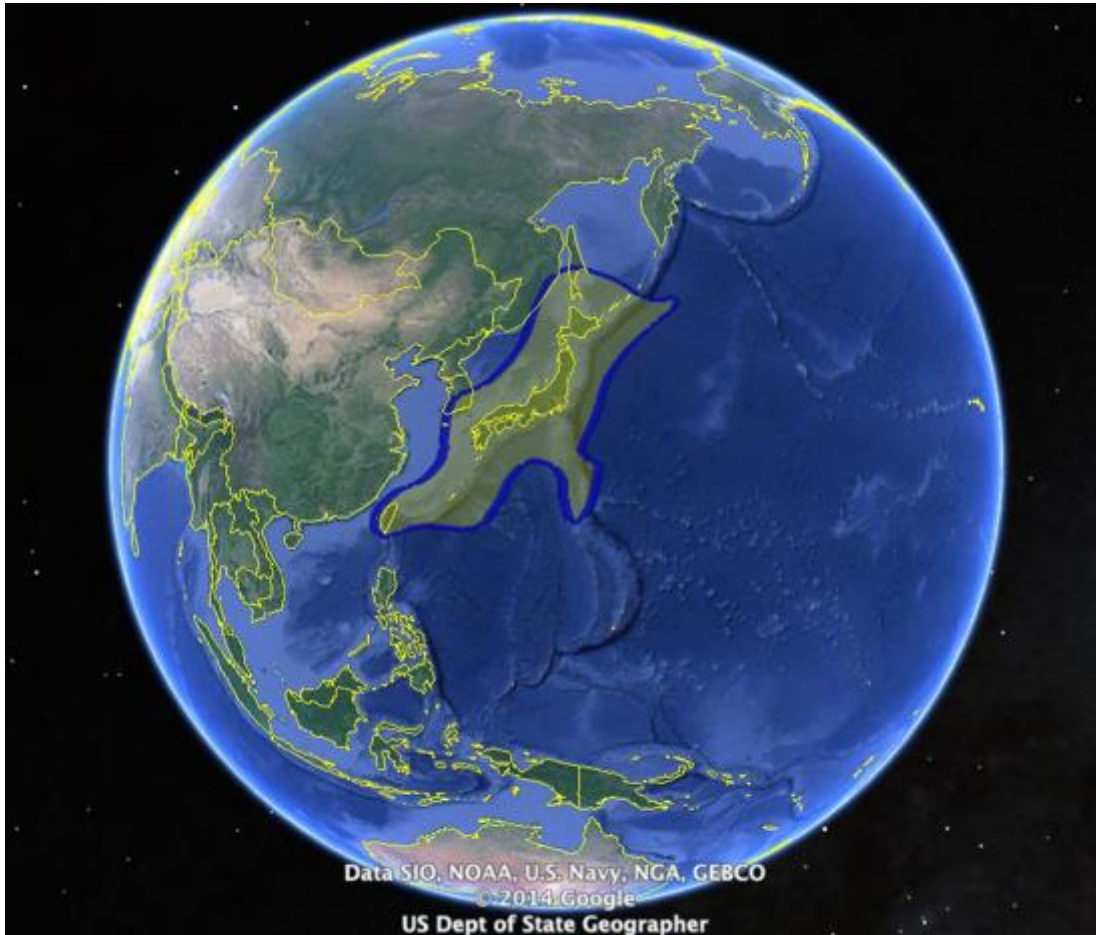
**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	31.0 deg
Lon	-104.2 deg
EIRP max	41.8 dBW
G/T	11.4 dB/K
<b>Satellite</b>	
Name	IS29e
Longitude	-50.0 deg
<b>Hub Earth Station</b>	
Site	Mountainside
Lat	39.6 deg
Lon	-77.76 deg
EIRP max	80.0 dBW
G/T	37.5 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.80
Overhead Rate	0.87
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.39 bps/Hz
Data Rate	9.25E+06 bps
Information Rate (Data + Overhead)	1.07E+07 bps
Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	2.24E+06 Hz
C/N Threshold	6.6 dB
<b>Uplink</b>	
Frequency	14.344 GHz
Back off	1.2 dB
EIRP Spectral Density	8.4 dBW/4kHz
Slant Range	39358 km
Space Loss, Ls	207.5 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	17.3 dB/K
Thermal Noise, C/No	78.5 dBHz
C/(No+Io)	78.0 dBHz
<b>Satellite</b>	
Flux Density	-122.8 dBW/m2
SFD @ Terminal	-94.3 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	26.5 dB
<b>Downlink</b>	
Frequency	10.856 GHz
Transponder Sat. EIRP @ Beam Peak	52.7 dBW
Transponder Sat. EIRP @ Hub	52.7 dBW
DL PSD Limit	14.0 dBW/4kHz
DL PSD @ Beam Peak	-6.1 dBW/4kHz
Carrier EIRP @ Beam Peak	26.2 dBW
Carrier EIRP @ Hub	26.2 dBW
Slant Range	38106 km
Space Loss, Ls	204.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	84.4 dBHz
C/(No+Io)	79.5194 dBHz
<b>End to End</b>	
End to End C/(No+Io)	75.7 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	7.4 dB
Link Margin	0.8 dB



### 13. JCSAT-5A

#### Coverage Map



## Satellite Operator Certification Letter



SKY Perfect JSAT Corporation  
1-14-14, Akasaka, Minato-ku  
Tokyo 107-0052, Japan  
TEL +81-3-5571-7800

Ref# MD-A-16-013

July 12, 2016

Federal Communications Commission  
International Bureau  
445 12th Street, S.W.  
Washington, D.C. 20554

Re: Engineering Certification of SKY Perfect JSAT Corporation for Astronics AeroSat


To Whom It May Concern:

This letter certifies that SKY Perfect JSAT Corporation ("JSAT") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek a modification to its blanket authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAAs") terminals, the HR129 and HR6400 terminals ("HR Terminals") with the JCSAT-5A satellite at 132° E.L and the Superbird C2 satellite at 144° E.L. JSAT understands that Astronics AeroSat will file the modification application pursuant to the FCC's rules governing ESAA terminal operations, including Section 25.227.

Based on the information provided by AeroSat, JSAT certifies that the proposed operation of the HR Terminals at the power density levels specified are consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from JCSAT-5A and Superbird C2. JSAT also acknowledges that the proposed operation of the Astronics AeroSat HR Terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, JSAT will take into consideration the power density levels associated with such operations in all future satellite network coordinations with other adjacent satellite operators.

Sincerely,

SKY Perfect JSAT Corporation

  
Mitsuru Ishii

General Manager  
Mobile Business Division  
Global Business Group  
Space & Satellite Business Unit

  
Date

# Link Budgets

## Forward Link Budget

Flitestream Terminal	
Antenna Type	HR6400
Lat	35.7 deg
Lon	138.4 deg
G/T	12.4 dB/K
Satellite	
Name	JCSAT-5A
Longitude	132.0 deg
Hub Earth Station	
Site	Tokyo
Lat	35.74 deg
Lon	139 deg
EIRP max	80.0 dBW
Signal	
Waveform	DVB-S2
Modulation	16APSK
Bits per symbol	4
Spread Factor	1
Coding Rate	0.83
Overhead Rate	0.93
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	3.10 bps/Hz
Data Rate	6.97E+07 bps
Information Rate (Data + Overhead)	7.50E+07 bps
Symbol Rate	2.25E+07 Hz
Chip Rate (Noise Bandwidth)	2.25E+07 Hz
Occupied Bandwidth	2.70E+07 Hz
C/N Threshold	12.4 dB
Uplink	
Frequency	14.259 GHz
Back off	10.0 dB
EIRP Spectral Density	32.5 dBW/4kHz
Slant Range	37218 km
Space Loss, Ls	206.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	10.0 dB/K
Thermal Noise, C/No	98.7 dBHz
C/(No+Io)	98.2 dBHz
Satellite	
Flux Density	-95.4 dBW/m2
SFD @ Hub	-92.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.4 dB
OBO	1.0 dB
Downlink	
Frequency	12.511 GHz
Transponder Sat. EIRP @ Beam Peak	57.5 dBW
Transponder Sat. EIRP @ Terminal	56.0 dBW
DL PSD Limit	19.5 dBW/4kHz
DL PSD @ Beam Peak	19.0 dBW/4kHz
Carrier EIRP @ Beam Peak	56.5 dBW
Carrier EIRP @ Terminal	55.0 dBW
Slant Range	37206 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	90.1 dBHz
C/(No+Io)	89.9 dBHz
End to End	
End to End C/(No+Io)	89.3 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	14.8 dB
Link Margin	2.4 dB

## Return Link Budget

Flitestream Terminal	
Antenna Type	HR6400
Lat	35.7 deg
Lon	138.4 deg
EIRP max	45.0 dBW
Satellite	
Name	JCSAT-5A
Longitude	132.0 deg
Hub Earth Station	
Site	Tokyo
Lat	35.74 deg
Lon	139 deg
G/T	35.5 dB/K
Signal	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.75
Overhead Rate	0.82
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.23 bps/Hz
Data Rate	8.20E+06 bps
Information Rate (Data + Overhead)	1.00E+07 bps
Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	5.9 dB
Uplink	
Frequency	14.259 GHz
Back off	0.0 dB
EIRP Spectral Density	14.8 dBW/4kHz
Slant Range	37206 km
Space Loss, Ls	206.9 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	10.0 dB/K
Thermal Noise, C/No	78.6 dBHz
C/(No+Io)	78.0 dBHz
Satellite	
Flux Density	-115.6 dBW/m2
SFD @ Terminal	-91.4 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	21.2 dB
Downlink	
Frequency	12.511 GHz
Transponder Sat. EIRP @ Beam Peak	57.5 dBW
Transponder Sat. EIRP @ Hub	56.0 dBW
DL PSD Limit	19.5 dBW/4kHz
DL PSD @ Beam Peak	4.2 dBW/4kHz
Carrier EIRP @ Beam Peak	36.4 dBW
Carrier EIRP @ Hub	34.9 dBW
Slant Range	37218 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.9 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	89.3 dBHz
C/(No+Io)	76.8 dBHz
End to End	
End to End C/(No+Io)	74.4 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	6.1 dB
Link Margin	0.2 dB

**Forward Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	37.0 deg
Lon	139.0 deg
EIRP max	41.6 dBW
G/T	11.5 dB/K
<b>Satellite</b>	
Name	JCSAT-5A
Longitude	132.0 deg
<b>Hub Earth Station</b>	
Site	Yokohama
Lat	35.5 deg
Lon	139.51 deg
EIRP max	75.0 dBW
G/T	32.5 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	1.50E+07 bps
Information Rate (Data + Overhead)	1.60E+07 bps
Symbol Rate	1.33E+07 Hz
Chip Rate (Noise Bandwidth)	1.33E+07 Hz
Occupied Bandwidth	1.60E+07 Hz
Power Equivelent Bandwidth	2.20E+07 Hz
C/N Threshold	2.7 dB
<b>Uplink</b>	
Frequency	14.089 GHz
Back off	17.7 dB
EIRP Spectral Density	22.1 dBW/4kHz
Slant Range	37212 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.3 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	11.0 dB/K
Thermal Noise, C/No	86.8 dBHz
C/(No+Io)	86.3 dBHz
<b>Satellite</b>	
Flux Density	-108.4 dBW/m2
SFD @ Hub	-97.0 dBW/m2
Small Signal Gain (IBO/OBO)	4.0 dB
OBO	7.4 dB
<b>Downlink</b>	
Frequency	12.341 GHz
Transponder Sat. EIRP @ Beam Peak	57.5 dBW
Transponder Sat. EIRP @ Terminal	56.0 dBW
DL PSD Limit	19.5 dBW/4kHz
DL PSD @ Beam Peak	14.9 dBW/4kHz
Carrier EIRP @ Beam Peak	50.1 dBW
Carrier EIRP @ Terminal	48.6 dBW
Slant Range	37314 km
Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	82.5 dBHz
C/(No+Io)	76.0 dBHz
<b>End to End</b>	
End to End C/(No+Io)	75.6 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.4 dB
Link Margin	0.7 dB

**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	37.0 deg
Lon	139.0 deg
EIRP max	41.6 dBW
G/T	11.5 dB/K
<b>Satellite</b>	
Name	JCSAT-5A
Longitude	132.0 deg
<b>Hub Earth Station</b>	
Site	Yokohama
Lat	35.5 deg
Lon	139.51 deg
EIRP max	75.0 dBW
G/T	32.5 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50
Overhead Rate	0.83
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz
Data Rate	5.55E+06 bps
Information Rate (Data + Overhead)	6.67E+06 bps
Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	1.09E+06 Hz
C/N Threshold	3.6 dB
<b>Uplink</b>	
Frequency	14.089 GHz
Back off	0.0 dB
EIRP Spectral Density	9.4 dBW/4kHz
Slant Range	37314 km
Space Loss, Ls	206.9 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	11.0 dB/K
Thermal Noise, C/No	73.7 dBHz
C/(No+Io)	73.2 dBHz
<b>Satellite</b>	
Flux Density	-121.4 dBW/m2
SFD @ Terminal	-97.0 dBW/m2
Small Signal Gain (IBO/OBO)	4.0 dB
OBO	20.5 dB
<b>Downlink</b>	
Frequency	12.341 GHz
Transponder Sat. EIRP @ Beam Peak	57.5 dBW
Transponder Sat. EIRP @ Hub	56.0 dBW
DL PSD Limit	19.5 dBW/4kHz
DL PSD @ Beam Peak	4.8 dBW/4kHz
Carrier EIRP @ Beam Peak	37.0 dBW
Carrier EIRP @ Hub	35.5 dBW
Slant Range	37212 km
Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.4 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	87.6 dBHz
C/(No+Io)	79.5350 dBHz
<b>End to End</b>	
End to End C/(No+Io)	72.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	4.1 dB
Link Margin	0.5 dB

***14. NSS-6***

**Coverage Map**



## Satellite Operator Certification Letter



Federal Communications Commission  
International Bureau  
445 12th Street, S.W.  
Washington, D.C. 20554  
United States

15<sup>th</sup> September 2016

**Subject: Engineering Certification for NSS-6**

To Whom It May Concern:

This letter confirms that SES is aware that Astronics AeroSat Corporation ("Astronic AeroSat"), licensed by the Federal Communications Commission ("FCC"), has filed an application seeking a modification to its blanket authorization (the "Modification Application") to operate Ku-band Earth Stations Aboard Aircraft ("ESAA") transmit/receive terminals (Call Sign E140087) pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules, on domestic and international flights. Among other changes, the Modification Application is seeking authority for Astronics AeroSat's ESAA terminals to communicate with the NSS-6 satellite at 95°E.L. under the current ESAA rules, including Section 25.227.

Based upon the contents of the Modification Application and the representations made to SES by Astronics AeroSat concerning how it will operate on NSS-6 according to its letter dated 28 June 2016.

SES acknowledges that the proposed operation of the Astronics AeroSat ESAA terminals has the potential to create harmful interference to satellite networks adjacent to NSS-6 that may be unacceptable.

SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by Astronics AeroSat are consistent with any existing coordination agreements to which SES is a party to adjacent satellite operators within +/- 6 degrees of orbital separation from NSS-6.

If the FCC authorizes the operations proposed by Astronics AeroSat, SES will include the power density levels specified by Astronics AeroSat in all future satellite network coordination with other operators of satellites adjacent to NSS-6.

**SES World Skies Singapore**  
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501 Orchard Road,  
#18-00 Wheelock Place  
238880 Singapore  
Tel. + 65 6593 3600  
Fax + 65 6593 3610  
[www.ses.com](http://www.ses.com)

Company Registration Number  
(UEN) 200914437G



SES has also reviewed the discussion in the Modification Application regarding the off-axis EIRP density of Astronics AeroSat antennas communicating with NSS-6 in directions other than along the GSO plane. SES is of the view that the non-compliant emissions would not create interference to Ku-band geostationary satellites.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'KS', with a long horizontal line extending to the right.

Kevin Seow  
VP Spectrum Management & Development – APAC  
SES

# Link Budgets

## Forward Link Budget

Flitestream Terminal	
Antenna Type	HR6400
Lat	36.1 deg
Lon	136.4 deg
G/T	12.5 dB/K
Satellite	
Name	NSS-6
Longitude	95.0 deg
Hub Earth Station	
Site	Cyprus
Lat	34.859 deg
Lon	33.384 deg
EIRP max	77.6 dBW
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.83330
Overhead Rate	0.93477
Channel Spacing	1.20000
Spectral Efficiency (Rate/Noise BW)	1.55789 bps/Hz
Data Rate	4.67E+07 bps
Information Rate (Data + Overhead)	5.00E+07 bps
Symbol Rate	3.00E+07 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 Hz
Occupied Bandwidth	3.60E+07 Hz
C/N Threshold	5.6 dB
Uplink	
Frequency	13.900 GHz
Back off	0.0 dB
EIRP Spectral Density	38.9 dBW/4kHz
Slant Range	40108 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.5 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	5.0 dB/K
Thermal Noise, C/No	98.3 dBHz
C/(No+Io)	97.8 dBHz
Satellite	
Flux Density	-91.0 dBW/m2
SFD @ Hub	-85.6 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	2.4 dB
Downlink	
Frequency	12.647 GHz
Transponder Sat. EIRP @ Beam Peak	54.5 dBW
Transponder Sat. EIRP @ Terminal	54.0 dBW
DL PSD Limit	14.7 dBW/4kHz
DL PSD @ Beam Peak	13.4 dBW/4kHz
Carrier EIRP @ Beam Peak	52.1 dBW
Carrier EIRP @ Terminal	51.6 dBW
Slant Range	38631 km
Space Loss, Ls	206.2 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	86.5 dBHz
C/(No+Io)	83.3 dBHz
End to End	
End to End C/(No+Io)	83.2 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	7.4 dB
Link Margin	1.8 dB

## Return Link Budget

Flitestream Terminal	
Antenna Type	HR6400
Lat	36.1 deg
Lon	136.4 deg
EIRP max	45.2 dBW
Satellite	
Name	NSS-6
Longitude	95.0 deg
Hub Earth Station	
Site	Cyprus
Lat	34.859 deg
Lon	33.384 deg
G/T	36.0 dB/K
Signal	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.85
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	7.54.E+06 bps
Information Rate (Data + Overhead)	8.89.E+06 bps
Symbol Rate	6.67.E+06 Hz
Chip Rate (Noise Bandwidth)	6.67.E+06 Hz
Occupied Bandwidth	8.00.E+06 Hz
C/N Threshold	5.0 dB
Uplink	
Frequency	14.472 GHz
Back off	0.0 dB
EIRP Spectral Density	13.0 dBW/4kHz
Slant Range	38631 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	8.0 dB/K
Thermal Noise, C/No	74.3 dBHz
C/(No+Io)	73.9 dBHz
Satellite	
Flux Density	-116.7 dBW/m2
SFD @ Terminal	-95.9 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	17.8 dB
Downlink	
Frequency	11.676 GHz
Transponder Sat. EIRP @ Beam Peak	50.0 dBW
Transponder Sat. EIRP @ Hub	50.0 dBW
DL PSD Limit	14.7 dBW/4kHz
DL PSD @ Beam Peak	-1.0 dBW/4kHz
Carrier EIRP @ Beam Peak	31.2 dBW
Carrier EIRP @ Hub	31.2 dBW
Slant Range	40108 km
Space Loss, Ls	205.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	83.5 dBHz
C/(No+Io)	82.8 dBHz
End to End	
End to End C/(No+Io)	73.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	5.1 dB
Link Margin	0.1 dB



**Forward Link Budget**

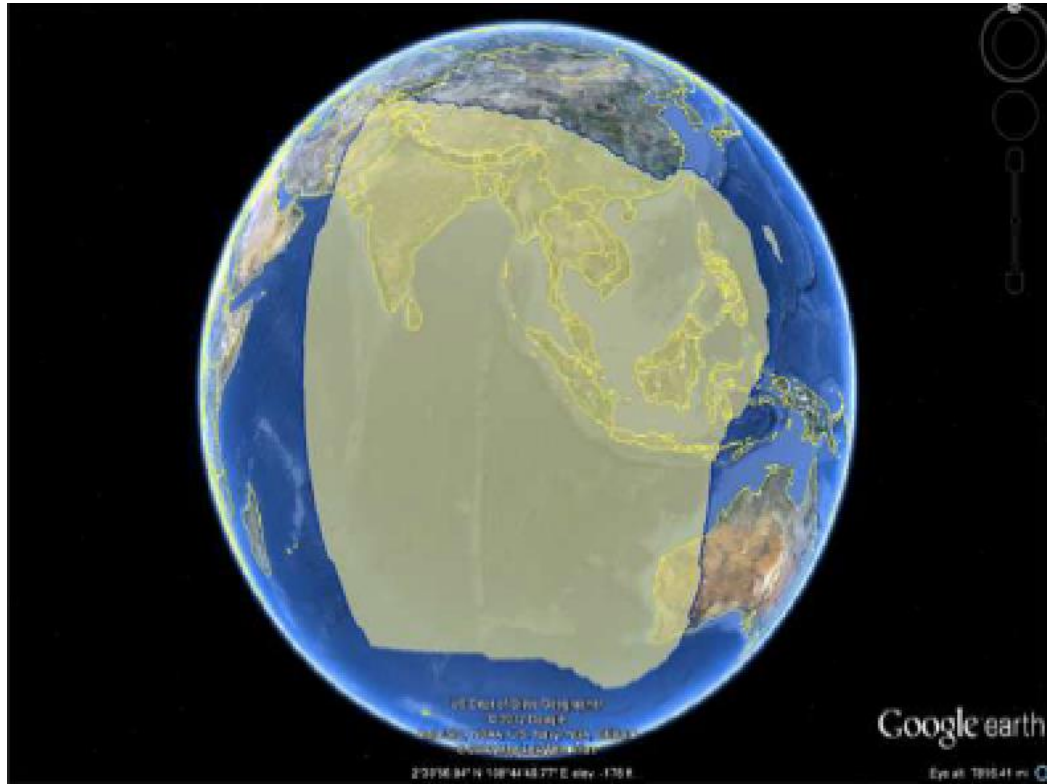
<b>eXConnect Terminal</b>	
Hub Earth Station	HR129
Lat	35.9 deg
Lon	138.0 deg
EIRP max	41.8 dBW
G/T	12.3 dB/K
<b>Satellite</b>	
Name	NSS-6
Longitude	95.0 deg
<b>Hub Earth Station</b>	
Site	Cyprus
Lat	34.92 deg
Lon	33.64 deg
EIRP max	80.0 dBW
G/T	36.0 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	8PSK
Bits per symbol	3
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.88 bps/Hz
Data Rate	5.64E+07 bps
Information Rate (Data + Overhead)	6.00E+07 bps
Symbol Rate	3.00E+07 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 Hz
Occupied Bandwidth	3.60E+07 Hz
Power Equivalent Bandwidth	3.58E+07 Hz
C/N Threshold	7.4 dB
<b>Uplink</b>	
Frequency	13.891 GHz
Back off	0.7 dB
EIRP Spectral Density	40.5 dBW/4kHz
Slant Range	40090 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.8 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	5.0 dB/K
Thermal Noise, C/No	99.7 dBHz
C/(No+Io)	99.2 dBHz
<b>Satellite</b>	
Flux Density	-89.6 dBW/m2
SFD @ Hub	-85.6 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	1.0 dB
<b>Downlink</b>	
Frequency	12.647 GHz
Transponder Sat. EIRP @ Beam Peak	54.5 dBW
Transponder Sat. EIRP @ Terminal	54.0 dBW
DL PSD Limit	14.7 dBW/4kHz
DL PSD @ Beam Peak	14.7 dBW/4kHz
Carrier EIRP @ Beam Peak	53.5 dBW
Carrier EIRP @ Terminal	53.0 dBW
Slant Range	38728 km
Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	87.1 dBHz
C/(No+Io)	84.0 dBHz
<b>End to End</b>	
End to End C/(No+Io)	83.9 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	8.1 dB
Link Margin	0.7 dB

**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	35.9 deg
Lon	138.0 deg
EIRP max	41.8 dBW
G/T	12.3 dB/K
<b>Satellite</b>	
Name	NSS-6
Longitude	95.0 deg
<b>Hub Earth Station</b>	
Site	Cyprus
Lat	34.92 deg
Lon	33.64 deg
EIRP max	80.0 dBW
G/T	36.0 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.34E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	3.69E+05 Hz
C/N Threshold	-1.2 dB
<b>Uplink</b>	
Frequency	14.390 GHz
Back off	0.0 dB
EIRP Spectral Density	9.6 dBW/4kHz
Slant Range	38728 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	8.0 dB/K
Thermal Noise, C/No	70.5 dBHz
C/(No+Io)	70.0 dBHz
<b>Satellite</b>	
Flux Density	-121.5 dBW/m2
SFD @ Terminal	-95.6 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	22.9 dB
<b>Downlink</b>	
Frequency	11.594 GHz
Transponder Sat. EIRP @ Beam Peak	50.0 dBW
Transponder Sat. EIRP @ Hub	50.0 dBW
DL PSD Limit	14.7 dBW/4kHz
DL PSD @ Beam Peak	-5.1 dBW/4kHz
Carrier EIRP @ Beam Peak	27.1 dBW
Carrier EIRP @ Hub	27.1 dBW
Slant Range	40090 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.4 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	79.5 dBHz
C/(No+Io)	74.0090 dBHz
<b>End to End</b>	
End to End C/(No+Io)	68.5 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	0.3 dB
Link Margin	1.5 dB

## 15. SUPERBIRD C2

### Coverage Map



## Satellite Operator Certification Letter



SKY Perfect JSAT Corporation  
1-14-14, Akasaka, Minato-ku  
Tokyo 107-0052, Japan  
TEL +81-3-5571-7800

Ref# MD-A-16-013

July 12, 2016

Federal Communications Commission  
International Bureau  
445 12th Street, S.W.  
Washington, D.C. 20554

Re: Engineering Certification of SKY Perfect JSAT Corporation for Astronics AeroSat

To Whom It May Concern:

This letter certifies that SKY Perfect JSAT Corporation ("JSAT") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek a modification to its blanket authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAAs") terminals, the HR129 and HR6400 terminals ("HR Terminals") with the JCSAT-5A satellite at 132° E.L and the Superbird C2 satellite at 144° E.L. JSAT understands that Astronics AeroSat will file the modification application pursuant to the FCC's rules governing ESAA terminal operations, including Section 25.227.

Based on the information provided by AeroSat, JSAT certifies that the proposed operation of the HR Terminals at the power density levels specified are consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from JCSAT-5A and Superbird C2. JSAT also acknowledges that the proposed operation of the Astronics AeroSat HR Terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, JSAT will take into consideration the power density levels associated such operations in all future satellite network coordinations with other adjacent satellite operators.

Sincerely,

SKY Perfect JSAT Corporation

  
\_\_\_\_\_  
Mitsuru Ishii

General Manager  
Mobile Business Division  
Global Business Group  
Space & Satellite Business Unit

  
\_\_\_\_\_  
Date

# Link Budgets

## Superbird-C2 LinkBudget

### Forward Link Budget

Flitestream Terminal	
Site	Mindoro Strait
Antenna Type	HR6400
Lat	11.6 deg
Lon	119.4 deg
G/T	12.6 dB/K
Satellite	
Name	Superbird C2
Transponder	K27
Longitude	144.0 deg
Hub Earth Station	
Site	Hong Kong
Lat	22.396 deg
Lon	114.11 deg
EIRP max	80.1 dBW
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50
Overhead Rate	0.83
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz
Data Rate	1.86E+07 bps
Information Rate (Data + Overhead)	2.25E+07 bps
Symbol Rate	2.25E+07 Hz
Chip Rate (Noise Bandwidth)	2.25E+07 Hz
Occupied Bandwidth	2.70E+07 Hz
C/N Threshold	0.9 dB
Uplink	
Frequency	14.433000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	42.6 dBW/4kHz
Slant Range	37247 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.9 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	-5.0 dB/K
Thermal Noise, C/No	93.8 dBHz
C/(No+Io)	93.2 dBHz
Satellite	
Flux Density	-85.3 dBW/m2
SFD @ Hub	-79.4 dBW/m2
Small Signal Gain (IBO/OBO)	1.4 dB
OBO	4.5 dB
Downlink	
Frequency	12.703000 GHz
Transponder Sat. EIRP @ Beam Peak	45.0 dBW
Transponder Sat. EIRP @ Terminal	45.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	3.1 dBW/4kHz
Carrier EIRP @ Beam Peak	40.6 dBW
Carrier EIRP @ Terminal	40.6 dBW
Slant Range	36596 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	75.8 dBHz
C/(No+Io)	75.8 dBHz
End to End	
End to End C/(No+Io)	75.8 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	1.2 dB
Link Margin	0.3 dB

### Return Link Budget

Flitestream Terminal	
Site	Mindoro Strait
Antenna Type	HR6400
Lat	11.6 deg
Lon	119.4 deg
Input Power Max	16.0 dBW
EIRP max	45.0 dBW
Satellite	
Name	Superbird C2
Transponder	K20
Longitude	144.0 deg
Hub Earth Station	
Site	Hong Kong
Lat	22.396 deg
Lon	114.11 deg
G/T	37.1 dB/K
Signal	
Waveform	iDirectRL-SF8
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.4310000
Overhead Rate	0.6764600
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.07 bps/Hz
Data Rate	4.81E+05 bps
Information Rate (Data + Overhead)	7.11E+05 bps
Symbol Rate	1.65E+06 Hz
Chip Rate (Noise Bandwidth)	6.60E+06 Hz
Occupied Bandwidth	7.92E+06 Hz
C/N Threshold	-5.0 dB
Uplink	
Frequency	14.184000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	1.0 dB
EIRP Spectral Density	11.8 dBW/4kHz
Slant Range	36596 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	1.0 dB/K
Thermal Noise, C/No	66.7 dBHz
C/(No+Io)	66.2 dBHz
Satellite	
Flux Density	-118.3 dBW/m2
SFD @ Terminal	-85.4 dBW/m2
Small Signal Gain (IBO/OBO)	1.4 dB
OBO	31.5 dB
Downlink	
Frequency	12.454000 GHz
Transponder Sat. EIRP @ Beam Peak	43.0 dBW
Transponder Sat. EIRP @ Hub	43.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-20.6 dBW/4kHz
Carrier EIRP @ Beam Peak	11.4 dBW
Carrier EIRP @ Hub	11.4 dBW
Slant Range	37247 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.7 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	67.7 dBHz
C/(No+Io)	67.3 dBHz
End to End	
End to End C/(No+Io)	63.7 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-4.5 dB
Link Margin	0.5 dB

**Forward Link Budget**

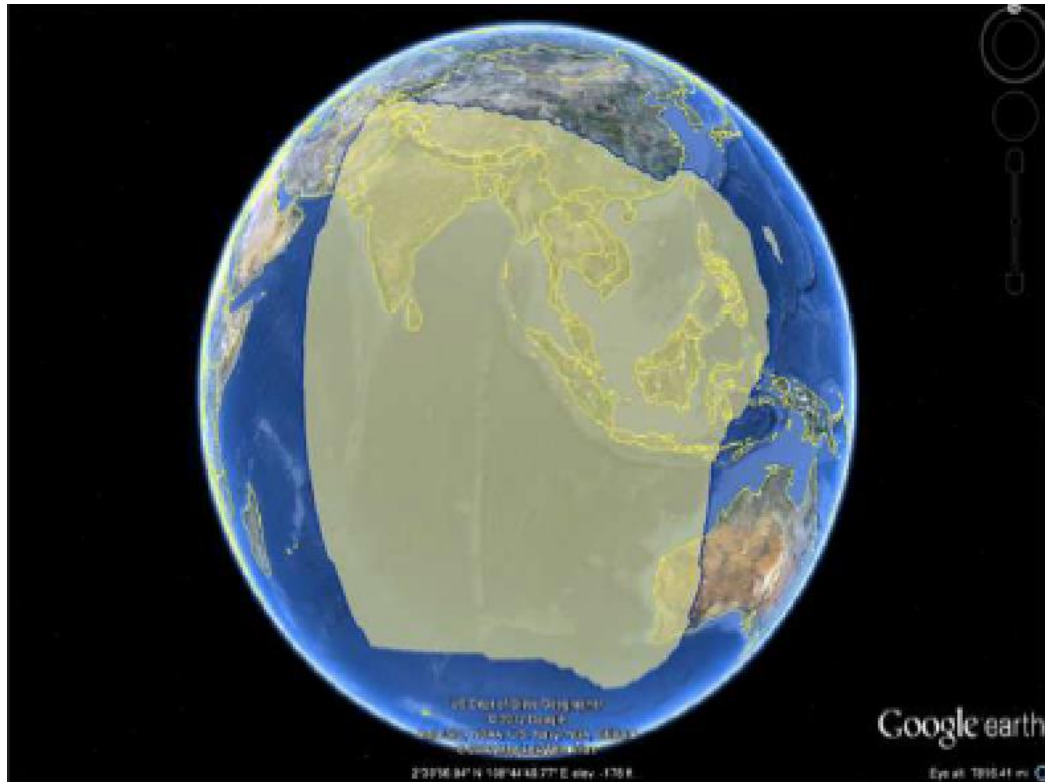
<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	1.0 deg
Lon	103.9 deg
EIRP max	42.0 dBW
G/T	11.3 dB/K
<b>Satellite</b>	
Name	SB-C2
Longitude	144.0 deg
<b>Hub Earth Station</b>	
Site	Hong Kong
Lat	22.45 deg
Lon	114.18 deg
EIRP max	80.0 dBW
G/T	37.3 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50
Overhead Rate	0.83
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz
Data Rate	1.86E+07 bps
Information Rate (Data + Overhead)	2.25E+07 bps
Symbol Rate	2.25E+07 Hz
Chip Rate (Noise Bandwidth)	2.25E+07 Hz
Occupied Bandwidth	2.70E+07 Hz
Power Equivalent Bandwidth	2.70E+07 Hz
C/N Threshold	0.9 dB
<b>Uplink</b>	
Frequency	14.433 GHz
Back off	3.4 dB
EIRP Spectral Density	39.1 dBW/4kHz
Slant Range	37251 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	-4.0 dB/K
Thermal Noise, C/No	88.1 dBHz
C/(No+Io)	87.6 dBHz
<b>Satellite</b>	
Flux Density	-91.9 dBW/m <sup>2</sup>
SFD @ Hub	-89.0 dBW/m <sup>2</sup>
Small Signal Gain (IBO/OBO)	2.4 dB
OBO	0.5 dB
<b>Downlink</b>	
Frequency	12.703 GHz
Transponder Sat. EIRP @ Beam Peak	46.0 dBW
Transponder Sat. EIRP @ Terminal	45.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	8.0 dBW/4kHz
Carrier EIRP @ Beam Peak	45.5 dBW
Carrier EIRP @ Terminal	44.5 dBW
Slant Range	37518 km
Space Loss, Ls	206.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	77.9 dBHz
C/(No+Io)	77.2 dBHz
<b>End to End</b>	
End to End C/(No+Io)	76.8 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	2.3 dB
Link Margin	1.4 dB

**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	1.0 deg
Lon	103.9 deg
EIRP max	42.0 dBW
G/T	11.3 dB/K
<b>Satellite</b>	
Name	SB-C2
Longitude	144.0 deg
<b>Hub Earth Station</b>	
Site	Hong Kong
Lat	22.45 deg
Lon	114.18 deg
EIRP max	80.0 dBW
G/T	37.3 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.50
Overhead Rate	0.74
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.09 bps/Hz
Data Rate	6.13E+05 bps
Information Rate (Data + Overhead)	8.34E+05 bps
Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	3.47E+05 Hz
C/N Threshold	-5.6 dB
<b>Uplink</b>	
Frequency	14.120 GHz
Back off	0.0 dB
EIRP Spectral Density	9.7 dBW/4kHz
Slant Range	37518 km
Space Loss, Ls	206.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	1.0 dB/K
Thermal Noise, C/No	64.1 dBHz
C/(No+Io)	63.6 dBHz
<b>Satellite</b>	
Flux Density	-121.1 dBW/m <sup>2</sup>
SFD @ Terminal	-95.0 dBW/m <sup>2</sup>
Small Signal Gain (IBO/OBO)	2.4 dB
OBO	23.7 dB
<b>Downlink</b>	
Frequency	12.390 GHz
Transponder Sat. EIRP @ Beam Peak	46.0 dBW
Transponder Sat. EIRP @ Hub	42.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-9.9 dBW/4kHz
Carrier EIRP @ Beam Peak	22.3 dBW
Carrier EIRP @ Hub	18.3 dBW
Slant Range	37251 km
Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.8 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	71.7 dBHz
C/(No+Io)	69.8315 dBHz
<b>End to End</b>	
End to End C/(No+Io)	62.7 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-5.6 dB
Link Margin	0.0 dB

## 16. TELSTAR 11N

### Coverage Map



## Satellite Operator Certification Letter



Telesat,  
1601 Telesat Court  
Ottawa, ON, Canada K1B 5P4

27 May 2016

Federal Communications Commission  
International Bureau  
445 12<sup>th</sup> Street SW  
Washington, DC 20554

### **Re: Engineering Certification for Astronics AeroSat**

To Whom It May Concern:

This letter certifies that Telesat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals to communicate with the Anik G1, Telstar 12V, and Telstar 11N satellites which are located at 107.3°W, 15°W, and 37.5°W, respectively. Specifically, we understand that Astronics AeroSat seeks to operate two types of Ku-band antennas, HR6400 antenna and HR129 antenna, for communication with these satellites for commercial purposes consistent with the FCC's Part 25 rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, Telesat understands the technical characteristics of the HR6400 and HR129 antennas and Telesat (i) recognizes that operation of these terminals at the power density levels provided to Telesat is consistent with the existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from Anik G1, Telstar 12V, and Telstar 11N; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics AeroSat, Telesat will take into consideration the power density levels associated with such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

A handwritten signature in black ink, appearing to be "B. Borna", enclosed within a large, loopy circular flourish.

BAHRAM BORNA  
Satellite Spectrum Coordination Engineer  
Telesat

# Link Budgets

## Forward Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	14.9 deg
Lon	-85.1 deg
EIRP max	41.6 dBW
G/T	11.2 dB/K
Satellite	
Name	Telstar 11N
Longitude	-37.6 deg
Hub Earth Station	
Site	Cologne
Lat	50.94 deg
Lon	6.96 deg
EIRP max	80.0 dBW
G/T	34.4 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.26 bps/Hz
Data Rate	3.77E+07 bps
Information Rate (Data + Overhead)	4.00E+07 bps
Symbol Rate	3.00E+07 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 Hz
Occupied Bandwidth	3.60E+07 Hz
Power Equivalent Bandwidth	5.40E+07 Hz
C/N Threshold	3.5 dB
Uplink	
Frequency	14.090 GHz
Back off	7.9 dB
EIRP Spectral Density	33.4 dBW/4kHz
Slant Range	39711 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.2 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	7.0 dB/K
Thermal Noise, C/No	97.1 dBHz
C/(No+Io)	96.6 dBHz
Satellite	
Flux Density	-94.0 dBW/m2
SFD @ Hub	-91.5 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	0.5 dB
Downlink	
Frequency	11.790 GHz
Transponder Sat. EIRP @ Beam Peak	51.0 dBW
Transponder Sat. EIRP @ Terminal	50.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	11.7 dBW/4kHz
Carrier EIRP @ Beam Peak	50.5 dBW
Carrier EIRP @ Terminal	49.5 dBW
Slant Range	38312 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	83.2 dBHz
C/(No+Io)	79.5 dBHz
End to End	
End to End C/(No+Io)	79.4 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.7 dB
Link Margin	0.2 dB

## Return Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	14.9 deg
Lon	-85.1 deg
EIRP max	41.6 dBW
G/T	11.2 dB/K
Satellite	
Name	Telstar 11N
Longitude	-37.6 deg
Hub Earth Station	
Site	Cologne
Lat	50.94 deg
Lon	6.96 deg
EIRP max	80.0 dBW
G/T	34.4 dB/K
Signal	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.50
Overhead Rate	0.74
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.18 bps/Hz
Data Rate	1.22E+06 bps
Information Rate (Data + Overhead)	1.67E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
Power Equivalent Bandwidth	2.12E+05 Hz
C/N Threshold	-2.3 dB
Uplink	
Frequency	14.029 GHz
Back off	0.0 dB
EIRP Spectral Density	9.4 dBW/4kHz
Slant Range	38312 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	6.0 dB/K
Thermal Noise, C/No	68.5 dBHz
C/(No+Io)	68.0 dBHz
Satellite	
Flux Density	-121.7 dBW/m2
SFD @ Terminal	-92.6 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	27.1 dB
Downlink	
Frequency	12.529 GHz
Transponder Sat. EIRP @ Beam Peak	52.0 dBW
Transponder Sat. EIRP @ Hub	52.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-7.3 dBW/4kHz
Carrier EIRP @ Beam Peak	24.9 dBW
Carrier EIRP @ Hub	24.9 dBW
Slant Range	39711 km
Space Loss, Ls	206.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	77.5 dBHz
C/(No+Io)	71.7471 dBHz
End to End	
End to End C/(No+Io)	66.5 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-1.7 dB
Link Margin	0.6 dB



Forward Link Budget

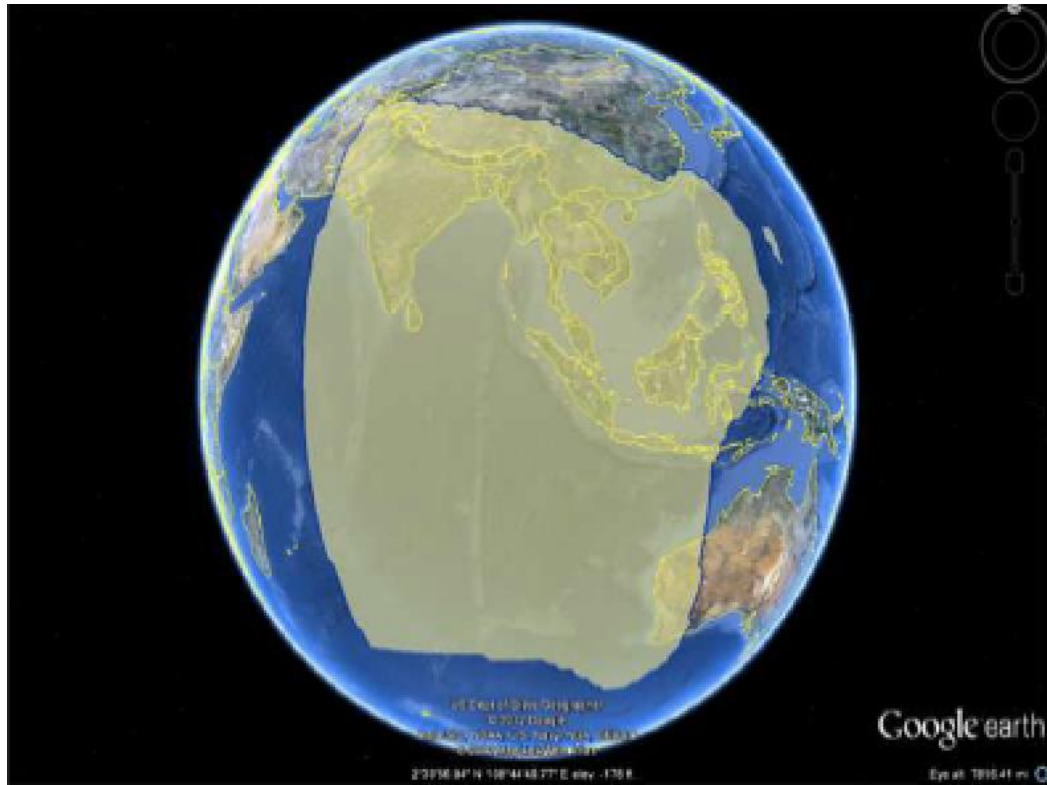
eXConnect Terminal	
Antenna Type	HR129
Lat	51.0 deg
Lon	-0.1 deg
EIRP max	42.5 dBW
G/T	11.0 dB/K
Satellite	
Name	Telstar 11N
Longitude	-37.6 deg
Hub Earth Station	
Site	Ellenwood
Lat	33.663 deg
Lon	-84.226 deg
EIRP max	90.0 dBW
G/T	40.0 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	1.55E+07 bps
Information Rate (Data + Overhead)	1.65E+07 bps
Symbol Rate	1.38E+07 Hz
Chip Rate (Noise Bandwidth)	1.38E+07 Hz
Occupied Bandwidth	1.65E+07 Hz
Power Equivalent Bandwidth	2.70E+07 Hz
C/N Threshold	2.7 dB
Uplink	
Frequency	13.888 GHz
Back off	0.3 dB
EIRP Spectral Density	54.3 dBW/4kHz
Slant Range	38879 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	-9.0 dB/K
Thermal Noise, C/No	97.1 dBHz
C/(No+Io)	96.6 dBHz
Satellite	
Flux Density	-78.2 dBW/m2
SFD @ Hub	-76.2 dBW/m2
Small Signal Gain (IBO/OBO)	1.0 dB
OBO	1.0 dB
Downlink	
Frequency	11.588 GHz
Transponder Sat. EIRP @ Beam Peak	45.8 dBW
Transponder Sat. EIRP @ Terminal	45.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	9.4 dBW/4kHz
Carrier EIRP @ Beam Peak	44.8 dBW
Carrier EIRP @ Terminal	44.0 dBW
Slant Range	39369 km
Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	77.5 dBHz
C/(No+Io)	75.2 dBHz
End to End	
End to End C/(No+Io)	75.2 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	2.8 dB
Link Margin	0.1 dB

Return Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	51.0 deg
Lon	-0.1 deg
EIRP max	42.5 dBW
G/T	11.0 dB/K
Satellite	
Name	Telstar 11N
Longitude	-37.6 deg
Hub Earth Station	
Site	Ellenwood
Lat	33.663 deg
Lon	-84.226 deg
EIRP max	90.0 dBW
G/T	40.0 dB/K
Signal	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.50
Overhead Rate	0.74
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.09 bps/Hz
Data Rate	6.13E+05 bps
Information Rate (Data + Overhead)	8.34E+05 bps
Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	3.81E+05 Hz
C/N Threshold	-5.6 dB
Uplink	
Frequency	14.212 GHz
Back off	0.0 dB
EIRP Spectral Density	10.2 dBW/4kHz
Slant Range	39369 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	2.0 dB/K
Thermal Noise, C/No	65.1 dBHz
C/(No+Io)	64.6 dBHz
Satellite	
Flux Density	-121.0 dBW/m2
SFD @ Terminal	-94.5 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	24.5 dB
Downlink	
Frequency	11.912 GHz
Transponder Sat. EIRP @ Beam Peak	45.8 dBW
Transponder Sat. EIRP @ Hub	42.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-10.9 dBW/4kHz
Carrier EIRP @ Beam Peak	21.3 dBW
Carrier EIRP @ Hub	17.5 dBW
Slant Range	38879 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.9 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	74.4 dBHz
C/(No+Io)	71.7265 dBHz
End to End	
End to End C/(No+Io)	63.9 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-4.4 dB
Link Margin	1.2 dB

# 17. TELSTAR 12V

## Coverage Map



## Satellite Operator Certification Letter



Telesat,  
1601 Telesat Court  
Ottawa, ON, Canada K1B 5P4

27 May 2016

Federal Communications Commission  
International Bureau  
445 12<sup>th</sup> Street SW  
Washington, DC 20554

### **Re: Engineering Certification for Astronics AeroSat**

To Whom It May Concern:

This letter certifies that Telesat is aware that Astronics AeroSat Corporation (“Astronics AeroSat”) is planning to seek authorization from the Federal Communications Commission (“FCC”) to operate Ku-band transmit/receive earth stations aboard aircraft (“ESAA”) terminals to communicate with the Anik G1, Telstar 12V, and Telstar 11N satellites which are located at 107.3°W, 15°W, and 37.5°W, respectively. Specifically, we understand that Astronics AeroSat seeks to operate two types of Ku-band antennas, HR6400 antenna and HR129 antenna, for communication with these satellites for commercial purposes consistent with the FCC’s Part 25 rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, Telesat understands the technical characteristics of the HR6400 and HR129 antennas and Telesat (i) recognizes that operation of these terminals at the power density levels provided to Telesat is consistent with the existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from Anik G1, Telstar 12V, and Telstar 11N; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics AeroSat, Telesat will take into consideration the power density levels associated with such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

A handwritten signature in black ink, appearing to read "Bahram Borina", enclosed within a circular scribble.

BAHRAM BORNA  
Satellite Spectrum Coordination Engineer  
Telesat

# Link Budgets

## Forward Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	29.8 deg
Lon	45.0 deg
EIRP max	42.0 dBW
G/T	10.6 dB/K
Satellite	
Name	T12V
Longitude	-15.0 deg
Hub Earth Station	
Site	Mt. Jackson
Lat	38.103 deg
Lon	-78.064 deg
EIRP max	90.0 dBW
G/T	40.0 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.40
Overhead Rate	0.93
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.74 bps/Hz
Data Rate	3.33E+07 bps
Information Rate (Data + Overhead)	3.60E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07 Hz
Power Equivalent Bandwidth	4.55E+07 Hz
C/N Threshold	0.2 dB
Uplink	
Frequency	29.610 GHz
Back off	8.7 dB
EIRP Spectral Density	40.8 dBW/4kHz
Slant Range	40335 km
Space Loss, Ls	214.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	22.9 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	18.2 dB/K
Thermal Noise, C/No	91.2 dBHz
C/(No+Io)	90.7 dBHz
Satellite	
Flux Density	-104.7 dBW/m2
SFD @ Hub	-95.8 dBW/m2
Small Signal Gain (IBO/OBO)	1.1 dB
OBO	7.8 dB
Downlink	
Frequency	11.138 GHz
Transponder Sat. EIRP @ Beam Peak	59.4 dBW
Transponder Sat. EIRP @ Terminal	58.4 dBW
DL PSD Limit	11.0 dBW/4kHz
DL PSD @ Beam Peak	11.0 dBW/4kHz
Carrier EIRP @ Beam Peak	51.5 dBW
Carrier EIRP @ Terminal	50.5 dBW
Slant Range	39817 km
Space Loss, Ls	205.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	83.8 dBHz
C/(No+Io)	78.6 dBHz
End to End	
End to End C/(No+Io)	78.3 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	0.8 dB
Link Margin	0.6 dB

## Return Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	29.8 deg
Lon	45.0 deg
EIRP max	42.0 dBW
G/T	10.6 dB/K
Satellite	
Name	T12V
Longitude	-15.0 deg
Hub Earth Station	
Site	Mt. Jackson
Lat	38.103 deg
Lon	-78.064 deg
EIRP max	90.0 dBW
G/T	40.0 dB/K
Signal	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.77
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.51 bps/Hz
Data Rate	3.43E+06 bps
Information Rate (Data + Overhead)	4.45E+06 bps
Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	1.71E+06 Hz
C/N Threshold	2.4 dB
Uplink	
Frequency	14.188 GHz
Back off	0.0 dB
EIRP Spectral Density	9.8 dBW/4kHz
Slant Range	39817 km
Space Loss, Ls	207.5 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	10.8 dB/K
Thermal Noise, C/No	73.3 dBHz
C/(No+Io)	72.8 dBHz
Satellite	
Flux Density	-121.6 dBW/m2
SFD @ Terminal	-88.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	30.8 dB
Downlink	
Frequency	18.488 GHz
Transponder Sat. EIRP @ Beam Peak	63.6 dBW
Transponder Sat. EIRP @ Hub	63.6 dBW
DL PSD Limit	11.0 dBW/4kHz
DL PSD @ Beam Peak	0.6 dBW/4kHz
Carrier EIRP @ Beam Peak	32.8 dBW
Carrier EIRP @ Hub	32.8 dBW
Slant Range	40335 km
Space Loss, Ls	209.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	13.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	78.0 dBHz
C/(No+Io)	76.6984 dBHz
End to End	
End to End C/(No+Io)	71.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	3.1 dB
Link Margin	0.7 dB

## Forward Link Budget

eXConnect Terminal	
Antenna Type	HR6400
Lat	29.8 deg
Lon	42.0 deg
EIRP max	45.5 dBW
G/T	10.0 dB/K
Satellite	
Name	T12V
Longitude	-15.0 deg
Hub Earth Station	
Site	Mt. Jackson
Lat	38.746 deg
Lon	-78.653 deg
EIRP max	90.0 dBW
G/T	39.0 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	4.37E+07 bps
Information Rate (Data + Overhead)	4.65E+07 bps
Symbol Rate	3.88E+07 Hz
Chip Rate (Noise Bandwidth)	3.88E+07 Hz
Occupied Bandwidth	4.65E+07 Hz
Power Equivalent Bandwidth	3.92E+07 Hz
C/N Threshold	2.7 dB
Uplink	
Frequency	29.810 GHz
Back off	10.0 dB
EIRP Spectral Density	40.2 dBW/4kHz
Slant Range	40403 km
Space Loss, Ls	214.1 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	22.3 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	18.2 dB/K
Thermal Noise, C/No	90.5 dBHz
C/(No+Io)	90.0 dBHz
Satellite	
Flux Density	-105.3 dBW/m2
SFD @ Hub	-95.8 dBW/m2
Small Signal Gain (IBO/OBO)	1.1 dB
OBO	8.5 dB
Downlink	
Frequency	11.138 GHz
Transponder Sat. EIRP @ Beam Peak	59.4 dBW
Transponder Sat. EIRP @ Terminal	58.4 dBW
DL PSD Limit	11.0 dBW/4kHz
DL PSD @ Beam Peak	11.0 dBW/4kHz
Carrier EIRP @ Beam Peak	50.9 dBW
Carrier EIRP @ Terminal	49.9 dBW
Slant Range	39554 km
Space Loss, Ls	205.3 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	82.6 dBHz
C/(No+Io)	80.7 dBHz
End to End	
End to End C/(No+Io)	80.2 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.3 dB
Link Margin	0.6 dB

## Return Link Budget

eXConnect Terminal	
Antenna Type	HR6400
Lat	29.8 deg
Lon	42.0 deg
EIRP max	45.5 dBW
G/T	10.0 dB/K
Satellite	
Name	T12V
Longitude	-15.0 deg
Hub Earth Station	
Site	Mt. Jackson
Lat	38.746 deg
Lon	-78.653 deg
EIRP max	90.0 dBW
G/T	39.0 dB/K
Signal	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.85
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	7.54E+06 bps
Information Rate (Data + Overhead)	8.89E+06 bps
Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	2.68E+06 Hz
C/N Threshold	5.0 dB
Uplink	
Frequency	14.188 GHz
Back off	2.6 dB
EIRP Spectral Density	10.7 dBW/4kHz
Slant Range	39554 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	11.8 dB/K
Thermal Noise, C/No	75.3 dBHz
C/(No+Io)	74.8 dBHz
Satellite	
Flux Density	-120.6 dBW/m2
SFD @ Terminal	-89.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	28.8 dB
Downlink	
Frequency	18.488 GHz
Transponder Sat. EIRP @ Beam Peak	63.6 dBW
Transponder Sat. EIRP @ Hub	63.6 dBW
DL PSD Limit	11.0 dBW/4kHz
DL PSD @ Beam Peak	2.6 dBW/4kHz
Carrier EIRP @ Beam Peak	34.8 dBW
Carrier EIRP @ Hub	34.8 dBW
Slant Range	40403 km
Space Loss, Ls	209.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	12.6 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	79.9 dBHz
C/(No+Io)	78.6128 dBHz
End to End	
End to End C/(No+Io)	73.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	5.0 dB
Link Margin	0.0 dB

## *18. YAMAL 300K*

### Coverage Map



## Satellite Operator Certification Letter



**ОТКРЫТОЕ  
АКЦИОНЕРНОЕ ОБЩЕСТВО  
«ГАЗПРОМ КОСМИЧЕСКИЕ СИСТЕМЫ»**

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28.06.2016

№ 1К-06/380/2974

Federal Communications Commission  
International Bureau  
445 12th Street, S.W.  
Washington, D.C. 20554

Re: Engineering Certification of Gazprom Space Systems.

To Whom It May Concern:

This letter certifies that Gazprom Space Systems (“GSS”) is aware that Astronics AeroSat Corporation (“Astronics AeroSat”) is planning to seek a modification to its blanket authorization from the Federal Communications Commission (“FCC”) to operate technically identical Ku-band transmit/receive earth stations aboard aircraft (“ESAAs”), Call Sign E140087, with the Yamal-401 satellite at 90°E and the Yamal-300K satellite at 183°E. Specifically, we understand that in addition to the previously authorized HR6400 terminals, Astronics AeroSat seeks to operate HR129 terminals with these satellites for commercial purposes consistent with the FCC’s ESAA rules, including Section 25.227.

GSS certifies that the proposed operation of the ESAA transmit/receive terminals at the power density levels specified are consistent with coordination agreements with affected satellite networks within +/- 6 degrees of orbital separation from the Yamal-401 and Yamal-300K satellites nominal positions. GSS also acknowledges that the proposed operation of the Astronics AeroSat ESAA terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, GSS will endeavour to ensure that the relevant Administration will include the power density levels specified by Astronics AeroSat in all coordinations with the future satellite networks.

Best regards,

Igor Kot,  
Deputy Director General



# Link Budgets

## Forward Link Budget

Flitestream Terminal	
Site	
Antenna Type	HR6400
Lat	46.9 deg
Lon	132.0 deg
G/T	11.8 dB/K
Satellite	
Name	Yamal-300K
Longitude	183.0 deg
Hub Earth Station	
Site	
Lat	48.1 deg
Lon	-119.8 deg
EIRP max	60.0 dBW
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50000
Overhead Rate	0.83000
Channel Spacing	1.20000
Spectral Efficiency (Rate/Noise BW)	0.83000 bps/Hz
Data Rate	3.74E+07 bps
Information Rate (Data + Overhead)	4.50E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07 Hz
C/N Threshold	0.9 dB
Uplink	
Frequency	14.380000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	14.2 dB
EIRP Spectral Density	25.3 dBW/4kHz
Slant Range	40298 km
Space Loss, Ls	207.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.6 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	4.0 dB/K
Thermal Noise, C/No	87.1 dBHz
C/(No+Io)	86.9 dBHz
Satellite	
Flux Density	-100.5 dBW/m2
SFD @ Hub	-94.5 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	3.0 dB
Downlink	
Frequency	11.580000 GHz
Transponder Sat. EIRP @ Beam Peak	53.5 dBW
Transponder Sat. EIRP @ Terminal	52.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	9.6 dBW/4kHz
Carrier EIRP @ Beam Peak	50.1 dBW
Carrier EIRP @ Terminal	49.1 dBW
Slant Range	39839 km
Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	83.6 dBHz
C/(No+Io)	83.3 dBHz
End to End	
End to End C/(No+Io)	81.7 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.2 dB
Link Margin	3.3 dB

## Return Link Budget (Link 1)

Flitestream Terminal	
Site	
Antenna Type	HR6400
Lat	46.9 deg
Lon	132.0 deg
EIRP max	45.1 dBW
Satellite	
Name	Yamal-300K
Longitude	183.0 deg
Hub Earth Station	
Site	
Lat	48.1 deg
Lon	-119.8 deg
G/T	37.5 dB/K
Signal	
Waveform	iDirectRL-SF8
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	-1.2 dB
Uplink	
Frequency	14.380000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	12.9 dBW/4kHz
Slant Range	39839 km
Space Loss, Ls	207.6 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	71.0 dBHz
C/(No+Io)	70.5 dBHz
Satellite	
Flux Density	-117.3 dBW/m2
SFD @ Terminal	-95.5 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	22.2 dB
Downlink	
Frequency	11.580000 GHz
Transponder Sat. EIRP @ Beam Peak	53.5 dBW
Transponder Sat. EIRP @ Hub	51.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	1.8 dBW/4kHz
Carrier EIRP @ Beam Peak	34.0 dBW
Carrier EIRP @ Hub	32.0 dBW
Slant Range	40298 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.4 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	88.9 dBHz
C/(No+Io)	86.9 dBHz
End to End	
End to End C/(No+Io)	70.4 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	3.2 dB
Link Margin	3.4 dB



**Forward Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	47.8 deg
Lon	-128.2 deg
EIRP max	42.0 dBW
G/T	11.1 dB/K
<b>Satellite</b>	
Name	Yamal-300K
Longitude	183.0 deg
<b>Hub Earth Station</b>	
Site	Brewster
Lat	48.1 deg
Lon	-119.8 deg
EIRP max	80.0 dBW
G/T	36.8 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	8PSK
Bits per symbol	3
Spread Factor	1
Coding Rate	0.75
Overhead Rate	0.92
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	2.07 bps/Hz
Data Rate	5.39E+07 bps
Information Rate (Data + Overhead)	5.85E+07 bps
Symbol Rate	2.60E+07 Hz
Chip Rate (Noise Bandwidth)	2.60E+07 Hz
Occupied Bandwidth	3.12E+07 Hz
Power Equivalent Bandwidth	6.46E+07 Hz
C/N Threshold	8.5 dB
<b>Uplink</b>	
Frequency	14.380 GHz
Back off	5.1 dB
EIRP Spectral Density	36.7 dBW/4kHz
Slant Range	40299 km
Space Loss, Ls	207.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.2 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	5.0 dB/K
Thermal Noise, C/No	97.5 dBHz
C/(No+Io)	97.0 dBHz
<b>Satellite</b>	
Flux Density	-91.5 dBW/m2
SFD @ Hub	-87.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	1.5 dB
<b>Downlink</b>	
Frequency	11.580 GHz
Transponder Sat. EIRP @ Beam Peak	53.6 dBW
Transponder Sat. EIRP @ Terminal	53.5 dBW
DL PSD Limit	14.0 dBW/4kHz
DL PSD @ Beam Peak	14.0 dBW/4kHz
Carrier EIRP @ Beam Peak	52.1 dBW
Carrier EIRP @ Terminal	52.0 dBW
Slant Range	39762 km
Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	85.5 dBHz
C/(No+Io)	84.4 dBHz
<b>End to End</b>	
End to End C/(No+Io)	84.2 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	9.0 dB
Link Margin	0.5 dB

**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	47.8 deg
Lon	-128.2 deg
EIRP max	42.0 dBW
G/T	11.1 dB/K
<b>Satellite</b>	
Name	Yamal-300K
Longitude	183.0 deg
<b>Hub Earth Station</b>	
Site	Brewster
Lat	48.1 deg
Lon	-119.8 deg
EIRP max	80.0 dBW
G/T	36.8 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.34E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	2.46E+05 Hz
C/N Threshold	-1.2 dB
<b>Uplink</b>	
Frequency	14.210 GHz
Back off	0.0 dB
EIRP Spectral Density	9.7 dBW/4kHz
Slant Range	39762 km
Space Loss, Ls	207.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	6.5 dB/K
Thermal Noise, C/No	69.0 dBHz
C/(No+Io)	68.5 dBHz
<b>Satellite</b>	
Flux Density	-121.6 dBW/m2
SFD @ Terminal	-90.9 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	27.7 dB
<b>Downlink</b>	
Frequency	11.160 GHz
Transponder Sat. EIRP @ Beam Peak	53.6 dBW
Transponder Sat. EIRP @ Hub	52.0 dBW
DL PSD Limit	14.0 dBW/4kHz
DL PSD @ Beam Peak	-6.3 dBW/4kHz
Carrier EIRP @ Beam Peak	26.0 dBW
Carrier EIRP @ Hub	24.3 dBW
Slant Range	40299 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.3 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	81.0 dBHz
C/(No+Io)	73.0394 dBHz
<b>End to End</b>	
End to End C/(No+Io)	67.2 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-1.0 dB
Link Margin	0.2 dB

## *19. YAMAL 401*

### Coverage Map



## Satellite Operator Certification Letter



**ОТКРЫТОЕ  
АКЦИОНЕРНОЕ ОБЩЕСТВО  
«ГАЗПРОМ КОСМИЧЕСКИЕ СИСТЕМЫ»**

(ОАО «Газпром космические системы»)  
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E-mail: info@gazprom-spacesystems.ru, www.gazprom-spacesystems.ru

28.06.2016

№ 1К-06/380/2974

Federal Communications Commission  
International Bureau  
445 12th Street, S.W.  
Washington, D.C. 20554

Re: Engineering Certification of Gazprom Space Systems.

To Whom It May Concern:

This letter certifies that Gazprom Space Systems (“GSS”) is aware that Astronics AeroSat Corporation (“Astronics AeroSat”) is planning to seek a modification to its blanket authorization from the Federal Communications Commission (“FCC”) to operate technically identical Ku-band transmit/receive earth stations aboard aircraft (“ESAAs”), Call Sign E140087, with the Yamal-401 satellite at 90°E and the Yamal-300K satellite at 183°E. Specifically, we understand that in addition to the previously authorized HR6400 terminals, Astronics AeroSat seeks to operate HR129 terminals with these satellites for commercial purposes consistent with the FCC’s ESAA rules, including Section 25.227.

GSS certifies that the proposed operation of the ESAA transmit/receive terminals at the power density levels specified are consistent with coordination agreements with affected satellite networks within +/- 6 degrees of orbital separation from the Yamal-401 and Yamal-300K satellites nominal positions. GSS also acknowledges that the proposed operation of the Astronics AeroSat ESAA terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, GSS will endeavour to ensure that the relevant Administration will include the power density levels specified by Astronics AeroSat in all coordinations with the future satellite networks.

Best regards,

Igor Kot,  
Deputy Director General



## Link Budgets

### Forward Link Budget

#### Flitestream Terminal

Antenna Type	HR6400
Lat	50.41 deg
Lon	40.26 deg
G/T	11.42 dB/K

#### Satellite

Name	Yamal-401
Longitude	90.00 deg

#### Hub Earth Station

Site	Moscow
Lat	55.80 deg
Lon	37.60 deg
EIRP max	73.83 dBW

#### Signal

Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	5.08E+07 bps
Information Rate (Data + Overhead)	5.40E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07 Hz
C/N Threshold	2.7 dB

#### Uplink

Frequency	14.180 GHz
Back off	4.6 dB
EIRP Spectral Density	28.7 dBW/4kHz
Slant Range	40423 km
Space Loss, Ls	207.61 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.55 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	4.50 dB/K
Thermal Noise, C/No	90.19 dBHz
C/(No+Io)	90.03 dBHz

#### Satellite

Flux Density	-98.5 dBW/m2
SFD @ Hub	-92.5 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB

OBO	3.0 dB
-----	--------

#### Downlink

Frequency	11.130 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Terminal	51.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	8.7 dBW/4kHz
Carrier EIRP @ Beam Peak	49.2 dBW
Carrier EIRP @ Terminal	48.6 dBW
Slant Range	39962 km
Space Loss, Ls	205.4 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Thermal Noise, C/No	83.1 dBHz
C/(No+Io)	82.1 dBHz

#### End to End

End to End C/(No+Io)	81.5 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.0 dB
Link Margin	1.3 dB

### Return Link Budget

#### Flitestream Terminal

Antenna Type	HR6400
Lat	50.4 deg
Lon	40.3 deg
EIRP max	45.0 dBW

#### Satellite

Name	Yamal-401
Longitude	90.0 deg

#### Hub Earth Station

Site	Moscow
Lat	55.8 deg
Lon	37.6 deg
G/T	31.7 dB/K

#### Signal

Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	-1.2 dB

#### Uplink

Frequency	14.180 GHz
Back off	0.0 dB
EIRP Spectral Density	12.8 dBW/4kHz
Slant Range	39962 km
Space Loss, Ls	207.51 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	71.0 dBHz
C/(No+Io)	70.6 dBHz

#### Satellite

Flux Density	-120.7 dBW/m <sup>2</sup>
SFD @ Terminal	-93.0 dBW/m <sup>2</sup>
Small Signal Gain (IBO/OBO)	3.0 dB

OBO	24.7 dB
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#### Downlink

Frequency	11.130 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Hub	51.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-2.3 dBW/4kHz
Carrier EIRP @ Beam Peak	30.0 dBW
Carrier EIRP @ Hub	29.4 dBW
Slant Range	40423 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.6 dB
Radome, Lr	0.0 dB
Thermal Noise, C/No	79.6 dBHz
C/(No+Io)	79.5 dBHz

#### End to End

End to End C/(No+Io)	70.0 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	1.8 dB
Link Margin	3.0 dB

**Forward Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	51.8 deg
Lon	34.9 deg
EIRP max	42.0 dBW
G/T	11.0 dB/K
<b>Satellite</b>	
Name	Yamal-401
Longitude	90.0 deg
<b>Hub Earth Station</b>	
Site	Moscow
Lat	55.8 deg
Lon	37.6 deg
EIRP max	80.0 dBW
G/T	38.5 dB/K
<b>Signal</b>	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.80
Overhead Rate	0.92
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.47 bps/Hz
Data Rate	2.94E+07 bps
Information Rate (Data + Overhead)	3.20E+07 bps
Symbol Rate	2.00E+07 Hz
Chip Rate (Noise Bandwidth)	2.00E+07 Hz
Occupied Bandwidth	2.40E+07 Hz
Power Equivelent Bandwidth	7.20E+07 Hz
C/N Threshold	5.1 dB
<b>Uplink</b>	
Frequency	14.380 GHz
Back off	6.8 dB
EIRP Spectral Density	36.2 dBW/4kHz
Slant Range	40424 km
Space Loss, Ls	207.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.8 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	5.0 dB/K
Thermal Noise, C/No	94.2 dBHz
C/(No+Io)	93.7 dBHz
<b>Satellite</b>	
Flux Density	-94.8 dBW/m2
SFD @ Hub	-88.8 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	3.0 dB
<b>Downlink</b>	
Frequency	11.580 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Terminal	51.5 dBW
DL PSD Limit	14.2 dBW/4kHz
DL PSD @ Beam Peak	12.1 dBW/4kHz
Carrier EIRP @ Beam Peak	49.1 dBW
Carrier EIRP @ Terminal	48.5 dBW
Slant Range	40357 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	81.8 dBHz
C/(No+Io)	79.3 dBHz
<b>End to End</b>	
End to End C/(No+Io)	79.1 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	5.1 dB
Link Margin	0.0 dB

**Return Link Budget**

<b>eXConnect Terminal</b>	
Antenna Type	HR129
Lat	51.8 deg
Lon	34.9 deg
EIRP max	42.0 dBW
G/T	11.0 dB/K
<b>Satellite</b>	
Name	Yamal-401
Longitude	90.0 deg
<b>Hub Earth Station</b>	
Site	Moscow
Lat	55.8 deg
Lon	37.6 deg
EIRP max	80.0 dBW
G/T	38.5 dB/K
<b>Signal</b>	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.12 bps/Hz
Data Rate	8.05E+05 bps
Information Rate (Data + Overhead)	1.11E+06 bps
Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	1.54E+05 Hz
C/N Threshold	-4.2 dB
<b>Uplink</b>	
Frequency	14.460 GHz
Back off	0.0 dB
EIRP Spectral Density	9.7 dBW/4kHz
Slant Range	40357 km
Space Loss, Ls	207.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	67.3 dBHz
C/(No+Io)	66.8 dBHz
<b>Satellite</b>	
Flux Density	-121.7 dBW/m2
SFD @ Terminal	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	29.7 dB
<b>Downlink</b>	
Frequency	11.660 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Hub	51.5 dBW
DL PSD Limit	14.2 dBW/4kHz
DL PSD @ Beam Peak	-9.8 dBW/4kHz
Carrier EIRP @ Beam Peak	22.4 dBW
Carrier EIRP @ Hub	21.8 dBW
Slant Range	40424 km
Space Loss, Ls	205.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.2 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	77.8 dBHz
C/(No+Io)	70.7777 dBHz
<b>End to End</b>	
End to End C/(No+Io)	65.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-2.9 dB
Link Margin	1.3 dB