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1050 OAK CREEK DRIVE
LOMBARD IL 60148
PHONE: (630) 620-0472
www.globaleagleent.com

**Ku Band Global Satellite Antenna Assembly (GSAA) Federal
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Document Number:	RWD11-0034-00	Rev.:	1.0
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	Name / Title	DATE
Prepared By:	Darshan Shah / Sr. RF Systems Engineer	_____
Reviewed By:	Mark Mielke / RF Systems Engineer Contract	_____
Approved By:	Atul Dhuria / Director Systems Engineering	_____
Approved By:	Simon McLellan / Chief Engineer	_____

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**Ku Band Global Satellite Antenna Assembly (GSAA)
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Document No.:	RWD11-0034-00
Rev.:	1.0
Page:	2/22
Date:	12/21/2016

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REVISION HISTORY				
ECO Number	Revision level	Approval Initial	Date Changed	Comments
1553	1.0	A. Dhuria		Initial Release

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TABLE OF CONTENTS

1 INTRODUCTION 7

2 ANTENNA PERFORMANCE 9

2.1 ANTENNA PATTERNS 10

 2.1.1 *Transmit Patterns* 10

 2.1.2 *Maximum EIRP Spectral Density Patterns* 11

2.2 ANTENNA CONTROL 19

2.3 ANTENNA POINTING ACCURACY AND TRACKING 20

EXHIBIT A: EIRP SPECTRAL DENSITY PLOTS

EXHIBIT B: COORDINATION LETTERS

EXHIBIT C: RADIATION HAZARD ANALYSIS

EXHIBIT D: SATELLITE COVERAGE MAPS

EXHIBIT E: LINK BUDGETS



TABLE OF FIGURES

Figure 1: GSAA Aperture Dimensions..... 8

Figure 2: 47 CFR Part 25.209(a)(2) Azimuth Co-Polarization Gain Envelope Compliance across all Skew & Elevation as well as Frequency (14.05– 14.47GHz) & Linear Polarization 9

Figure 3: 47 CFR Part 25.209(a)(5) Elevation Co-Polarization Gain Envelope Compliance across all Skew & Elevation as well as Frequency (14.05– 14.47GHz) & Linear Polarization 9

Figure 4: 47 CFR Part 25.209(b)(1) and 47 CFR Part 25.209(b)(2) Azimuth and Elevation Cross-Polarization Gain Envelope Compliance respectively across all Skew & Elevation as well as Frequency (14.05– 14.47GHz) & Linear Polarization 10

Figure 5: Skew and Elevation Angles Drawn for SES-1 (Located at 101°W Longitudinal Orbital Slot)..... 15



**Ku Band Global Satellite Antenna Assembly (GSAA)
Federal Communication Commission (FCC) Filing**

Document No.: **RWD11-0034-00**
Rev.: **1.0**
Page: **6/22**
Date: **12/21/2016**

TABLE OF TABLES

Table 1: Form 312 Differences from Existing License to Modification for GSAA Antenna..... 8

Table 2: GSAA Maximum Transmit Power Density Applied to the Antenna Flange to comply to 47 CFR Part 25.227(a)(1)(i)(A) 12

Table 3: GSAA Maximum EIRP Density to comply to 47 CFR Part 25.227(a)(1)(i)(A) 12

Table 4: GSAA Maximum EIRP Density to comply to 47 CFR Part 25.227(a)(1)(i)(A) for a 1.024 MHz Emission Bandwidth 13

Table 5: GSAA Maximum EIRP Density to comply to 47 CFR Part 25.227(a)(1)(i)(A) for a 2.048 MHz Emission Bandwidth 13

Table 6: GSAA Maximum EIRP Density to comply to 47 CFR Part 25.227(a)(1)(i)(A) for a 4.096 MHz Emission Bandwidth 14

Table 7: HPA Power/Emission Bandwidth Mapping to Power Spectral Density at the Antenna Flange, EIRP Spectral Densities, and Aircraft Transmit EIRP 16

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**Ku Band Global Satellite Antenna Assembly (GSAA)
Federal Communication Commission (FCC) Filing**

Document No.: **RWD11-0034-00**
Rev.: **1.0**
Page: **7/22**
Date: **12/21/2016**

1 INTRODUCTION

This application requests the modification of the existing Row 44¹, Ku Band Earth Stations Aboard Aircraft (ESAA) blanket Earth Station license to add a third antenna model for use as part of the Satellite Broadband Aircraft Subsystem. In some aircraft installations, Row 44 will incorporate a QEST antenna and High Power Transceiver (HPT), which shall be referred to as the Global Satellite Antenna Assembly (GSAA), illustrated in Figure 1. Row 44 does not seek an increase in the total number of units authorized for operation with its system but would utilize all existing antennas, including the new GSAA, up to a previously authorized combined maximum of 1,000 units.

The GSAA is being introduced to allow for more robust performance in international operation while satisfying Federal Communication Commission (FCC) requirements as identified in 47 CFR Part 25.209 for antenna performance in the plane, as well as that perpendicular to the Geo-Stationary Orbit (GSO) Arc, and Part 25.227 for Effective Isotropic Radiated Power (EIRP) off-axis co-polarization spectral density, off-axis cross polarization spectral density, and pointing accuracy requirements in conformance with two degree satellite spacing.

In North America, the GSAA operates slightly differently than the existing Satellite Antenna Assembly (SAA) system. The GSAA has a third axis of motion which allows the antenna to operate with elevation angles as low as 0° of continuous coverage with an azimuth coverage that is continuous over 360° and extending the skew up to 90°. There is an operational dependency between both elevation and skew angle which is described and characterized for the GSAA in a Section 2. A clear depiction of how the GSAA will be used for RF transmission is described in Section 2. Both the GSAA and SAA systems utilize independent linear polarized array antennas for communication to and from a geostationary satellite in space. RF signal bandwidth and transmit power delivered to the antenna shall be characterized in this document such that it complies with the FCC EIRP spectral density masks.

Except for the parameters specified in Table 1 with respect to the GSAA antenna, all aspects of GEE's ESAA system operation will remain unaltered from those described in its previous application and license.

¹ The in-flight connectivity business established by Row 44 now operates under the name Global Eagle Entertainment, which is the parent company of Row 44 (see IBFS File No. SES-T/C-20121203-01063). As Row 44 remains the name of the FCC licensee, that designation is used in this application.

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**Ku Band Global Satellite Antenna Assembly (GSAA)
Federal Communication Commission (FCC) Filing**

Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **8/22**
 Date: **12/21/2016**

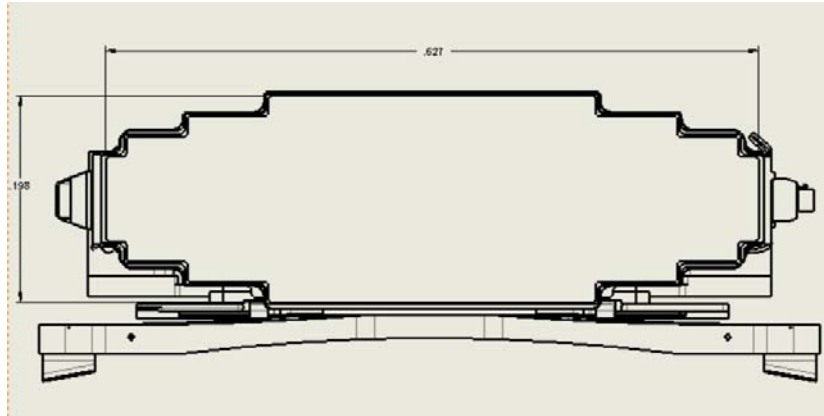


Figure 1: GSAA Aperture Dimensions

Table 1: Form 312 Differences from Existing License to Modification for GSAA Antenna

Form 312 Line	Parameter (Units)	Value for GSAA	Value for SAA
E32	Antenna Size (meters)	0.63	0.62
E33	Diameter/Minor (meters)	0.20	0.15
E34	Diameter/Major (meters)	0.63	0.62
E40	Total EIRP for all carriers (dBW)	41.9	43.8
E41	Antenna Gain (Transmit)	33.6 dBi at 14.25 GHz	28.8 dBi at 14.25 GHz
E42	Antenna Gain (Receive)	32.1 dBi at 11.75 GHz	31.1 dBi at 11.75 GHz
E43	Frequency Band (Receive)	10.95-12.5 GHz	10.95-12.75 GHz
E44	Frequency Band (Transmit)	14.05-14.47 GHz	14.04-14.47 GHz
E48	Maximum EIRP per carrier (dBW)	41.9	43.8
E49	Maximum EIRP Density per carrier (dBW/4kHz)	17.8	18.7
E60	Maximum EIRP density toward the horizon (dBW/4kHz)	-4.5	13.3

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2 ANTENNA PERFORMANCE

Row 44's GSAA is not compliant with the 47 CFR Part 25.209 off-axis antenna gain envelope for all skew and elevation value combinations. Figure 2 depicts the GSAA compliance "matrix" applicable to co-pol, tangent to the GSO Arc, considering the 47 CFR Part 25.209(a)(2) limits.

Table with 19 columns (0-90) and 19 rows (0-90) showing compliance values (1 or 0) for azimuth co-polarization gain envelope.

Figure 2: 47 CFR Part 25.209(a)(2) Azimuth Co-Polarization Gain Envelope Compliance Across All Skew and Elevation As Well As Frequency (14.05– 14.47GHz) and Linear Polarization

Note: For the figures below '1' indicates the antenna is compliant and '0' indicates the antenna is not compliant to the requirement indicated in the caption. Also note that skew angles are reversed in this table.

Due to the aerodynamic restrictions for fuselage-mounted antennas, the GSAA Aperture's vertical dimension (and therefore vertical radiation pattern performance) is limited. As such, Row 44 cannot satisfy the static elevation plane criteria under 47 CFR Part 25.209(a)(5) (the "matrix" is depicted in Figure 3).

Table with 19 columns (0-90) and 19 rows (0-90) showing compliance values (1 or 0) for elevation co-polarization gain envelope.

Figure 3: 47 CFR Part 25.209(a)(5) Elevation Co-Polarization Gain Envelope Compliance Across All Skew and Elevation as well as Frequency (14.05– 14.47GHz) & Linear Polarization

Note: For the figures below '1' indicates the antenna is compliant and '0' indicates the antenna is not compliant to the requirement indicated in the caption.

However, Row 44 will comply in its operations to 47 CFR Part 25.227(a)(2) of the FCC's rules, by coordinating with the requirements of satellite operators (SES Americom, Intelsat, and Echostar Satellite Services) that are providing space segment capacity for the service or are operating adjacent satellites to Row44's satellite provider.

Row 44 has obtained the required coordination letters for this antenna pursuant to 47 CFR Part 25.227(b) with all satellite space segment providers. Copies of these letters are attached in Exhibit B. All operations will also be subject to existing coordination agreements executed in 2008 with the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF) covering the transmit band operations of Row 44's license ESAA network.



The GSAA antenna is compliant for the cross-polarization gain envelope in both the azimuth and elevation direction for all skew and elevation as described in Figure 4.

Table with 19 columns (Elevation(deg)\Skew(deg) from 0 to 90) and 19 rows (Elevation from 0 to 90). All cells contain the value '1', indicating compliance.

Figure 4: 47 CFR Part 25.209(b)(1) and 47 CFR Part 25.209(b)(2) Azimuth and Elevation Cross-Polarization Gain Envelope Compliance Respectively Across All Skew and Elevation As Well As Frequency (14.05 – 14.47GHz) and Linear Polarization

Note: For the figures below '1' indicates the antenna is compliant and '0' indicates the antenna is not compliant to the requirement indicated in the caption.

2.1 Antenna Patterns

2.1.1 Transmit Patterns

Antenna EIRP spectral density plots for the transmit band at 14.00 GHz, 14.25 GHz, and 14.50 GHz are attached as Exhibit A in conformance with 47 CFR Part 25.227 and as required under 47 CFR Part 25.225(g)(1). Patterns are provided for vertical and horizontal polarization, each for a given range of elevation and/or skew values. Each plot demonstrates compliance with the off-axis EIRP density limits for one of a variety of conditions where the aircraft's location, not being of the same longitude as the target satellite, invokes a skew of the antenna's orientation relative to that of the satellite.

The specific skew and elevation combinations were selected so as to associate with the best-case and worst-case off-axis scenarios relating to compliance. Please note that the GSAA EIRP spectral density performance in the plane perpendicular to the GSO plane (i.e. the FCC mask as required under 47 CFR Part 25.227(a)(1)(i)(B)) is not fully compliant to the same EIRP spectral density levels in the plane tangent to the GSO plane (i.e. the FCC mask as required under 47 CFR Part 25.227(a)(1)(i)(A)). This is well understood with the satellite space segment provider and has been coordinated with the adjacent satellites.

The vertical and horizontal polarizations off-axis gain characteristics indicate the antenna can support the EIRP spectral densities as described in section 2.1.2 while being compliant to 47 CFR Part 25.227, the transmit power being set to values being respectively compatible with the prevailing values of the antenna skew and elevation.

In practice, during aircraft movement, the skew and elevation angle values are monitored by the GSAA. The aircraft transmitter shall be muted in the event that the skew angle and elevation combination exceeds a specific limit, corresponding to that beyond which, the off-axis EIRP density would otherwise exceed the 47 CFR Part 25.227 EIRP Density values consistent with those of Row 44's current authorization.



2.1.2 Maximum EIRP Spectral Density Patterns

This section describes how the GSAA will be utilized from the perspective of RF Transmission.

The values of conducted transmit power to the antenna flange (for given skew and elevation combinations) are maximum implementable levels serving to satisfy the FCC 47 CFR Part 25.227(a)(1)(i)(A) limits. EIRP spectral densities are also provided in association with these transmit power levels at the antenna flange to satisfy the FCC 47 CFR Part 25.227(a)(1)(i)(A) limits. These levels are given under various conditions. The first condition being realizing the performance of the aperture itself in dBW/4kHz. The second condition being in practice how the antenna performs in Row44's operational aircraft system so it will include the following items:

- 25 watts of HPA power
- transmission line losses
- radome losses
- assume the operational bandwidths that can be configured for the system which will be reported in a power spectral density with respect to dBW/4kHz:
 - 1.024 MHz
 - 2.048 MHz
 - 4.096 MHz.

In practice, for a specific satellite coverage area over the United States (see geographical depiction in Figure 5), the worst case skew and elevation combination relative to the orbital location is determined. The maximum conducted power density to the antenna flange is determined considering the associated value from Table 2. The maximum corresponding EIRP spectral density (as well as its highest EIRP spectral density) is then located in Table 3.

Finally with the maximum conducted power spectral density applied to the antenna flange, the emission bandwidth (1.024 MHz, 2.048 MHz, and 4.096 MHz), HPA power setting (up to 25 watts) will be determined for all inroute/uplink emissions within the specific coverage area, such that it complies with 47 CFR Part 25.227(a)(1)(i)(A) as described by Table 4, Table 5, and Table 6.

The transmit EIRP Spectral Density as well as transmit EIRP from the aircraft is determined from Table 7 as well based on these operational bandwidths. Exhibit A contains EIRP Density plots for both vertical and horizontal polarizations over a $\pm 180^\circ$ azimuth at 14.00 GHz, 14.25 GHz, and 14.50 GHz for the maximum EIRP spectral density in a 4 kHz bandwidth for the aperture performance only. This is subsequently the supporting data for the derivation applicable to Table 3.



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Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **12/20**
 Date: **12/21/2016**

Table 2: GSA Maximum Transmit Power Density Applied to the Antenna Flange to Comply to 47 CFR Part 25.227(a)(1)(i)(A)

		GSA MAXIMUM SPECTRAL DENSITY AT THE ANTENNA FLANGE (dBW/4kHz)																			
Elevation(deg)\Skew(deg)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90		
0	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3	-26.6	-27.7	-28.4		
5	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3	-26.6	-27.7	-28.4		
10	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3	-26.6	-27.7	-28.4		
15	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.9	-17.4	-17.9	-18.5	-19.2	-20.1	-21.1	-22.1	-23.3	-24.6	-26.0	-27.2	-28.2		
20	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.9	-17.4	-17.9	-18.5	-19.2	-20.1	-21.1	-22.1	-23.3	-24.6	-26.0	-27.2	-28.2		
25	-15.6	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3	-26.6	-27.7		
30	-15.6	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3	-26.6	-27.7		
35	-15.6	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.9	-17.4	-17.9	-18.5	-19.2	-20.1	-21.1	-22.1	-23.3	-24.6	-26.0	-27.2		
40	-15.6	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.9	-17.4	-17.9	-18.5	-19.2	-20.1	-21.1	-22.1	-23.3	-24.6	-26.0	-27.2		
45	-15.6	-15.6	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3	-26.6		
50	-15.6	-15.6	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.9	-17.4	-17.9	-18.5	-19.2	-20.1	-21.1	-22.1	-23.3	-24.6	-26.0		
55	-15.6	-15.6	-15.6	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7	-24.0	-25.3		
60	-15.6	-15.6	-15.6	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.9	-17.4	-17.9	-18.5	-19.2	-20.1	-21.1	-22.1	-23.3	-24.6		
65	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5	-21.6	-22.7		
70	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.7	-15.8	-16.1	-16.4	-16.6	-17.1	-17.7	-18.2	-18.9	-19.6	-20.5		
75	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.7	-15.9	-16.2	-16.6	-17.1	-17.7		
80	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6		
85	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6		
90	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6		

Note: This data uses the antenna gain at 14.50 GHz

Table 3: GSA Maximum EIRP Density to Comply to 47 CFR Part 25.227(a)(1)(i)(A)

		GSA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz)																			
Elevation(deg)\Skew(deg)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90		
0	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6	7.3	6.2	5.5		
5	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6	7.3	6.2	5.5		
10	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6	7.3	6.2	5.5		
15	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8	11.8	10.6	9.3	7.9	6.7	5.7		
20	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8	11.8	10.6	9.3	7.9	6.7	5.7		
25	18.3	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6	7.3	6.2		
30	18.3	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6	7.3	6.2		
35	18.3	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8	11.8	10.6	9.3	7.9	6.7		
40	18.3	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8	11.8	10.6	9.3	7.9	6.7		
45	18.3	18.3	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6	7.3		
50	18.3	18.3	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8	11.8	10.6	9.3	7.9		
55	18.3	18.3	18.3	18.3	18.3	18.2	18.0	17.7	17.3	16.8	16.2	15.7	15.0	14.3	13.4	12.3	11.2	9.9	8.6		
60	18.3	18.3	18.3	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8	11.8	10.6	9.3		
65	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.3	13.4	12.3		
70	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.2	18.1	17.8	17.5	17.0	16.5	16.0	15.4	14.7	13.8	12.8		
75	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		
80	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		
85	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		
90	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		

Note: This data uses the antenna gain at 14.50 GHz



Ku Band Global Satellite Antenna Assembly (GSAA) Federal Communication Commission (FCC) Filing

Document No.: RWD11-0034-00
 Rev.: 1.0
 Page: 13/20
 Date: 12/21/2016

Table 4: GSAA Maximum EIRP Density to Comply to 47 CFR Part 25.227(a)(1)(i)(A) for a 1.024 MHz Emission Bandwidth

		GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) for 1.024 MHz Emission Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90		
0	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	5.4	
5	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	5.4	
10	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	5.4	
15	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.0	16.5	15.9	15.4	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	5.7	
20	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.0	16.5	15.9	15.4	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	5.7	
25	17.8	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	
30	17.8	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	
35	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.0	16.5	15.9	15.4	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	
40	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.0	16.5	15.9	15.4	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	
45	17.8	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	
50	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.0	16.5	15.9	15.4	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	
55	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1
60	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.0	16.5	15.9	15.4	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6
65	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9	8.6
70	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.4	17.2	16.7	16.2	15.6	15.0	14.2	13.3	12.3	11.2	9.9
75	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.7	17.2	16.7	16.2	15.6	15.0
80	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
85	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
90	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8

Note: This data includes an HPA with maximum 25 watts, coaxial losses, radome losses, and uses the antenna gain at 14.50 GHz

Table 5: GSAA Maximum EIRP Density to Comply to 47 CFR Part 25.227(a)(1)(i)(A) for a 2.048 MHz Emission Bandwidth

		GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) for 2.048 MHz Emission Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90		
0	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	5.4	
5	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	5.4	
10	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	5.4	
15	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	5.7	
20	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	5.7	
25	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	
30	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	
35	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	
40	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	
45	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1	
50	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6	
55	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6	7.3	6.1
60	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.7	10.6	9.3	7.9	6.6
65	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	13.3	12.3	11.2	9.9	8.6
70	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.6	13.8	12.8	11.2	9.9
75	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
80	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
85	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
90	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8

Note: This data includes an HPA with maximum 25 watts, coaxial losses, radome losses, and uses the antenna gain at 14.50 GHz



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Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **14/20**
 Date: **12/21/2016**

Table 6: GSAA Maximum EIRP Density to Comply to 47 CFR Part 25.227(a)(1)(i)(A) for a 4.096 MHz Emission Bandwidth

		GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) for 4.096 MHz Emission Bandwidth																	
Elevation(deg)\Skew(deg)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
5	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
10	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
15	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
20	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
25	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
30	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
35	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
40	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
45	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
50	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
55	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
60	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
65	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
70	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
75	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
80	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
85	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4
90	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.2	9.9	8.6	7.3	6.1	5.4

Note: This data includes an HPA with maximum 25 watts, coaxial losses, radome losses, and uses the antenna gain at 14.50 GHz

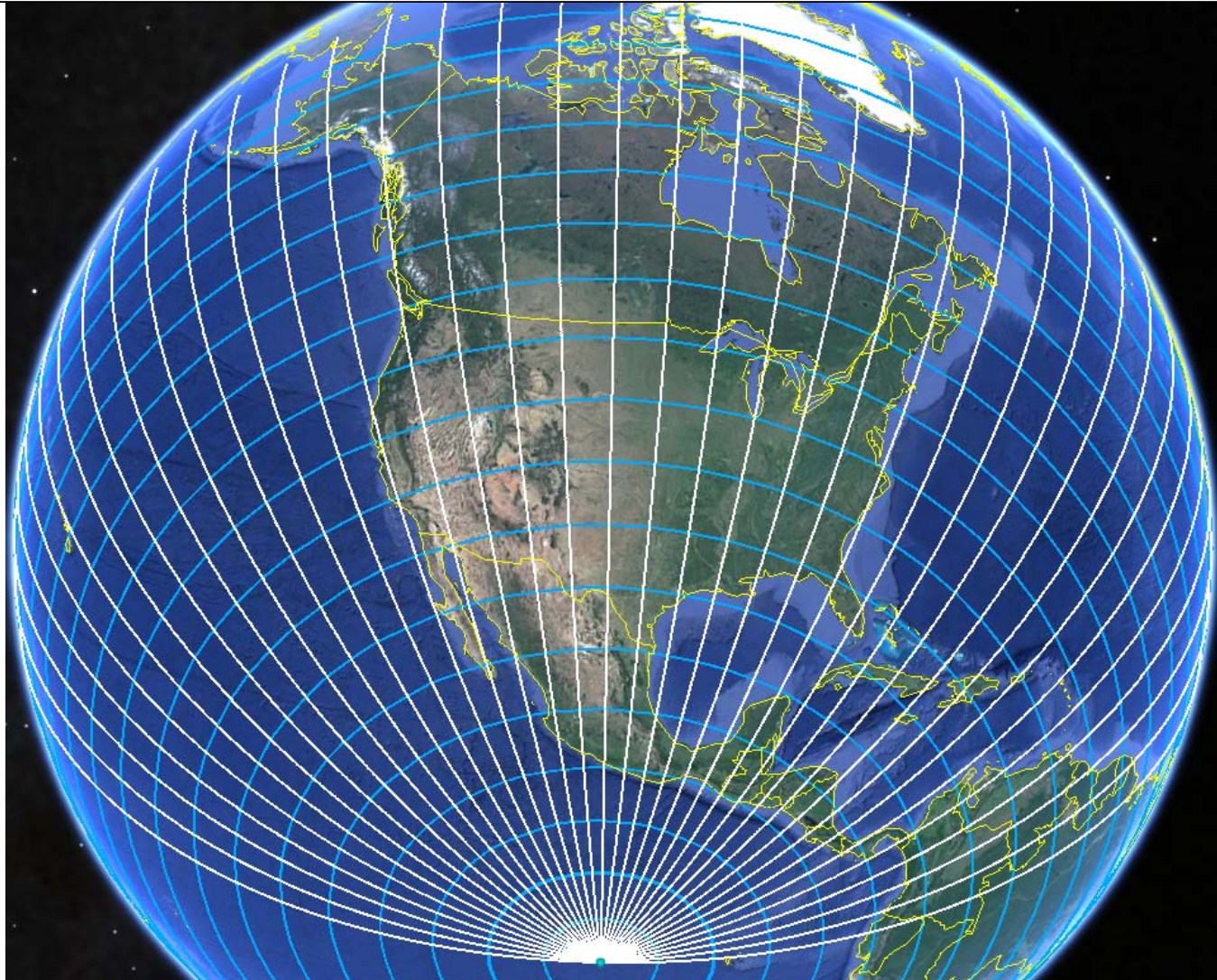


Figure 5: Skew and Elevation Angles Drawn for SES-1 (Located at 101°W Longitudinal Orbital Slot)

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Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **16/20**
 Date: **12/21/2016**

Table 7: HPA Power/Emission Bandwidth Mapping to Power Spectral Density at the Antenna Flange, EIRP Spectral Densities, and Aircraft Transmit EIRP

HPA Power (Watts)	HPA Power (dBW)	Spectral Density at the Flange, dBW/4kHz			EIRP Spectral Density, dBW/4kHz*			Maximum Tx EIRP, dBW**
		Emission Bandwidth, kHz			Emission Bandwidth, kHz			
		1024	2048	4096	1024	2048	4096	
25.0	13.98	-15.3	-18.3	-21.3	17.8	14.8	11.8	41.9
24.4	13.88	-15.4	-18.4	-21.4	17.7	14.7	11.7	41.8
23.9	13.78	-15.5	-18.5	-21.5	17.6	14.6	11.6	41.7
23.3	13.68	-15.6	-18.6	-21.6	17.5	14.5	11.5	41.6
22.8	13.58	-15.7	-18.7	-21.7	17.4	14.4	11.4	41.5
22.3	13.48	-15.8	-18.8	-21.8	17.3	14.3	11.3	41.4
21.8	13.38	-15.9	-18.9	-21.9	17.2	14.2	11.2	41.3
21.3	13.28	-16.0	-19.0	-22.0	17.1	14.1	11.1	41.2
20.8	13.18	-16.1	-19.1	-22.1	17.0	14.0	11.0	41.1
20.3	13.08	-16.2	-19.2	-22.2	16.9	13.9	10.9	41.0
19.9	12.98	-16.3	-19.3	-22.3	16.8	13.8	10.8	40.9
19.4	12.88	-16.4	-19.4	-22.4	16.7	13.7	10.7	40.8
19.0	12.78	-16.5	-19.5	-22.5	16.6	13.6	10.6	40.7
18.5	12.68	-16.6	-19.6	-22.6	16.5	13.5	10.5	40.6
18.1	12.58	-16.7	-19.7	-22.7	16.4	13.4	10.4	40.5
17.7	12.48	-16.8	-19.8	-22.8	16.3	13.3	10.3	40.4
17.3	12.38	-16.9	-19.9	-22.9	16.2	13.2	10.2	40.3
16.9	12.28	-17.0	-20.0	-23.0	16.1	13.1	10.1	40.2
16.5	12.18	-17.1	-20.1	-23.1	16.0	13.0	10.0	40.1
16.1	12.08	-17.2	-20.2	-23.2	15.9	12.9	9.9	40.0
15.8	11.98	-17.3	-20.3	-23.3	15.8	12.8	9.8	39.9
15.4	11.88	-17.4	-20.4	-23.4	15.7	12.7	9.7	39.8
15.1	11.78	-17.5	-20.5	-23.5	15.6	12.6	9.6	39.7
14.7	11.68	-17.6	-20.6	-23.6	15.5	12.5	9.5	39.6
14.4	11.58	-17.7	-20.7	-23.7	15.4	12.4	9.4	39.5
14.1	11.48	-17.8	-20.8	-23.8	15.3	12.3	9.3	39.4
13.7	11.38	-17.9	-20.9	-23.9	15.2	12.2	9.2	39.3
13.4	11.28	-18.0	-21.0	-24.0	15.1	12.1	9.1	39.2
13.1	11.18	-18.1	-21.1	-24.1	15.0	12.0	9.0	39.1
12.8	11.08	-18.2	-21.2	-24.2	14.9	11.9	8.9	39.0
12.5	10.98	-18.3	-21.3	-24.3	14.8	11.8	8.8	38.9
12.2	10.88	-18.4	-21.4	-24.4	14.7	11.7	8.7	38.8
12.0	10.78	-18.5	-21.5	-24.5	14.6	11.6	8.6	38.7
11.7	10.68	-18.6	-21.6	-24.6	14.5	11.5	8.5	38.6
11.4	10.58	-18.7	-21.7	-24.7	14.4	11.4	8.4	38.5

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Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **17/20**
 Date: **12/21/2016**

HPA Power (Watts)	HPA Power (dBW)	Spectral Density at the Flange, dBW/4kHz			EIRP Spectral Density, dBW/4kHz*			Maximum Tx EIRP, dBW**
		Emission Bandwidth, kHz			Emission Bandwidth, kHz			
		1024	2048	4096	1024	2048	4096	
11.2	10.48	-18.8	-21.8	-24.8	14.3	11.3	8.3	38.4
10.9	10.38	-18.9	-21.9	-24.9	14.2	11.2	8.2	38.3
10.7	10.28	-19.0	-22.0	-25.0	14.1	11.1	8.1	38.2
10.4	10.18	-19.1	-22.1	-25.1	14.0	11.0	8.0	38.1
10.2	10.08	-19.2	-22.2	-25.2	13.9	10.9	7.9	38.0
10.0	9.98	-19.3	-22.3	-25.3	13.8	10.8	7.8	37.9
9.7	9.88	-19.4	-22.4	-25.4	13.7	10.7	7.7	37.8
9.5	9.78	-19.5	-22.5	-25.5	13.6	10.6	7.6	37.7
9.3	9.68	-19.6	-22.6	-25.6	13.5	10.5	7.5	37.6
9.1	9.58	-19.7	-22.7	-25.7	13.4	10.4	7.4	37.5
8.9	9.48	-19.8	-22.8	-25.8	13.3	10.3	7.3	37.4
8.7	9.38	-19.9	-22.9	-25.9	13.2	10.2	7.2	37.3
8.5	9.28	-20.0	-23.0	-26.0	13.1	10.1	7.1	37.2
8.3	9.18	-20.1	-23.1	-26.1	13.0	10.0	7.0	37.1
8.1	9.08	-20.2	-23.2	-26.2	12.9	9.9	6.9	37.0
7.9	8.98	-20.3	-23.3	-26.3	12.8	9.8	6.8	36.9
7.7	8.88	-20.4	-23.4	-26.4	12.7	9.7	6.7	36.8
7.5	8.78	-20.5	-23.5	-26.5	12.6	9.6	6.6	36.7
7.4	8.68	-20.6	-23.6	-26.6	12.5	9.5	6.5	36.6
7.2	8.58	-20.7	-23.7	-26.7	12.4	9.4	6.4	36.5
7.0	8.48	-20.8	-23.8	-26.8	12.3	9.3	6.3	36.4
6.9	8.38	-20.9	-23.9	-26.9	12.2	9.2	6.2	36.3
6.7	8.28	-21.0	-24.0	-27.0	12.1	9.1	6.1	36.2
6.6	8.18	-21.1	-24.1	-27.1	12.0	9.0	6.0	36.1
6.4	8.08	-21.2	-24.2	-27.2	11.9	8.9	5.9	36.0
6.3	7.98	-21.3	-24.3	-27.3	11.8	8.8	5.8	35.9
6.1	7.88	-21.4	-24.4	-27.4	11.7	8.7	5.7	35.8
6.0	7.78	-21.5	-24.5	-27.5	11.6	8.6	5.6	35.7
5.9	7.68	-21.6	-24.6	-27.6	11.5	8.5	5.5	35.6
5.7	7.58	-21.7	-24.7	-27.7	11.4	8.4	5.4	35.5
5.6	7.48	-21.8	-24.8	-27.8	11.3	8.3	5.3	35.4
5.5	7.38	-21.9	-24.9	-27.9	11.2	8.2	5.2	35.3
5.3	7.28	-22.0	-25.0	-28.0	11.1	8.1	5.1	35.2
5.2	7.18	-22.1	-25.1	-28.1	11.0	8.0	5.0	35.1
5.1	7.08	-22.2	-25.2	-28.2	10.9	7.9	4.9	35.0
5.0	6.98	-22.3	-25.3	-28.3	10.8	7.8	4.8	34.9
4.9	6.88	-22.4	-25.4	-28.4	10.7	7.7	4.7	34.8

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Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **18/20**
 Date: **12/21/2016**

HPA Power (Watts)	HPA Power (dBW)	Spectral Density at the Flange, dBW/4kHz			EIRP Spectral Density, dBW/4kHz*			Maximum Tx EIRP, dBW**
		Emission Bandwidth, kHz			Emission Bandwidth, kHz			
		1024	2048	4096	1024	2048	4096	
4.8	6.78	-22.5	-25.5	-28.5	10.6	7.6	4.6	34.7
4.7	6.68	-22.6	-25.6	-28.6	10.5	7.5	4.5	34.6
4.5	6.58	-22.7	-25.7	-28.7	10.4	7.4	4.4	34.5
4.4	6.48	-22.8	-25.8	-28.8	10.3	7.3	4.3	34.4
4.3	6.38	-22.9	-25.9	-28.9	10.2	7.2	4.2	34.3
4.2	6.28	-23.0	-26.0	-29.0	10.1	7.1	4.1	34.2
4.1	6.18	-23.1	-26.1	-29.1	10.0	7.0	4.0	34.1
4.1	6.08	-23.2	-26.2	-29.2	9.9	6.9	3.9	34.0
4.0	5.98	-23.3	-26.3	-29.3	9.8	6.8	3.8	33.9
3.9	5.88	-23.4	-26.4	-29.4	9.7	6.7	3.7	33.8
3.8	5.78	-23.5	-26.5	-29.5	9.6	6.6	3.6	33.7
3.7	5.68	-23.6	-26.6	-29.6	9.5	6.5	3.5	33.6
3.6	5.58	-23.7	-26.7	-29.7	9.4	6.4	3.4	33.5
3.5	5.48	-23.8	-26.8	-29.8	9.3	6.3	3.3	33.4
3.5	5.38	-23.9	-26.9	-29.9	9.2	6.2	3.2	33.3
3.4	5.28	-24.0	-27.0	-30.0	9.1	6.1	3.1	33.2
3.3	5.18	-24.1	-27.1	-30.1	9.0	6.0	3.0	33.1
3.2	5.08	-24.2	-27.2	-30.2	8.9	5.9	2.9	33.0
3.1	4.98	-24.3	-27.3	-30.3	8.8	5.8	2.8	32.9
3.1	4.88	-24.4	-27.4	-30.4	8.7	5.7	2.7	32.8
3.0	4.78	-24.5	-27.5	-30.5	8.6	5.6	2.6	32.7
2.9	4.68	-24.6	-27.6	-30.6	8.5	5.5	2.5	32.6
2.9	4.58	-24.7	-27.7	-30.7	8.4	5.4	2.4	32.5
2.8	4.48	-24.8	-27.8	-30.8	8.3	5.3	2.3	32.4
2.7	4.38	-24.9	-27.9	-30.9	8.2	5.2	2.2	32.3
2.7	4.28	-25.0	-28.0	-31.0	8.1	5.1	2.1	32.2
2.6	4.18	-25.1	-28.1	-31.1	8.0	5.0	2.0	32.1
2.6	4.08	-25.2	-28.2	-31.2	7.9	4.9	1.9	32.0
2.5	3.98	-25.3	-28.3	-31.3	7.8	4.8	1.8	31.9
2.4	3.88	-25.4	-28.4	-31.4	7.7	4.7	1.7	31.8
2.4	3.78	-25.5	-28.5	-31.5	7.6	4.6	1.6	31.7
2.3	3.68	-25.6	-28.6	-31.6	7.5	4.5	1.5	31.6
2.3	3.58	-25.7	-28.7	-31.7	7.4	4.4	1.4	31.5
2.2	3.48	-25.8	-28.8	-31.8	7.3	4.3	1.3	31.4
2.2	3.38	-25.9	-28.9	-31.9	7.2	4.2	1.2	31.3
2.1	3.28	-26.0	-29.0	-32.0	7.1	4.1	1.1	31.2
2.1	3.18	-26.1	-29.1	-32.1	7.0	4.0	1.0	31.1

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**Ku Band Global Satellite Antenna Assembly (GSAA)
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Document No.: **RWD11-0034-00**
 Rev.: **1.0**
 Page: **19/20**
 Date: **12/21/2016**

HPA Power (Watts)	HPA Power (dBW)	Spectral Density at the Flange, dBW/4kHz			EIRP Spectral Density, dBW/4kHz*			Maximum Tx EIRP, dBW**
		Emission Bandwidth, kHz			Emission Bandwidth, kHz			
		1024	2048	4096	1024	2048	4096	
2.0	3.08	-26.2	-29.2	-32.2	6.9	3.9	0.9	31.0
2.0	2.98	-26.3	-29.3	-32.3	6.8	3.8	0.8	30.9
1.9	2.88	-26.4	-29.4	-32.4	6.7	3.7	0.7	30.8
1.9	2.78	-26.5	-29.5	-32.5	6.6	3.6	0.6	30.7
1.9	2.68	-26.6	-29.6	-32.6	6.5	3.5	0.5	30.6
1.8	2.58	-26.7	-29.7	-32.7	6.4	3.4	0.4	30.5
1.8	2.48	-26.8	-29.8	-32.8	6.3	3.3	0.3	30.4
1.7	2.38	-26.9	-29.9	-32.9	6.2	3.2	0.2	30.3
1.7	2.28	-27.0	-30.0	-33.0	6.1	3.1	0.1	30.2
1.7	2.18	-27.1	-30.1	-33.1	6.0	3.0	0.0	30.1
1.6	2.08	-27.2	-30.2	-33.2	5.9	2.9	-0.1	30.0
1.6	1.98	-27.3	-30.3	-33.3	5.8	2.8	-0.2	29.9
1.5	1.88	-27.4	-30.4	-33.4	5.7	2.7	-0.3	29.8
1.5	1.78	-27.5	-30.5	-33.5	5.6	2.6	-0.4	29.7
1.5	1.68	-27.6	-30.6	-33.6	5.5	2.5	-0.5	29.6
1.4	1.58	-27.7	-30.7	-33.7	5.4	2.4	-0.6	29.5
1.4	1.48	-27.8	-30.8	-33.8	5.3	2.3	-0.7	29.4
1.4	1.38	-27.9	-30.9	-33.9	5.2	2.2	-0.8	29.3
1.3	1.28	-28.0	-31.0	-34.0	5.1	2.1	-0.9	29.2
1.3	1.18	-28.1	-31.1	-34.1	5.0	2.0	-1.0	29.1
1.3	1.08	-28.2	-31.2	-34.2	4.9	1.9	-1.1	29.0
1.3	0.98	-28.3	-31.3	-34.3	4.8	1.8	-1.2	28.9
1.2	0.88	-28.4	-31.4	-34.4	4.7	1.7	-1.3	28.8
1.2	0.78	-28.5	-31.5	-34.5	4.6	1.6	-1.4	28.7
1.2	0.68	-28.6	-31.6	-34.6	4.5	1.5	-1.5	28.6
1.1	0.58	-28.7	-31.7	-34.7	4.4	1.4	-1.6	28.5
1.1	0.48	-28.8	-31.8	-34.8	4.3	1.3	-1.7	28.4
1.1	0.38	-28.9	-31.9	-34.9	4.2	1.2	-1.8	28.3
1.1	0.28	-29.0	-32.0	-35.0	4.1	1.1	-1.9	28.2
1.0	0.18	-29.1	-32.1	-35.1	4.0	1.0	-2.0	28.1
1.0	0.08	-29.2	-32.2	-35.2	3.9	0.9	-2.1	28.0

Note: *This data includes coaxial losses

**This data includes an HPA with maximum 25 watts, coaxial losses, radome losses, and antenna gain at 14.50 GHz

2.2 Antenna Control

The GSAA configuration operates the same way as the existing SAA configuration. The Antenna Control Unit (ACU) which is a separate device connected to the existing SAA is now integrated

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**Ku Band Global Satellite Antenna Assembly (GSAA)
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Document No.: **RWD11-0034-00**
Rev.: **1.0**
Page: **20/20**
Date: **12/21/2016**

within the GSAA. The GSAA controls the antenna's azimuth, elevation, and polarization orientation relative to the aircraft motion in order to point the antenna toward the target geostationary satellite. The GSAA obtains information about the aircraft's velocity and heading from the on-board Air Data Inertial Reference Units (ADIRUs) via either an ARINC 429, ARINC 629, or ARINC 664 data bus. The GSAA antenna is gimballed, permitting the transmission beam to be directed in azimuth, elevation, and polarization according to the received signal quality and aircraft position. As in the existing implementation, the combination of the aircraft's ADIRU data and measured Es/N0 data provided to the GSAA from the Modem Data Unit (MDU) allows the 0.2° peak error to be maintained under various types of aircraft motion and in situations where skew causes the aircraft to not have the same longitude as the target satellite.

2.3 Antenna Pointing Accuracy and Tracking

In compliance with 47 CFR Part 25.227(a)(1)(ii)(A), as well as ITU-R M.1643, Annex 1, Part A, Section 2, antenna pointing accuracy is controlled by the GSAA to a pointing error of less than 0.2° peak between the orbital location of the target satellite and the axis of the main lobe of the antenna. Row 44 has designed its system so that all emissions shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the antenna is projected to exceed $\pm 0.2^\circ$. This provides ample margin to ensure satisfaction of the requirement of 47 CFR Part 25.227(a)(1)(iii)(A) that transmissions cease in the event this angle exceeds $\pm 0.5^\circ$.