ATTACHMENT A

TECHNICAL APPENDIX

IN SUPPORT OF THE 17/24 GHZ PAYLOAD OF SES-1 (101°W.L.)

TECHNICAL APPENDIX

1.0 Overall Description

SES-1 is a hybrid C- and Ku-band communications satellite to be operated at 101° W.L. with coverage of the Continental USA, Alaska, Hawaii, Mexico and the Caribbean. The satellite also contains a 17/24 GHz broadcasting-satellite service payload, which will not be operated at the 101° W.L. orbital location. SES Americom, Inc. (doing business as "SES WORLD SKIES") is requesting authority to operate the spacecraft only in the standard C- and Ku-band frequencies. Materials describing the technical characteristics of the spacecraft itself and the C- and Ku-band operations are already on file with the Commission and are incorporated by reference herein.[1] Nothing in this document changes any of the information previously supplied with respect to the C- and Ku-band payloads or the TT&C functions of the spacecraft. This document describes only the technical characteristics of the 17/24 GHz payload.

2.0 Schedule S

The Schedule S database is attached as an electronic file. Where items have been left blank in the attached Schedule S, the relevant information was provided in the Schedule S attached to the SES-1 Application and is unchanged.

The following items supplement the information provided in Schedule S.

1. *Transponder frequency plan.*

The 17/24 GHz payload is capable of operating on the following frequencies:

Uplinks: 24.75-25.25 GHz

Downlinks: 17.3-17.8 GHz

The 17/24 GHz payload consists of a single "transponder" powered by a single TWTA, with single uplink beam (KAR) and single downlink beam (KAT). The single uplink and downlink beams for the transponder are described in Section S8. This single transponder, however, can support multiple carriers of variable bandwidth across the entire band and, thus, a variety of frequency plans. In a typical operational scenario, the uplink and downlink frequencies on this transponder would be divided into 14 uplink and downlink "channels" of 31 MHz bandwidth (consisting of multiple carriers with a total bandwidth of 31 MHz), and 34.3 MHz channel

[1] File No. SAT-RPL-20100120-00014, Call Sign S2807 (the "SES-1 Application").

spacing using single polarization. This typical channel plan is depicted at Section S9 of the Schedule S, with each uplink channel labeled KAR1 through KAR14 and each downlink channel labeled KAT1 through KAT14. The polarization of the uplinks is LHCP, and that of the downlinks is RHCP. Section S10 of the Schedule S shows how each uplink channel would correspond to each downlink channel in the typical scenario. However, due to the limitations in the Schedule S software and form, SES WORLD SKIES was forced to assign a different Transponder ID to each row of Section S10 in order to show this correspondence. These different Transponder IDs in Section S10 should be understood as all referring to the same, single 17/24 GHz BSS transponder on SES-1.

As noted above, the payload uses a single TWTA. The payload also has single input and output filters for the entire 500 MHz band. Table 1 shows the filter characteristics.

Table 1. Input and output channel filter characteristics (frequency band: 17.3-17.8 GHz)

Offset from center frequency, MHz	Input filter Insertion loss variation, dBp-p, max	Input filter Group delay variation, ns, max	Output filter Insertion loss variation, dBp-p, max	Output filter Group delay variation, ns, max
± 125	0.15	0.8	0.1	0.4
± 150	0.2	1	0.1	0.5
± 175	0.3	1.4	0.15	0.6
± 200	0.4	2	0.2	0.8
± 225	0.55	3	0.25	1.1
± 250	0.8	5	0.4	1.9

2. *Saturation Flux Density values.*

SFD values for the 17/24 GHz payload can be obtained by using the expression

SFD = -97.7 – (G/T) +Transponder Gain Setting, dBW/m2

3.0 Satellite Antenna Gain Contours

Annex 1 shows the antenna gain contours for the transmit and receive beams, which use horn antennas. Schedule S includes the footprints of the receive and transmit antennas (files KAR.GXT and KAT.GXT). The gain contours are only shown to -12 dBi instead of down to -20 dBi as requested in 25.114(d)(3), because the remaining gain contours do not intersect the earth.

In addition, section S7 of Schedule S shows the maximum gains of the receive and transmit antennas, maximum EIRP, and maximum G/T values.

4.0 Emission Designators and Link Budgets

Table 2 shows two typical link budgets.

5.0 Cessation of Emissions

The TWTA of the payload is commandable to apply or remove RF drive of the associated amplifier as required under § 25.207.

6.0 Service to Alaska and Hawaii

SES WORLD SKIES does not seek authority to provide video programming services using the 17/24 GHz payload on SES-1, and accordingly, the requirements of Sections 25.225(a) and (b) relating to design and operation of 17/24 GHz BSS spacecraft to ensure provision of such services to Alaska and Hawaii[2] are not applicable here. Nevertheless, SES WORLD SKIES demonstrates herein that, if it were to operate from the 101° W.L. orbital location, the 17/24 GHz payload on SES-1 would be technically capable of providing service to Alaska and Hawaii since the satellite EIRP and G/T values would be sufficiently high over those areas (see Annex 1). The EIRP and G/T values in the Alaskan region would be comparable to those in CONUS, and hence typical link budgets for transmit and receive sites in CONUS would also be typical in Alaska. The EIRP and G/T values at Hawaii would be poorer than the peak values in CONUS by 4 dB, which could be compensated for by using larger antennas. A typical link budget for hypothetical service to Honolulu is shown in Table 3. At more easterly orbital locations, larger antennas could be used as appropriate.

[2] 47 C.F.R. **§** 25.225(a) and (b).

Table 2. Typical link budgets –CONUS and Alaska

Parameter	KA_1	KA_2
Carrier designation	1M20G1W	5M50G1W
Throughput rate, Mbps	1.43	4.75
Required bandwidth, MHz	1.20	5.50
Allocated bandwidth, MHz	1.20	5.50
FEC code rate	0.50	0.50
C/N required, dB	4.70	1.28
Faded system margin, dB	0.50	0.50
Uplink		
Transmit Power (dBW)	4.00	10.50
Antenna diameter	9.00	9.00
Antenna Gain (dBi)	65.00	65.00
TxES antenna input power density, dBW/MHz	3.21	3.10
Ground Station EIRP (dBW)	77.50	75.50
Uplink Rain Loss (dB)	0.00	0.00
Satellite G/T (dB/K)	-9.00	-8.00
C/N, dB	25.23	17.24
C/I(X-pol uplink), dB	30.00	30.00
Downlinks:		
Satellite Carrier EIRP (dBW)	34.00	34.00
Ground station antenna dia, m	0.95	1.50
Ground Station G/T (dB/K)	20.90	24.87
C/N(clear weather), dB	14.74	11.72
Min C/N down, dB	7.06	2.65
C/I(ASI), dB	10.00	10.00
C/I(total), dB	9.91	9.91
Rain margin to min C/N down, dB	7.69	9.07
Availability, %		
BIRMINGHAM AL	99.21%	99.71%
LITTLE ROCK AR	99.27%	99.75%
DENVER CO	99.90%	99.97%
WASHINGTON DC	99.50%	99.83%
MIAMI FL	99.36%	99.55%
LOS ANGELES CA	99.98%	99.99%
MOBILE AL	99.07%	99.63%

Table 3. Typical link budgets –Hawaii

Parameter	KA_1	KA_2
Carrier designation	1M20G1W	5M50G1W
Throughput rate, Mbps	1.43	4.75
Required bandwidth, MHz	1.20	5.50
Allocated bandwidth, MHz	1.20	5.50
FEC code rate	0.50	0.50
C/N required, dB	4.70	1.28
Faded system margin, dB	0.50	0.50
Uplink		
Transmit Power (dBW)	4.00	10.50
Antenna diameter	9.00	9.00
Antenna Gain (dBi)	65.00	65.00
TxES antenna input power density, dBW/MHz	3.21	3.10
Ground Station EIRP (dBW)	77.50	75.50
Uplink Rain Loss (dB)	0.00	0.00
Satellite G/T (dB/K)	-12.00	-12.00
C/N, dB	22.23	13.24
C/I(X-pol uplink), dB	30.00	30.00
Downlinks:		
Satellite Carrier EIRP (dBW)	31.00	31.00
Ground station antenna dia, m	0.95	1.50
Ground Station G/T (dB/K)	20.90	24.87
C/N(clear weather), dB	11.74	8.72
Min C/N down, dB	7.12	2.88
C/I(ASI), dB	10.00	10.00
C/I(total), dB	9.91	9.91
Rain margin to min C/N down, dB	4.62	5.84

7.0 Interference Analysis and Compliance with PFD and Off-axis EIRP Density Limits

Even though no operating authority is being sought for the 17/24 GHz payload, information is provided here to demonstrate that the payload is capable of complying with Commission rules for operation in a four-degree spacing environment at an Appendix F grid location.[3]

[3] *See* 47 C.F.R. § 25.262(a). As discussed in the legal narrative for this amendment, Section 25.140(b)(4), which specifies the interference showing that must be made in a 17/24 GHz BSS application for operations at a non-grid location, is inapplicable here because the rule applies only to applicants "for a *license to operate* a 17/24 GHz BSS space station." 47 C.F.R. **§** 25.140(b)(4) (emphasis added). *See also* 47 C.F.R. **§** 25.140(b)(3) & (5) (describing interference showing required of an applicant for an operating license at an on-grid location).

To achieve compatibility between satellites spaced with an orbital separation of 4°, the FCC has defined limits on downlink PFD at the earth's surface[4] and uplink off-axis EIRP density.[5] Table 4 shows the allowable PFD values (from Section 25.208 of the FCC rules) in the 17.3 – 17.7 GHz and 17.7-17.8 GHz bands and the actual PFD values for the SES-1 payload. The SES-1 payload complies with the applicable limits in all cases.

The allowable off-axis EIRP density limit in the uplinks that are in the frequency range 24.75-25.25 GHz is $32.5 - 25 \log \theta$ dBW/MHz for off-axis angle range $2° \leq \theta < 7°$. Since large antennas will be used in the uplinks, the sidelobe envelope is $29 - 25 \log \theta$. As a result, the allowable power density at the input to the transmit earth station is 3.5 dBW/MHz. The system would be operated such that this limit[6] will not be exceeded. Table 2 shows that in the two typical cases the value of the power density is 3.21 dBW/MHz and 3.1 dBW/MHz.

Again, SES WORLD SKIES is not seeking an operating license for the SES-1 17/24 GHz BSS payload. In any event, if Section 25.140(b)(4) did apply here, the rule's requirements would be satisfied. Under Section 25.140(b)(4), an applicant "must demonstrate that its proposed network will not cause more interference to the adjacent 17/24 GHz BSS satellite networks" than if the planned network was operating at an Appendix F grid location. Because SES WORLD SKIES is not requesting authority to turn on the SES-1 17/24 GHz BSS payload at 101° W.L., it will not be causing *any* interference to adjacent 17/24 GHz BSS licensees.

[4] 47 C.F.R. § 25.208.

[5] 47 C.F.R. § 25.223.

[6] The actual off-axis eirp density levels will meet the entire mask in § 25.223, taking into account that the limits apply over the range of the off-axis angles (2° to 180°).

Table 4. PFD Values

Elevation angle, deg	5.00	10.00	15.00	20.00	25.00	Maximum EIRP, dBW
Max. EIRP, dBW	35.00	35.00	35.00	35.00	35.00	35.00
EIRP at elevation angle, dBW	34.32	34.35	34.40	34.45	34.50	35.00
Minimum spreading loss, dB/m2	-163.27	-163.15	-163.06	-162.94	-162.84	-162.00
Carrier bandwidth, MHz	1.00	1.00	1.00	1.00	1.00	1.00
PFD, dBW/m2/MHz	-128.95	-128.80	-128.66	-128.49	-128.34	-127.00
25.208 PFD limit (17.3-17.7 GHz, minimum among different regions), dBW/m2/MHz	-121.00	-121.00	-121.00	-121.00	-121.00	-121.00
25.208 PFD limit (17.7-17.8 GHz band), dBW/m2/MHz	-115.00	-115.00	-115.00	-115.00	-115.00	-115.00
Margin (in 17.3-17.7GHz band), dB	7.95	7.80	7.66	7.49	7.34	6.00
Margin (in 17.7-17.8GHz band), dB	13.95	13.80	13.66	13.49	13.34	12.00

Table 5 shows C/I and C/(N+I) estimates of the SES-1 carriers when interfered with by a hypothetical adjacent satellite system operating at 4° orbital separation, and operating at the maximum satellite EIRP density allowed by the FCC. In this conservative model the C/N margin is seen to be positive (approximately 2 dB) in the two typical cases. SES WORLD SKIES will use larger earth station antennas with the 17/24 GHz payload in the event that there are two adjacent satellite interferers operating at higher power levels and as otherwise necessary to improve link performance.

In the hypothetical case of operations of the SES-1 17/24 GHz payload with adjacent satellites less than 4 degrees away, SES WORLD SKIES would conform its operations to comply with Section 25.262(d) of the Commission's rules as required.

As noted above, SES WORLD SKIES is not seeking authority to operate the 17/24 GHz payload on SES-1 at 101° W.L. If SES WORLD SKIES in the future decides to pursue authority to operate the 17/24 GHz payload, SES WORLD SKIES will submit an application supported by an interference analysis for the specific orbital location and operating levels proposed.

Table 5. Single-entry interference Analysis (wanted carrier: SES-1)

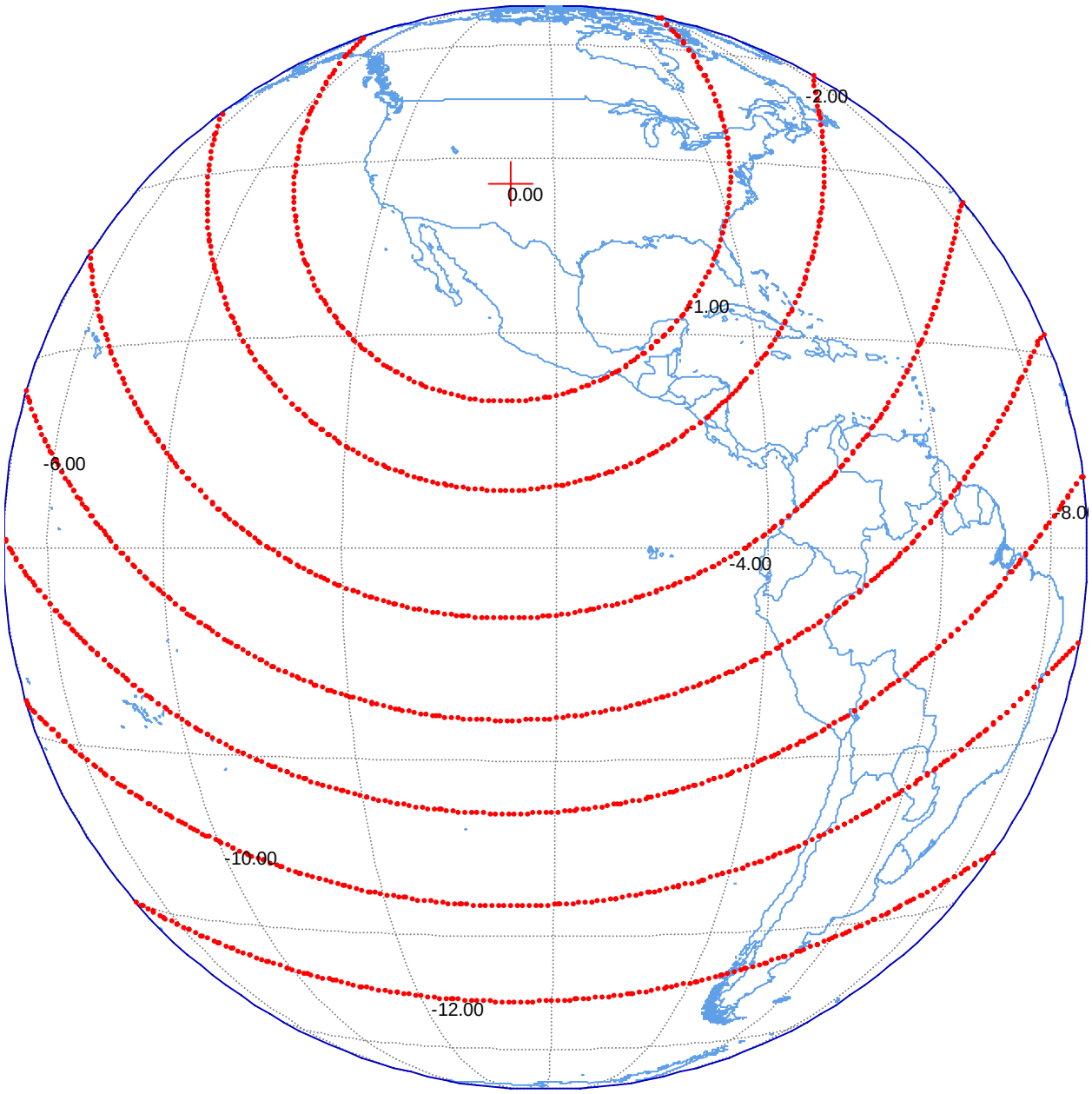
	1M20G1W	5M50G1W
Bandwidth, MHz	1.2	5.5
Uplink		
Uplink EIRP, dBW	77.5	75.5
Uplink EIRP density, dBW/MHz	76.7	68.1
ASI off-axis EIRP density, dBW/MHz	17.4	17.4
Downlink		
SES Satellite EIRP, dBW	34.0	34.0
SES Satellite EIRP density, dBW/MHz	33.2	26.6
Interfering satellite PFD, dBW/m2/MHz	-115.0	-115.0
Interfering satellite EIRP density, dBW/MHz	48.5	48.5
RxES antenna gain, dBi	41.7	45.7
Geocentric angle of neighboring satellite, deg	4.0	4.0
Topocentric angle (10% greater than geo. Angle)	4.4	4.4
Max satellite station keeping error, deg	0.1	0.1
RxES Pointing error[7], deg	0.5	0.5
Net off-axis angle, deg	3.8	3.8
Sidelobe (29-25 log theta), dB	14.5	14.5
DL C/I, dB	11.9	9.3
C/N clear weather, dB	11.7	8.7
C/(N+I), clear weather, dB	8.8	6.0
Up and downlink		
C/(N+I), clear weather, dB	8.8	6.0
C/(N+I) margin, dB	4.1	4.7

[7] It should be noted that these values for receive earth station pointing error are very conservative assumptions, particularly for these earth station antenna sizes.

ANNEX 1

COVERAGE MAPS

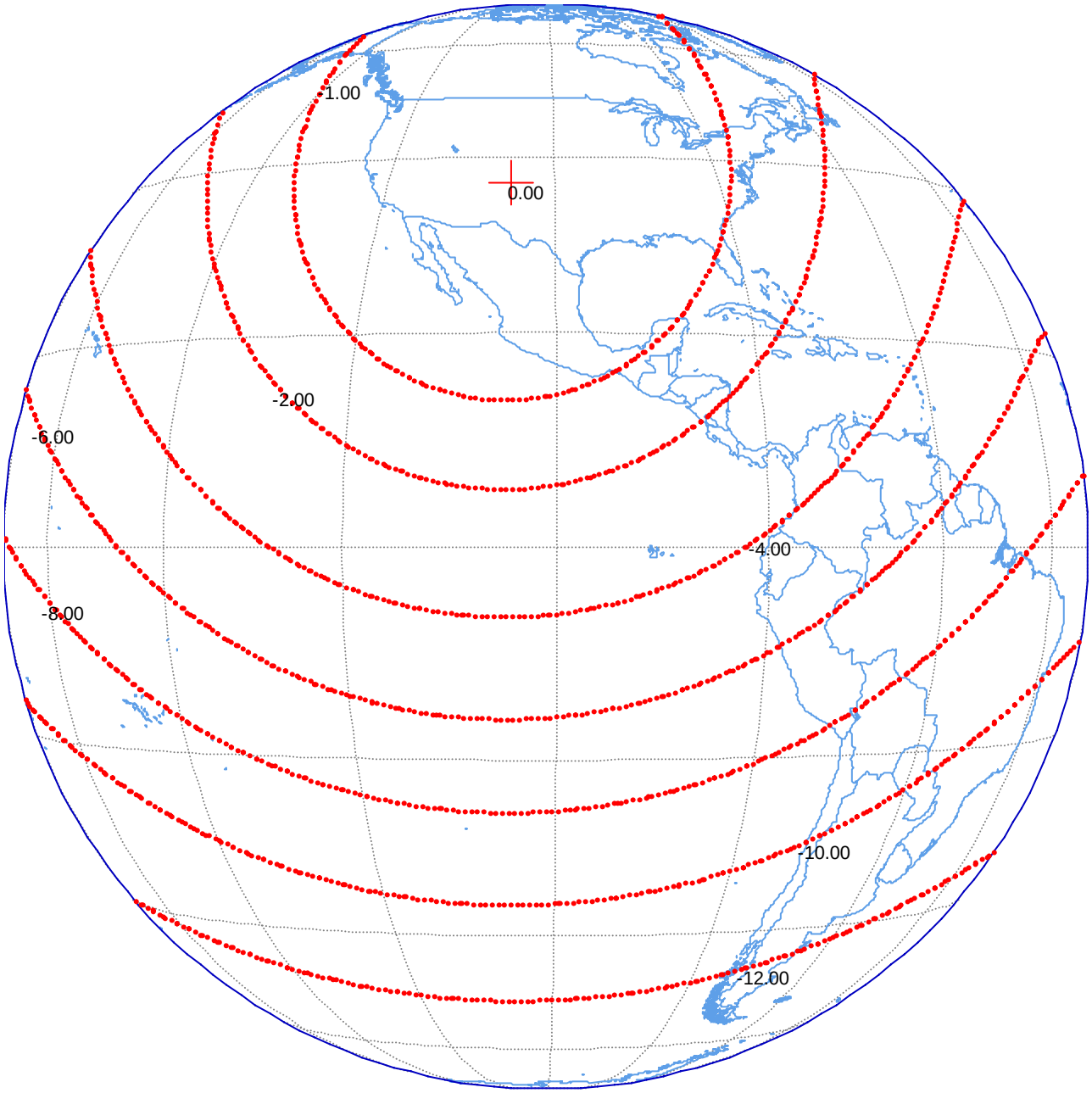
Fig 1. 17/24 GHz Payload, Receive beam, LHCP
G/T max -7.7 dB/K, Antenna gain max. 23.5 dBi[8]



[8] The gain contours are only shown to -12 dBi instead of down to -20 dBi as requested in 25.114(d)(3), because the remaining gain contours do not intersect the Earth.

Fig 2. 17/24 GHz Payload, Transmit beam, RHCP
EIRP Max 35 dBW, Antenna gain max. 23.48 dBi[9]

[9] The gain contours are only shown to -12 dBi instead of down to -20 dBi as requested in 25.114(d)(3), because the remaining gain contours do not intersect the Earth.


-1.00
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-12.00

Engineering Declaration

DECLARATION OF Krish Jonnalagadda

I, Krish Jonnalagadda, hereby certify under penalty of perjury that I am the technically qualified person responsible for preparation of the technical information contained in the foregoing exhibit; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical information contained in the exhibit and that it is complete and accurate to the best of my knowledge, information and belief.

/s/ Krish Jonnalagadda

Manager, Spectrum Development

SES Americom, Inc.

Dated: March 9, 2010