Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Gogo LLC	)	File No. SES-AMD-_____
	)	Call Sign E120106
Amendment to Application for Blanket Authority	)	
for Operation of 1000 Technically Identical	)	
Ku-Band Transmit/Receive Earth Stations in the	)	
Aeronautical Mobile Satellite Service	)	

AMENDMENT

Gogo LLC ("Gogo") hereby amends its pending application for a blanket license to operate 1000 technically identical Ku-band transmit/receive earth stations for the provision of Aeronautical Mobile Satellite Service ("AMSS") on domestic and international flights.[1] Specifically, Gogo is updating the information in the Gogo Application to: (1) reflect the completion of coordination of its AMSS network with adjacent satellite operators and the National Science Foundation ("NSF"); (2) revise certain language relating to proposed use of the 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz bands for receive operations and seek associated waivers; (3) make other technical corrections; and (4) request that the Gogo Application be treated as "permit-but-disclose" for the purposes of the Commission's *ex parte* rules.

A narrative description of the relevant changes is provided here, and Gogo is attaching an FCC Form 312 with corrected Schedule B. In addition, Gogo is providing for the Commission's convenience updated versions of the Gogo Application's legal narrative and

[1] *Gogo LLC*, File No. SES-LIC-20120619-00574, Call Sign E120106 (the "Gogo Application").

technical appendix that incorporate the changes described here. Finally, copies of the relevant coordination agreements are attached as well.

The changes made herein fall into the following categories:

(1) *Update on coordination*: Coordination has been finalized with operators of satellites adjacent to the Intelsat and SES spacecraft that will be used in the Gogo AMSS network, and the Gogo Application materials have been updated to reflect this development. Affidavits certifying the completion of coordination for those satellites are attached hereto as Amendment Exhibit A. In addition, Gogo reached a coordination agreement with NSF, which is attached hereto as Amendment Exhibit B.

(2) *Use of non-conventional Ku-band receive frequencies*: For AMSS operations in U.S. airspace, Gogo will primarily rely on conventional Ku-band downlink spectrum. However, Gogo will also need access to additional frequencies on some routes.

Specifically, Gogo plans to use capacity on Intelsat 19 in the 12.25-12.75 GHz band for AMSS downlinks within the satellite's footprint, including for U.S. domestic service and other operations within ITU Region 2. Because this band is not allocated for downlinks from fixed-satellite service spacecraft in Region 2, Gogo is seeking a waiver of the Table of Allocations in Section 2.106 of the Commission's rules.

In addition, Gogo seeks Commission authority to use the 10.95-11.2 GHz and 11.45-11.7 GHz bands for U.S. domestic service on an unprotected basis. Gogo seeks a waiver of the international-only limitation on these bands in order to permit this use.

(3) *Technical corrections*: Gogo amends the technical documentation provided in support of its AMSS application in order to rectify minor errors. Specifically, the updated technical materials provided with this amendment include the following changes:

- In Section 3.1 of the Technical Appendix, the maximum data rate transmitted from the terminal has been revised to 1500 kbits/s. In addition, the channel bandwidths used in the TDMA scheme have been corrected.

- In the FCC Form 312 Schedule B, item E38, the total input power at the antenna flange, has been corrected.

- In the FCC Form 312 Schedule B, item E50, corrections corresponding to the channel bandwidth changes mentioned above have been made to the transmit emission designators, and the associated power characteristics have been updated. In addition, references to "BPSK digital services" have been replaced with "Digital Data Services."

- In Appendix D, a reference in the table heading to one of the FCC rules has been corrected.

In addition, the Technical Appendix has been revised to reflect the planned use of the 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz band for AMSS operations including domestic service, as discussed above. Finally, other typographical errors have been corrected and minor editorial changes have been made.

(4) *Request for permit-but-disclose treatment*: Gogo asks that the Commission designate the Gogo Application proceeding as permit-but-disclose for purposes of the *ex parte* rules.

Gogo amends the Gogo Application to update the record and reflect the changes described herein. Gogo respectfully requests that the Commission expeditiously consider and grant the Gogo Application as amended in order to allow introduction of new AMSS competition.

Respectfully submitted,

GOGO LLC

By: */s/ William J. Gordon*_____

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Dated: July 31, 2012

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In the Matter of	)	
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Gogo LLC	)	File No. SES-LIC-_____
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Application for Blanket Authority for Operation of 1000 Technically Identical Ku-Band Transmit/Receive Earth Stations in the Aeronautical Mobile Satellite Service	)	

APPLICATION FOR BLANKET AUTHORITY

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Dated: June 18, 2012, as amended July 31, 2012

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Gogo LLC	)	File No. SES-LIC-_____
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Application for Blanket Authority for Operation of 1000 Technically Identical Ku-Band Transmit/Receive Earth Stations in the Aeronautical Mobile Satellite Service	)	

APPLICATION FOR BLANKET AUTHORITY

Gogo LLC ("Gogo") hereby respectfully requests that the Commission grant a blanket license authorizing Gogo to operate 1000 technically identical Ku-band transmit/receive earth stations for the provision of Aeronautical Mobile Satellite Service ("AMSS") on domestic and international flights. Grant of the requested authority is consistent with Commission precedent and will serve the public interest by allowing Gogo to expand the coverage of its existing in-flight broadband service, enhancing competition in this important market.

I. INTRODUCTION

Gogo is the world's leading provider of in-flight connectivity and a pioneer in wireless in-cabin digital entertainment solutions. Gogo offers service today through its proprietary platform and dedicated air-to-ground ("ATG") network, and provides a variety of in-cabin offerings that make it easy and convenient for passengers to extend their connected lifestyles to the aircraft cabin. Gogo serves both the commercial aviation and general aviation markets. North American airlines that use the Gogo broadband service today include Delta Air Lines, American Airlines, Virgin America, Alaska Airlines, US Airways, Frontier Airlines and Air Tran Airways. From the inception of its service in August 2008 to March 1, 2012, the

company provided more than 21 million Gogo sessions to more than 5 million registered unique users.

Gogo provides in-flight broadband today across the contiguous U.S. and to portions of Alaska using the ATG network. Gogo seeks a blanket AMSS license to allow it to expand the coverage of its in-flight offerings beyond this footprint. Specifically, Gogo seeks authority to add a satellite-based component that will allow Gogo to provide continuous in-flight connectivity on transoceanic and other domestic and international flights. The satellite component of the Gogo service will use Ku-band Fixed-Satellite Service ("FSS") capacity.[1]

Gogo will employ proven antenna and modem technology in its AMSS network. Aircraft remote terminals use the AeroSat HR6400 antenna model. A previous version of this antenna was approved by the Commission, and the antenna has logged more than 40,000 flight hours with no complaints of interference.[2] Similarly, the iDirect modem is currently in use by other AMSS providers.

As the Commission has recognized, authorizing aircraft earth stations ("AESs") to communicate with FSS space stations promotes efficient spectrum use and allows the delivery of important communications services to crew and consumers onboard aircraft.[3] A global

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[1] Specifically, Gogo will perform uplinks in the 14.0-14.5 GHz conventional Ku-band spectrum throughout its network. Downlinks will use the 11.7-12.2 GHz band as well as the 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz bands. Additional detail regarding the planned spectrum use is provided below, along with requests for necessary waivers associated with the intended operations.

[2] The antenna has been physically modified to provide space for the iDirect modem and associated interconnections.

[3] *See Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service,* IB Docket No. 05-20, Notice of Proposed Rulemaking, 20 FCC Rcd 2906 (2005) ("*Ku-Band AMSS NPRM"*) at ¶ 1.

secondary allocation for AMSS in the 14-14.5 GHz band was added in 2003, and the Commission has proposed a regulatory framework for Ku-band AMSS operations.[4] Pending the adoption of service rules for such operations, the Commission has granted several operators blanket licenses for Ku-band AMSS networks.[5]

Grant of an AMSS blanket license to Gogo is consistent with this precedent and will serve the public interest. The introduction of a satellite component for Gogo's existing in-flight broadband network will enable Gogo to improve service to customers and will promote competition in this significant market.

II. NETWORK DESCRIPTION

The Gogo inflight system consists of three segments: the AES segment, the space segment, and the ground segment. An overview of each element is provided below, and additional detail is supplied in the attached technical narrative.

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4 *See id.*

5 *See Panasonic Avionics Corporation, Application for Authority to Operate Up to 50 Technically Identical Aeronautical Mobile-Satellite Service Aircraft Earth Stations in the 14.0-14.4 GHz and 11.7-12.2 GHz Frequency Bands,* Order and Authorization, 26 FCC Rcd 12557 (Int'l Bur. and OET 2011) ("*Panasonic AMSS Order*"); *Row 44, Inc., Application for Blanket Authority to Operate up to 1,000 Technically Identical Aeronautical Mobile Satellite Service Transmit/Receive Earth Stations Aboard Commercial and Private Aircraft,* Order and Authorization, 24 FCC Rcd 10223 (Int'l Bur. and OET 2009) ("*Row 44 AMSS Order"*); *ViaSat Inc., Application for Blanket Authority for Operation of Up to 1,000 Technically Identical Ku-Band Aircraft Earth Stations in the United States and Over Territorial Waters,* Order and Authorization, 22 FCC Rcd 19964 (Int'l Bur. and OET 2007) ("*ViaSat AMSS Order"*); *ARINC Incorporated Application for Blanket Authority for Operation of up to One Thousand Technically Identical Ku-Band Transmit/Receive Airborne Mobile Stations Aboard Aircraft Operating in the United States and Adjacent Waters,* Order and Authorization, 20 FCC Rcd 7553 (Int'l Bur. and OET 2005) ("*ARINC AMSS Order")*; *Boeing Company Application for Blanket Authority to Operate Up to Eight Hundred Technically-Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands,* Order and Authorization, 16 FCC Rcd 22645 (Int'l Bur. and OET, 2001) ("*Boeing AMSS Order"*).

A. AES Segment

Each AES consists of the AeroSat Ku-band antenna system, which incorporates the iDirect satellite modem. These systems interface with the space segment to communicate with the ground earth segment. With input from the aircraft's navigational interface, the AeroSat antenna is steered by the antenna control system and satellite modem as the aircraft maneuvers and travels in the air.

As noted above, a previous version of the AeroSat antenna was approved by the Commission for AMSS operations in Ku-band FSS spectrum.[6] In the current version, the antenna control unit has been physically changed to accommodate the iDirect modem. The antenna is compliant with the emission limits specified in Section 25.202(f) of the Commission's rules.[7] In addition, the antenna is capable of maintaining a pointing accuracy of +/- 0.2 degrees, and emissions will automatically be terminated if this angle exceeds 0.5 degrees. The antenna also conforms to the technical specifications for Ku-band AMSS operations embodied in Recommendation ITU-R M.1643.

B. Space Segment

Gogo will use transponder capacity on commercial Ku-band FSS satellites. Gogo is initially seeking authority to communicate with four Intelsat satellites, Intelsat 14 at 45° W.L., Intelsat 27 at 55.5° W.L., Intelsat 21 at 58° W.L., and Intelsat 19 at 166° E.L., and two SES satellites, NSS-703 at 47° W.L. and SES-1 at 101° W.L. Two of the Intelsat spacecraft, Intelsat 14 and Intelsat 19, are currently in-orbit, as are both of the SES spacecraft. Intelsat 21

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6 *See Row 44 Inc.*, File Nos. SES-LIC-20080508-00570, SES-AMD-20080619-00826, SES-AMD-20080819-01074, SES-AMD-20080829-01117, SES-AMD-20090115-00041, SES-AMD-20090416-00501, Call Sign E080100 (granted Aug. 5, 2009).

7 47 C.F.R. § 25.202(f).

and Intelsat 27 are replacement satellites scheduled for launch within the next eight months. The Commission granted the Intelsat 21 license earlier this month,[8] and Intelsat's application for an FCC license for Intelsat 27 is pending.[9]

With the exception of NSS-703, all the satellites are or will be U.S. licensed. The Commission has authorized U.S. earth stations to communicate with NSS-703 by placing the satellite on the Permitted Space Station List ("Permitted List") for operations in the conventional C- and Ku-bands.[10] Gogo proposes to use NSS-703 conventional Ku-band spectrum as well as other receive frequencies on the satellite, and Gogo demonstrates below that such operations are consistent with the Commission's market access policies. Gogo is also negotiating for capacity on other spacecraft to provide additional AMSS coverage, and will amend this application as appropriate to include these spacecraft.

Intelsat and SES have completed coordination of the Gogo AMSS technical parameters with operators of all satellites within 6 degrees of each of the spacecraft to be used in the Gogo AMSS network. Specifically, Intelsat has confirmed that operation of the Gogo AMSS terminals is consistent with coordination agreements that are in place with respect to the Intelsat 19, Intelsat 21 and Intelsat 27 spacecraft.[11] Gogo is attaching affidavits certifying that

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8 *See Intelsat License LLC,* File No. SAT-RPL-20120326-00061, Call Sign S2863, grant-stamped July 12, 2012.

9 *See Intelsat License LLC,* File Nos. SAT-LOA-20110610-00105 & SAT-AMD-20111111-00215, Call Sign S2827 (Intelsat 27).

10 *See SES Satellites (Gibraltar) Limited,* File Nos. SAT-PPL-20101103-00230 and SAT-APL-20110120-00015, Call Sign S2818, grant-stamped Oct. 31, 2011 ("*NSS-703 Grant*"). In addition to the conventional C- and Ku-bands, NSS-703 is capable of operating in additional Ku-band frequencies. These frequencies are not subject to inclusion on the Permitted List, but technical information regarding these bands was included in the NSS-703 Permitted List filing. *See id.*, Attachment to Grant at 1 n.3.

11 *See* Technical Appendix, Attachment C & Amendment Exhibit A.

coordination has been completed with respect to the remaining Intelsat and SES satellites – Intelsat 14, SES-1, and NSS-703.[12]

C. Ground Segment

The ground segment includes the gateway earth stations and network operations centers used for overall satellite network management. A list of these is provided in the technical narrative.

III. SPECTRUM USE AND SHARING

The Gogo AMSS network will use Ku-band capacity to provide continuous connectivity and entertainment services on domestic and international flights. A description of each frequency band to be used by the system is provided below.

A. Downlink Spectrum

For AMSS downlink operations (communications from the satellite to the AES mobile terminals), Gogo proposes to use the 11.7-12.2 GHz conventional Ku-band spectrum as well as the 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz bands. Specifically, the 11.7-12.2 GHz band will be used for receive operations over the U.S. and the airspace above U.S. territorial waters, as well as for service over the remainder of North America, South America, and the Atlantic Ocean. Gogo plans to use the 10.95-11.2 GHz and 11.45-11.7 GHz portions of the extended Ku-band primarily for service outside the U.S., but also seeks authority to use these bands for service in U.S. airspace. Finally, Gogo plans to use the 12.25-12.75 GHz band for receive operations both within and outside U.S. airspace.

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[12] *See* Technical Appendix, Attachment B & Amendment Exhibit A.

Gogo below requests waivers of the Table of Allocations in Section 2.106 of the Commission's rules to use each of these downlink spectrum bands on a non-interference basis. Specifically, Gogo will accept interference from lawful operation of any station in the 11.7-12.2 GHz, 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz bands in accordance with the Table of Allocations. In addition, Gogo will immediately terminate its AMSS operations upon notification that such operations are causing harmful interference to any lawfully operating radio system in the 11.7-12.2 GHz, 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz bands in conformance with the Table of Allocations. Gogo also seeks a waiver of Section 25.202(a)(1) and footnote NG104 to the Table of Allocations to permit U.S. domestic use of the 10.95-11.2 GHz and 11.45-11.7 GHz bands on an unprotected, non-interference basis.

B. Uplink Spectrum

For AMSS uplink operations (communications from the AES mobile terminals to the satellite), Gogo proposes to use the 14.0-14.5 GHz conventional Ku-band spectrum. This band is allocated on a secondary basis for non-Federal-government mobile satellite service.[13] As a secondary service, AMSS must protect other existing services authorized to operate in this spectrum. A description of how the Gogo network will share with each of the relevant services is provided below and in the attached technical materials.

Geostationary Orbit ("GSO") FSS Systems: The Gogo AMSS network will protect GSO FSS systems by controlling the off-axis EIRP spectral density of the AES terminal so that it is within the parameters for other Ku-band mobile terminals under Part 25.[14] The

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13 *See Ku-Band AMSS NPRM* at ¶ 19.

14 *See, e.g.*, 47 C.F.R. § 25.222 (technical requirements for ESVs); 47 C.F.R. § 25.226 (technical requirements for vehicle mounted earth stations or "VMESs").

attached Technical Appendix includes a detailed description of the off-axis EIRP spectral density characteristics of the Gogo AES terminals.[15] Gogo will also conform to the conditions that have typically been placed on other AMSS blanket licenses. Specifically, Gogo will immediately terminate operation of an AES upon notification that such operation is causing harmful interference.[16] Furthermore, as noted above, Gogo's operations have been coordinated with adjacent satellites. In the event that a GSO FSS satellite for which coordination has not been completed commences operations within six degrees of one of the space stations used for the Gogo service, Gogo will demonstrate that its AMSS operation will not cause interference to the new satellite or will suspend use of that space station pending completion of coordination.[17]

Nongeostationary Orbit ("NGSO") FSS Systems: Gogo recognizes that it is obligated to protect any NGSO FSS network operating in the 14.0-14.5 GHz band from harmful interference. However, there currently are no such networks in operation, and to Gogo's knowledge, no NGSO FSS system applications are pending. In the event a future NGSO FSS network is deployed, Gogo will demonstrate that its AMSS operation will not cause interference to the new network or will suspend operations pending completion of coordination.[18]

Space Research Operations: The 14.0-14.2 GHz band is allocated in the U.S. for Federal operation in the Space Research Service ("SRS"), and NASA operates earth stations in the 14.0-14.05 GHz portion of the band as part of the SRS Tracking and Data Relay Satellite System ("TDRSS"). Gogo is in the process of negotiating a coordination agreement with NASA

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15 *See* Technical Appendix, Appendices B and C.

16 *See, e.g., Panasonic AMSS Order* at ¶ 26(d).

17 *Id.* at ¶ 26(b).

18 *Id.* at ¶ 26(c).

for protection of existing and future TDRSS sites from interference that could result from Gogo's AMSS operations. Pending completion of coordination with NASA, Gogo agrees not to operate AES antennas in the 14.0-14.2 GHz band within line of site of NASA TDRSS facilities.[19] This commitment is consistent with the requirements the Commission imposes under the rules for other mobile operations using FSS spectrum.[20] Accordingly, completion of coordination with NASA is not required in advance of Commission action on the Gogo Application.

Terrestrial Radio Systems: There are no active FCC-licensed terrestrial services in the 14-14.5 GHz band with which the Gogo AMSS operations could conflict.[21] Gogo will limit the power flux density ("PFD") of emissions to the levels stated in Recommendation ITU-R M.1643 at locations where protection of terrestrial fixed service is required.

Radio Astronomy: For purposes of protecting radio astronomy sites, Gogo will limit PFD levels to conform to Recommendation ITU-R M.1643, Part C. In addition, Gogo has reached a coordination agreement with the National Science Foundation concerning protection of U.S. radio astronomy observatories.[22]

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[19] This approach conforms to requirements in the analogous portions of the Commission's ESV and VMES rules. *See* 47 C.F.R. §§ 25.222(d) and 25.226(c).

[20] *See* 47 C.F.R. § 25.222(c) (specifying requirements for earth stations on vessels to protect NASA facilities); 47 C.F.R. § 25.226(c) (same with respect to operations of vehicle-mounted earth stations).

[21] In the *Panasonic AMSS Order*, the Commission observed that footnote NG184 to the U.S. Table of Allocations permitted continued operation of grandfathered land mobile stations licensed prior to March 1, 2005 until their licenses expired. *Panasonic AMSS Order* at ¶ 22. At the time, the Commission indicated that only one such license remained in effect, with a scheduled expiration date of July 23, 2012. *Id.* This remaining license has now expired.

[22] *See* Amendment Exhibit B.

IV. OPERATIONS PENDING ADOPTION OF AMSS RULES

As noted previously, in the *Ku-Band AMSS NPRM*, the Commission has proposed a regulatory framework for AMSS operations in the Ku-band, but has not yet acted in that proceeding. Gogo recognizes that any AMSS blanket authority it receives will be subject to the requirements that are ultimately adopted in that rulemaking.

Pending completion of the rulemaking, Gogo commits to operating consistent with the general regulatory framework the Commission has adopted for other mobile uses of the Ku-band FSS spectrum, such as ESVs and VMESs. In particular, Gogo will:

- Maintain a point of contact available 24 hours per day, seven days per week, with the authority and ability to terminate operations of the Gogo AMSS system and to discuss interference concerns with other licensees and U.S. Government agencies; and

- Collect and maintain for one year records of the following data for each operating AES: location (latitude, longitude, altitude); aircraft attitude (pitch, yaw, roll); transmit frequency and occupied bandwidth; data rate; EIRP and target satellite. Gogo will also maintain records of instances when AES pointing error exceeds 0.2 degrees, which it will make available to the Commission or FSS system operator within twenty-four hours of receiving such a request.

V. WAIVER REQUESTS

Gogo requests limited waivers of the Commission's rules in connection with this AMSS blanket license application. Grant of these waivers is consistent with Commission policy:

> The Commission may waive a rule for good cause shown. Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested

> would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[23]

A. Waivers of the Table of Allocations

Gogo requests waivers of the Table of Allocations in Section 2.106 of the Commission's rules to permit use of the specified downlink frequencies, 11.7-12.2 GHz, 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.25-12.75 GHz, for AMSS operations. Grant of the requested waivers is consistent with Commission precedent regarding other AMSS Ku-band blanket license applications and will serve the public interest.

In ruling on prior AMSS blanket license requests, the Commission has granted waivers for downlink operations in the 11.7-12.2 GHz conventional Ku-band downlink spectrum "based upon either a showing that the proposed AMSS downlink transmissions will not exceed the 10 dBW/4 kHz limit for routine processing in Section 25.134(g)(2) of the Commission's rules or proof that adjacent satellite operators have consented to the operations."[24]

The Commission has permitted use of the 11.45-11.7 GHz extended Ku-band frequencies for AMSS downlinks pursuant to the same rationale.[25] In the *Ku-Band AMSS NPRM*, the Commission recognized that "AES terminals on U.S.-registered aircraft may need to access foreign satellites while traveling outside of the United States (*e.g.*, over international waters), and therefore may need to downlink in the extended Ku-band in certain

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[23] *PanAmSat Licensee Corp.*, 17 FCC Rcd 10483, 10492 (Sat. Div. 2002) (footnotes omitted).

[24] *See Panasonic AMSS Order* at ¶ 11.

[25] *See Row 44 Inc.*, File No. SES-MFS-20100715-00903, Call Sign E080100, Attachment at 3 (requesting extension of the waiver of Section 2.106 that Row 44 was granted for conventional Ku-band downlinks to cover the proposed use of the 11.45-11.7 GHz band), grant-stamped Dec. 23, 2010.

circumstances."[26] The Commission went on to observe that it did "not anticipate that unprotected receive-only operations in the extended Ku-band would interfere with or restrict other authorized operations in the band."[27] Accordingly, the Commission sought comment on whether AMSS should be permitted in the 10.95-11.2 GHz and 11.45-11.7 GHz portions of the extended Ku-band.[28]

As noted above, the satellite operators that will provide capacity to Gogo have coordinated the AMSS operations with satellites within six degrees. Under these circumstances, grant of a Section 2.106 waiver is justified to permit use of the conventional and extended Ku-bands for AMSS downlinks, consistent with the precedent described above.

In addition to the extended Ku-band spectrum proposed for use in the *Ku-Band AMSS NPRM*, Gogo also proposes to use the 12.25-12.75 GHz band for AMSS downlinks for service within and outside of U.S. airspace. Pursuant to the International Table of Allocations in Section 2.106, FSS downlinks have primary status in the 12.5-12.75 GHz band in ITU Region 1 and in the 12.25-12.75 GHz band in ITU Region 3. Gogo respectfully requests a waiver of Section 2.106 to allow AMSS operations in the 12.5-12.75 GHz band in Region 1 and in the 12.25-12.75 GHz band in Region 3 on a non-interference basis. Because these proposed operations are coordinated, grant of the requested waiver will promote efficient use of spectrum and serve the public interest.

Gogo also proposes to use 12.25-12.75 GHz capacity on Intelsat 19 for space-to-Earth operations in ITU Region 2, which includes the U.S. To permit this use of Intelsat 19

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26 *Ku-Band AMSS NPRM* at ¶ 18 (footnote omitted).

27 *Id.*

28 *Id.*

downlink spectrum, Gogo seeks a waiver of the table of allocations, which specifies that in Region 2, the 12.2-12.7 GHz band is available for Fixed Service ("FS") and Broadcast Satellite Service ("BSS"), and the 12.7-12.75 GHz band is allocated for FS operations, Mobile Service, and FSS in the Earth-to-space direction.

Intelsat 19 was launched earlier this year to replace the Intelsat 8 spacecraft located at 166° E.L. Like Intelsat 8, Intelsat 19 uses Ku-band downlink frequencies in the 12.25-12.75 GHz band and has coverage of portions of the west coast of the continental U.S. Intelsat 19 also provides coverage of Alaska and Hawaii.[29] The Commission granted Intelsat's application to launch and operate Intelsat 19 in May, but the authority does not extend to use of the 12.25-12.75 GHz band in ITU Region 2.[30] Intelsat has filed a modification application seeking to add authority for the 12.25-12.75 GHz band in Region 2 and requesting a waiver of the U.S. Table of Allocations for this purpose.[31]

The Intelsat 19 Modification provides a full justification for this waiver, demonstrating that Intelsat's use of the 12.25-12.75 GHz band in Region 2 will not cause harmful interference to any FS or BSS networks.[32] Intelsat also makes clear that it will not claim

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29 *See Intelsat License LLC,* File No. SAT-RPL-20111222-00245, Call Sign S2850, Engineering Statement at 4.

30 *See Intelsat License LLC,* File No. SAT-RPL-20111222-00245, Call Sign S2850, grant-stamped May 25, 2012, Attachment to Grant at 2, ¶ 7

31 *See Intelsat License LLC,* File No. SAT-MOD-20120628-00107, Call Sign S2850 (the "Intelsat 19 Modification").

32 *See id.*, Narrative at 3-6. Specifically, Intelsat explains that in the 12.25-12.7 GHz band, FS systems will be protected because Intelsat 19 complies with power flux density limits and there is sufficient orbital separation to ensure that BSS networks will not experience interference. Intelsat states that in the 12.7-12.75 GHz band, Intelsat 19 transmissions will comply with ITU Art. No. 21.16 to protect terrestrial networks and that Intelsat will neither cause harmful interference to, or claim interference protection from, any Earth-to-Space FSS operations.

protection from interference with respect to any regularly authorized Region 2 terrestrial or space systems.[33] In addition, Intelsat observes that the Commission has waived the Table of Allocations to allow use of the 12.25-12.75 GHz band in Region 2 for Intelsat 19's predecessor spacecraft, and that there have been no reports of interference from those operations.[34]

Gogo similarly seeks a waiver of Section 2.106 to permit use of the 12.25-12.75 GHz band payload on Intelsat 19 for AMSS operations in Region 2, including service in U.S. airspace and over foreign territory and international waters. In support of this waiver request, Gogo incorporates by reference the waiver showing made in the Intelsat 19 Modification. Gogo seeks to use capacity on Intelsat 19 capacity in the 12.25-12.75 GHz band in Region 2 for AMSS on an unprotected, non-interference basis. Such use will be fully consistent with the technical parameters described in the Intelsat 19 Modification, including compliance with power limits and ITU specifications. Thus, the same reasons cited by Intelsat in support of its waiver request in the Intelsat 19 Modification apply here as well and justify grant of a waiver for use of this Intelsat 19 capacity in Region 2 as part of the Gogo AMSS network.

B. Waiver for Domestic Service in the Extended Ku-Band

Gogo requests a waiver of Section 25.202(a)(1) and footnote NG104 to the Table of Allocations to permit use of the 10.95-11.2 GHz and 11.45-11.7 GHz bands for U.S. domestic service on an unprotected basis. Grant of this waiver is likewise consistent with Commission precedent.

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33 *See id.*, Narrative at 1, 3-5.

34 *See id.*, Narrative at 6 & n.17.

Section 25.202(a)(1) and footnote NG104 both specify that use of these extended Ku-band frequencies by GSO FSS systems is limited to international service.[35] A waiver to permit Gogo to use these bands to receive transmissions for domestic service is justified because it will not undermine the purpose of the applicable rule.

The intent of the international-only restriction on these bands, which are shared with terrestrial FS operations, is to preserve availability of the band for the fixed service.[36] Specifically, the rule is designed to reduce the number of earth stations with which FS operators would need to coordinate.[37] In granting EchoStar a waiver of this restriction for receive operations on an unprotected basis, the International Bureau held that:

> a waiver of footnote NG 104 would not undermine the rule's purpose because it involves only passive receive-only earth stations that are not capable of causing interference into FS stations operating in this band. Further, because EchoStar has agreed to accept any level of interference from FS stations into its receive-only earth stations' operations in the extended Ku-bands, FS operators will not be required to coordinate their station operations with the EchoStar receive-only earth stations' operations. Under these circumstances, we determine that additional coordination burden[s] would not be placed upon FS operators and that their ability to expand service in the future would not in any manner be restricted.[38]

The same rationale applies to airborne terminals. In seeking comment on whether the 10.95-11.2 GHz and 11.45-11.7 GHz bands should be made available for AMSS on an

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35 *See* 47 C.F.R. § 25.202(a)(1) note 2 & § 2.106 footnote NG104.

36 *See EchoStar KuX Corporation Application for Authority to Construct, Launch and Operate a Geostationary Satellite Using the Extended Ku-band Frequencies in the Fixed-Satellite Service at the 83º W.L. Orbital Location*, Order and Authorization, 20 FCC Rcd 919, 923 (IB 2004).

37 *See id.*

38 *Id.*

unprotected basis, the Commission observed that "Footnote NG 104 would not be applicable" to AMSS operations because the aeronautical "receivers would not need any coordination with fixed terrestrial services since they would operate on an unprotected basis."[39]

These factors justify grant of a waiver for Gogo. Gogo is not seeking protection from interference from existing or future licensed terrestrial FS networks in the extended Ku-band. Accordingly, allowing Gogo terminals to use these bands for domestic service will not compromise the purpose of the international-only limitation in this spectrum.

VI. PUBLIC INTEREST SHOWING

Grant of the Gogo AMSS blanket license application will promote competition in the market for in-flight broadband services, to the benefit of air travelers in the U.S. and abroad. Furthermore, grant of the application is consistent with Commission policies and precedent.

In proposing a regulatory framework for Ku-band AMSS operations, the Commission has recognized the value of in-flight services:

> AMSS potentially offers consumers the benefits of broadband services while traveling by air, both domestically and internationally. Such service might be particularly attractive to passengers on long-haul flights. AMSS provides a means for passengers to access high-speed Internet and interactive entertainment, while broadband capability for crews could "enhance aircraft operations through real-time equipment and supply information, weather updates, [and] security monitoring."[40]

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39 *Ku-Band AMSS NPRM* at ¶ 18 n.58.

40 *Id.* at ¶ 2, *quoting* The Boeing Company, Petition for Rulemaking, Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum in the 14-14.5 GHz Band to the Aeronautical Mobile-Satellite Service and To Adopt Licensing and Service Rules for AMSS Operations in the Ku-Band, filed July 21, 2003, at 27.

Similarly, the Commission decisions granting blanket license applications have held that authorizing new AMSS operators serves the public interest by "enhancing competition in an important sector of the mobile telecommunications market in the United States."[41]

Grant of the Gogo AMSS application is consistent with these objectives. Adding the AMSS component to Gogo's existing ground-based in-flight connectivity and entertainment services will allow Gogo to expand its coverage and provide continuous service on both domestic and international flights. With its technological expertise and proven record of customer service, Gogo is well-positioned to bring high-quality, reliable in-flight communications to air travelers in the U.S. and abroad.

Grant of Gogo's application will also enhance public safety by satisfying communications requirements for U.S. government agencies providing aviation security to U.S. airlines domestically and internationally.

Finally, Gogo's proposed AMSS network conforms to the Commission's *DISCO II* policies, which are intended to ensure that entry by a foreign-licensed satellite will not distort competition in the U.S.[42] The NSS-703 spacecraft, which is the only non-U.S.-licensed satellite proposed here for use with the Gogo AMSS system, has already been evaluated by the Commission under this framework and has been placed on the Permitted List for communications with U.S.-licensed terminals in the conventional Ku-band frequencies.[43]

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41 *See Panasonic AMSS Order* at ¶ 1; *see also Row 44 AMSS Order* at ¶ 1; *ViaSat AMSS Order* at ¶ 1.

42 *See Amendment of the Commission's Policies to Allow Non-U.S. Licensed Space Stations providing Domestic and International Service in the United States,* Report & Order, 12 FCC Rcd 24094 (1997) ("*DISCO II*"). These policies are codified in Section 25.137 of the Commission's rules, 47 C.F.R. § 25.137.

43 *See NSS-703 Grant*.

Furthermore, the Commission applies the same legal framework that governs requests for addition to the Permitted List to petitions seeking authority to use foreign-licensed satellites in bands other than the conventional C- and Ku-bands.[44] Complete technical information regarding NSS-703, including data relating to its full Ku-band payload, is already on file with the Commission.[45] Accordingly, the Commission should rule that NSS-703 can be used for communications with the Gogo AES terminals in the relevant extended and international Ku-band frequencies, 10.95-11.2 GHz, 11.45-11.7 GHz, and 12.5-12.7 GHz.

VII. REQUEST FOR PERMIT-BUT-DISCLOSE TREATMENT

Gogo asks that the Commission designate the Gogo Application proceeding as permit-but-disclose for purposes of the *ex parte* rules. Section 1.1200(a) of the Commission's rules confers discretion on the Commission and its staff to modify the *ex parte* status of a proceeding based on a finding that such modification is in the public interest.[46] Grant of permit-but-disclose status for the Gogo Application will facilitate communication between the Commission, Gogo and any other parties regarding the Gogo Application, allowing the Commission to develop a full and complete record. As a result, permit-but-disclose designation will enhance the Commission's ability to process and act on the Gogo Application.

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44 *See DISCO II* at ¶ 192.

45 *See NSS-703 Grant*, Attachment to Grant at1 n.3.

46 47 C.F.R. § 1.1200(a).

VIII. CONCLUSION

For the foregoing reasons, Gogo respectfully requests that the Commission grant Gogo authority to operate 1000 Ku-band transmit/receive earth stations for the provision of AMSS on domestic and international flights, consistent with the technical parameters specified herein.

Respectfully submitted,

GOGO LLC

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Dated: June 18, 2012, as amended July 31, 2012

Gogo AMSS System

Technical Appendix

June 18, 2012 as Amended July 31, 2012

Table of Contents

TECHNICAL APPENDIX

This Technical Appendix describes the operational characteristics of the Aeronautical Earth Station (AES) and the Gogo Ku-band Aeronautical Mobile Satellite Service (AMSS) system.

1. Introduction

Gogo LLC (Gogo) is seeking authority to operate up to 1000 technically identical Aeronautical Earth Stations in the Ku-band to provide multimedia and data services to commercial aircraft operating over the United States and its territorial waters and internationally. The terminals will transmit in the 14.0-14.5 GHz band, and will receive in the 11.7-12.2, 10.95-11.2, 11.45-11.7, and 12.25-12.75 GHz bands, depending on the satellite with which the terminal is communicating.

The Gogo Inflight System brings Gogo's technological expertise with its terrestrial Air-to-Ground network (ATG) to the Broadband Satellite Multimedia (BSM) market, using equipment and technology previously approved by the Commission. With AeroSat's satellite antenna technology, combined with iDirect's proven modem technology in satellite communications that is currently being used for fixed and mobile VSAT applications in the commercial and government industries, Gogo seeks to provide a unique experience to the end customers.

2. System Description

2.1. Overview

A high-level representation of the system is shown in Figure 1 below. The Gogo AMSS system can logically be divided into three segments, the Space Segment, the Aeronautical Segment, and the Ground Segment.

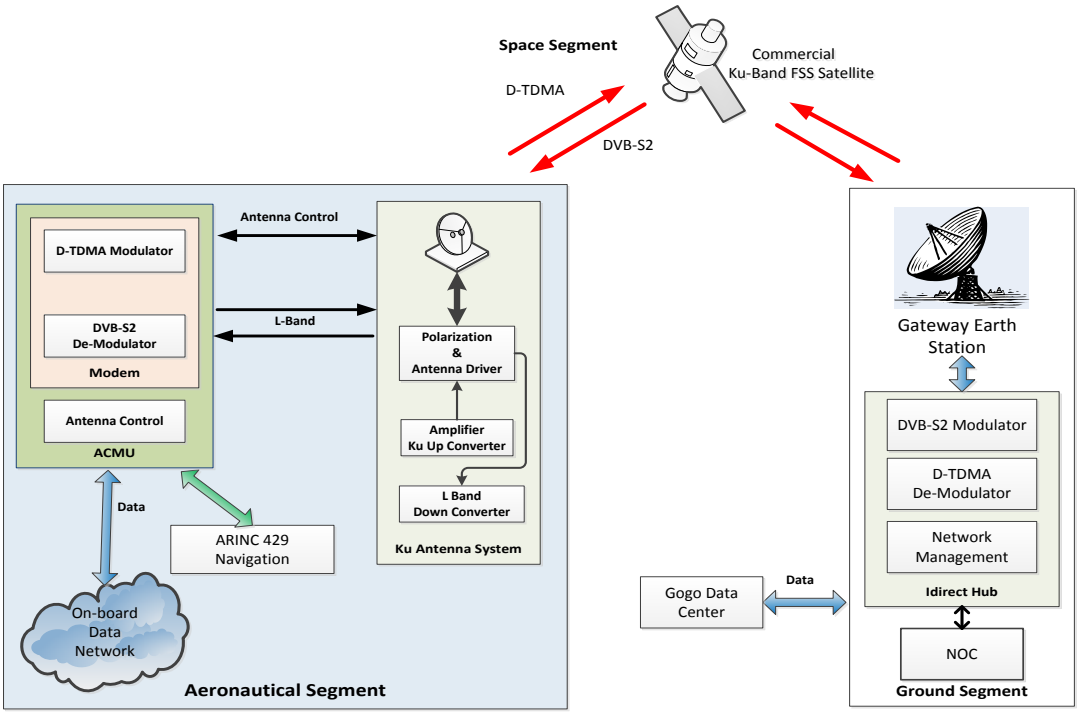


Figure 1 - AMSS System Block Diagram

2.2. Aeronautical Segment

2.2.1. AES Overview

The Aeronautical Segment consists of all operational Aeronautical Earth Stations (AESs) operating on the Gogo AMSS system. Each AES consists of the AeroSat Ku antenna system, which incorporates the iDirect satellite modem. This system interfaces with the various satellites which comprise the Space Segment (via the Ku band). The satellites in turn communicate with the Ground Segment, which consists of the Gateway Earth Stations and Network Operations Centers (NOCs) that are associated with the satellites and the overall Gogo AMSS network. Utilizing input from the aircraft's navigation system ARINC 429 interface, the antenna is steered by the antenna control system and satellite modem as the aircraft maneuvers and travels in the air. The AeroSat antenna system was previously authorized by the FCC for AMSS.[1] Gogo's on-board data network interfaces with the satellite modem to provide users with access to online connectivity, as well as to in-flight entertainment content.

The AeroSat HR6400 Satellite Antenna Subsystem is made up of four major physically separated components, along with the interconnecting RF Cabling. These four major components are the radome, and the Fuselage Mounted Antenna (Antenna) both of which are mounted on the top of the aircraft fuselage and constitute the Satellite Antenna Assembly, and the Antenna Control Modem Unit (ACMU), and High Power Transceiver (HPT), both of which are mounted within the pressurized airframe, just under and in close proximity to the antenna.

2.2.2. ACMU

The ACMU is the Antenna Control Unit (ACU) of the previously authorized AeroSat antenna system, but it has been physically modified to provide space for the iDirect modem and associated interconnections. The ACMU obtains information on the aircraft's position (latitude, longitude and altitude), and attitude (roll angle, pitch angle, and heading), and on changes in those factors (roll rate, pitch rate, yaw rate, and ground speed) from the on-board Inertial Navigation System (INS) via the ARINC 429 data bus. Based on the location of the aircraft and pre-loaded maps, the modem selects the appropriate serving satellite. The ACMU controls the antenna's positioner to the correct azimuth, elevation and polarization orientation relative to the aircraft position and orientation in order to accurately point the antenna toward the target satellite. The aircraft position data (latitude and longitude) is updated every 200 milliseconds or less, and its attitude data is updated every 50 milliseconds or less for heading and every 20 milliseconds or less for pitch and roll. The positioner controls are updated continuously to maintain accurate pointing towards the satellite.

[1] *See Row 44 Inc.*, File Nos. SES-LIC-20080508-00570, SES-AMD-20080619-00826, SES-AMD-20080819-01074, SES-AMD-20080829-01117, SES-AMD-20090115-00041, SES-AMD-20090416-00501, Call Sign E080100 (granted Aug. 5, 2009).

2.2.3. Ku Antenna System

The Ku Antenna System includes the radome, the Antenna and the HPT. The radome protects the Antenna from the external environment and minimizes the impact of the fuselage-mounted equipment on the flight dynamics on the aircraft. It is transparent to RF energy over the Ku-band.

The Antenna consists of an antenna array which receives and transmits satellite signals and a Low Noise Block Amplifier (LNA). It is mounted on a positioner with an elevation over azimuth gimbal. The polarization control is integral to the antenna array. RF signals to and from the antenna are connected to the HPT via rotary joints and cables, and control and power signals connect to the ACMU via slip rings and power/control cables.

The HPT is connected between the antenna and the ACMU's modem, up-converting the L-band transmit signal to Ku-band, and down-converting the received Ku-band signal to L-band.

2.2.4. Antenna Pointing

The antenna pointing accuracy is controlled by the ACMU to a pointing error of less than 0.2° between the orbital location of the target satellite and the axis of the main lobe of the antenna. All emissions 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 exceeds 0.5°, and transmission is not resumed until the angle is verified to be less than 0.2°. The gimbaled antenna is mechanized by a positioner that slaves the antenna beam in azimuth, elevation and polarization utilizing received signal quality to assure alignment of the positioner's reference system with that of the aircraft inertial navigation system. The pointing error is continuously computed by the ACMU from receive INS data and positioner sensors. In the event that the pointing error exceeds 0.5°, the ACMU will mute the transmitter by disabling power to the power amplifier within the HPT and will not re-enable it until the error is determined to be within 0.2°. Once the HPT is commanded to mute, power is disabled in less than 1 millisecond. The mute line is a direct connection to the Power Amplifier and requires no CPU inputs.

The control and positioner system result in less than 0.2° pointing error being maintained under normal aircraft operational conditions, including situations where the aircraft is not on the same longitude as the serving satellite.

In summary, the control system relies on a combination of the aircraft position and attitude information from the onboard aircraft computer augmented with signal strength data provided by the modem as received/processed from the satellite, providing a closed loop tracking update.

2.3. Space Segment

The Gogo AMSS system will lease transponder capacity on commercial Ku-band FSS satellites. Partial or whole transponders may be used, and transponders may be operated with a single carrier or with multiple carriers. Forward and return links may be on the same or different transponders. The spectrum will typically be within the conventional Ku band – 11.7-12.2 GHz downlink and 14.0-14.5 GHz uplink. On some satellites, receive frequencies in the 10.95-11.2, 11.45-11.7, and 12.25-12.75 GHz bands will be used.

2.3.1. Satellite System List

Operation of the Gogo AMSS system with these satellites will conform to the coordinated uplink off-axis EIRP spectral density limitations and downlink power density limits for the listed satellites. SES and Intelsat have coordinated the Gogo AMSS technical parameters with operators of the adjacent satellites.

Satellite	Location	Beam Coverage Area	Tx (GHz)	Rx (GHz)	Satellite Operator
SES 1	101W	North America	14-14.5	11.7 – 12.2	SES
NSS 703	313E	S2 - North Atlantic	14-14.5	11.7 – 11.95	
		S1 - North Atlantic	14-14.5	10.95 – 11.2; 11.45-11.7	
		S3 - North Atlantic	14-14.5	12.5-12.75	
IS 14	315E	So America	14-14.5	11.7 – 12.2	Intelsat
IS 27	304.5E	North Atlantic	14-14.5	11.45 – 11.7	
IS 21	302E	Brazil	14-14.5	11.7 – 12.2	
IS 19	166E	Northeast Pacific	14-14.5	12.25-12.75	
		Northwest Pacific	14-14.5	12.25-12.75	
		Australia	14-14.5	12.25-12.75	
		Southwest Pacific	14-14.5	12.25-12.75	

2.4. Ground Segment

The Ground Segment consists of the Gateway Earth Stations which interface with the Space Segment and provide overall satellite network management via one or more NOCs. Data will be transmitted to the Gogo Data Center, which will in turn direct data to/from the Internet and other data systems.

2.4.1. Gateway Earth Stations

Satellite	Teleport Location	Call Sign
SES 1	Woodbine, MD	E920698
NSS 703	Woodbine, MD	E070181
IS 14	ATL teleport ATL-C06	E940333
	ATL teleport ATL-K15	E090093
IS 27	MTN teleport MTN-K02	E030051
IS 21	TBD	N/A
IS 19	Napa teleport NAP-K31	E980460
	Napa teleport NAP-C30	E980467

2.4.2. NOCs

Gogo LLC
Network Operations Center
1250 North Arlington Heights Rd
Itasca, IL 60143
Phone: +1 866 943 4662 – NOC Engineer on Duty
Email: noc@aircell.com

SES
Network Operations Center
8000 Gainsford Court
Bristow, VA 20136
Phone: +1 703 367 7300
Email: NOC@ses.com

Intelsat
Carrier Management Center
Carrier access, measurement and monitoring for fault detection and resolution 24x7 support
Phone: +1 404 381 2600
+1 800 321 3959
Fax: +1 404 381 2426
E-mail: cmcops@intelsat.com

Data Operations Center
IntelsatONE Broadband and managed network services 24x7 support
Phone: +1 404 381 2828
Fax: +1 404 381 2596
E-mail: doc@intelsat.com

2.5. Waveforms

2.5.1. Description

The network uses a star topology with a Time Division Multiplexed (TDM) broadcast outbound channel from a central hub location shared by a number of remote terminals. Each remote terminal transmits to the hub on a shared set of Time Division Multiple Access (TDMA) inbound channels with dynamic timeslot assignments.

2.5.2. Satellite Access Techniques

DVB-S2 with Adaptive Coding and Modulation (ACM) is utilized for the outbound channel, initially with one carrier in each satellite coverage area. All of the forward link traffic for the aircraft operating in that region will be time division multiplexed on this carrier. Modulation and coding will be varied on a frame-by-frame basis and terminals will attempt to demodulate all of the frames they receive and determine which data is addressed to them. Information regarding receive quality is transmitted back to

the hub modems via the return link so that it may adapt future frame coding and modulation to ensure acceptable performance. As traffic volumes increase in a coverage area, additional outbound carriers will be added, with each AES assigned to a particular carrier.

The return link uses iDirect's proven Deterministic TDMA (D-TDMA), a Multi-Frequency TDMA (MF-TDMA) access scheme. The hub assigns terminals time slots on one or more in-route carriers for data traffic, assuring that no carrier and time slot assignments are duplicated amongst terminals. Individual in-route carriers have a fixed modulation and coding scheme, but modulation and coding may differ amongst multiple in-route carriers that are provisioned in a coverage area. Terminals will transmit a single carrier in each of their assigned time slots. As user demand varies with time on the return link, the terminal will signal the changed demand to the hub over the return link, and the hub will adjust the number of time slots assigned to that terminal.

No contention exists in the return link as time slots on each carrier are uniquely assigned to one AES. This makes managing off-axis EIRP spectral density within the system simple and robust.

2.5.3. Out of Band Emissions

The Gogo AMSS system will comply with the emissions limitations in 47 C.F.R. §25.202(f).

2.6. Network Management

2.6.1. Network Monitoring and Management

The NOCs will be the focal points responsible for configuring, monitoring and controlling the Gogo AMSS network. iDirect's Network Management System (NMS), a widely deployed and field-proven system, will be used to access and manage the various network elements in the system.

NOCs will be staffed on a 24/7/365 basis, providing continuous supervision of the network, monitoring system performance and identifying any network element failures. The NMS provides the ability to re-configure and/or disable network elements in response to performance problems and/or element failures.

2.6.2. Commissioning - authorizing terminals to connect to the network

After an aeronautical terminal is installed on an aircraft, the AES is commissioned. The Antenna orientation is adjusted to peak on the received signal from a satellite, and its orientation is compared to and aligned with that derived from the aircraft's INS and the antenna positioner. Cable losses are measured and verified to ensure accurate transmit and receive chain calibration. The terminal information and associated profiles are entered into the NMS.

Once the terminal is fully activated and enabled into the NMS, log-in invitations will be issued and only then is it possible for a terminal to attempt to log in to the network.

2.6.3. Acquisition

Acquisition timeslots and carriers are uniquely assigned to inactive remotes, ensuring that only a single remote can transmit in an acquisition timeslot. Thus, no contention can occur on any acquisition time slot, and off-axis EIRP spectral density is deterministically controlled. Terminals may only begin transmitting to a satellite and beam that is consistent with the pre-loaded maps, and only after the antenna

has been pointed at the appropriate satellite and the log-in invitation information has been received. During acquisition, the transmit power is minimized and must be below the level that would exceed the off-axis EIRP limits established for the serving beam at the terminal's current location.

2.6.4. Automatic Beam Selection

The Gogo AMSS system uses iDirect's Automatic Beam Selection (ABS) to switch between beams as an aircraft travels between different served areas. The modem's satellite maps contain the information regarding which satellite and beam is preferred based on the terminal's geographic location. When a beam switch is required, the modem will provide the ACU with the updated satellite position, transmission will be disabled, the new antenna position will be calculated and sent to the antenna positioner, and the antenna will re-orient to the new satellite and acquire the new satellite signal. The modem will acquire synchronization of the received signal and, on receipt of a log-in invitation, will initiate signal transmissions. In the case of beam-to-beam transitions on the same satellite, the process is similar, except that no re-orientation of the antenna is required.

2.6.5. Return Link Power Control

The iDirect demodulator monitors the C/N of the signals received from served remotes, and issues power control corrections to remotes which are outside the target C/N range. These corrections adjust the return link power to the target C/N after the remote has log-in, and maintain the target level as the return link characteristics change with the remote's geographic position and operating environment.

The High Power Transceiver has a power detector, which is stable over frequency and temperature, that reports the Ku-band transmit power from the Power Amplifier (PA). This allows accurate power control to be maintained at the PA output, despite any variations in PA gain over temperature and frequency.

The modem within the ACMU also calculates the Power Spectral Density (PSD) and ensures that the remote will not exceed the PSD limits required to comply with FCC regulations.

2.6.6. Return Link Frequency Control

The modem and High Power Transceiver are phase locked to a 10 MHz reference provided within the High Power Transceiver. The return link frequency stability is determined by the frequency stability of the 10 MHz reference. If there is a loss of lock to the reference by either the High Power Transceiver or the modem, the terminal immediately ceases transmission. The frequency stability of the 10 MHz reference is ±0.01 parts per million.

2.6.7. Fault Management

There are multiple modes of fault detection within the Antenna System and the hub. All emissions 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 exceeds 0.5°, and transmission is not resumed until the angle is less than 0.2°. In addition, if the ACMU loses communication with the aircraft inertial reference system, or if there is a failure of the ACMU itself, it will cause the transmitter to immediately mute. If the reference oscillator fails, the Antenna System will cease transmission. Finally, the Antenna System will

not transmit until it sees the appropriate out-route signal from the satellite; if the signal is not received, the Antenna System will not transmit.

3. Protection of Other Co-Frequency Spectrum Users

The FCC has not yet established service rules applicable to Ku-band AMSS operations, and Gogo therefore has provided the technical and coordination information specified under the requirements set forth in 47 C.F.R. §25.220. Additionally, Gogo has included technical data demonstrating compliance with two-degree satellite spacing requirements, analogous to those that currently apply to ESVs set forth in 47 C.F.R. §25.222 and VMES in 47 C.F.R. §25.226.

3.1. Protection of GSO FSS Systems

The Gogo AES will operate in accordance with the off-axis EIRP spectral density limits for Ku-band terminals in the Commission's rules.[2] The data rates transmitted from the terminal will vary from 500 kbits/s to 1500 kbits/s. The AES will transmit using a TDMA scheme with channel bandwidths of 4.1 MHz, 6.0 MHz, 6.56 MHz, 6.94 MHz, and 8.0 MHz. The co-polarized off-axis EIRP spectral density levels of the AES terminal are shown in Figure 2 below at +/-7 degrees. Complete antenna patterns and EIRP spectral density plots are included in Appendices B and C, respectively. The associated data in tabular form are included in Appendix D. The terminal's off-axis EIRP spectral density, shown in Figure 2 and in Appendix C, remains below the combined off-axis EIRP spectral density limit derived from §25.209(2) and §25.212(c), as shown in the Figure below. All Gogo operations will conform to the requirements set forth by the satellite operators' coordination agreements. If Gogo is notified that any adjacent satellite operator is experiencing harmful interference from Gogo's operations, Gogo will cease terminal transmissions immediately. In addition, if another co-frequency, co-coverage GSO FSS satellite commences operation at a location within six degrees of one of Gogo's serving satellites, Gogo will cease operation absent a coordination agreement or will demonstrate that it will not cause harmful interference to the new satellite.

[2] Gogo is pursuing this authorization under 47 CFR §25.220. The performance of the Gogo AES antenna will also comply with the following FCC rules: §25.128(f), which governs conventional Ku-band VSATs; §25.222(a)(1)(i), which governs ESVs, and §25.226(a)(1)(i), which governs VMES operations. The Gogo AES terminal complies with off-axis EIRP spectral density limits in the azimuth plane.

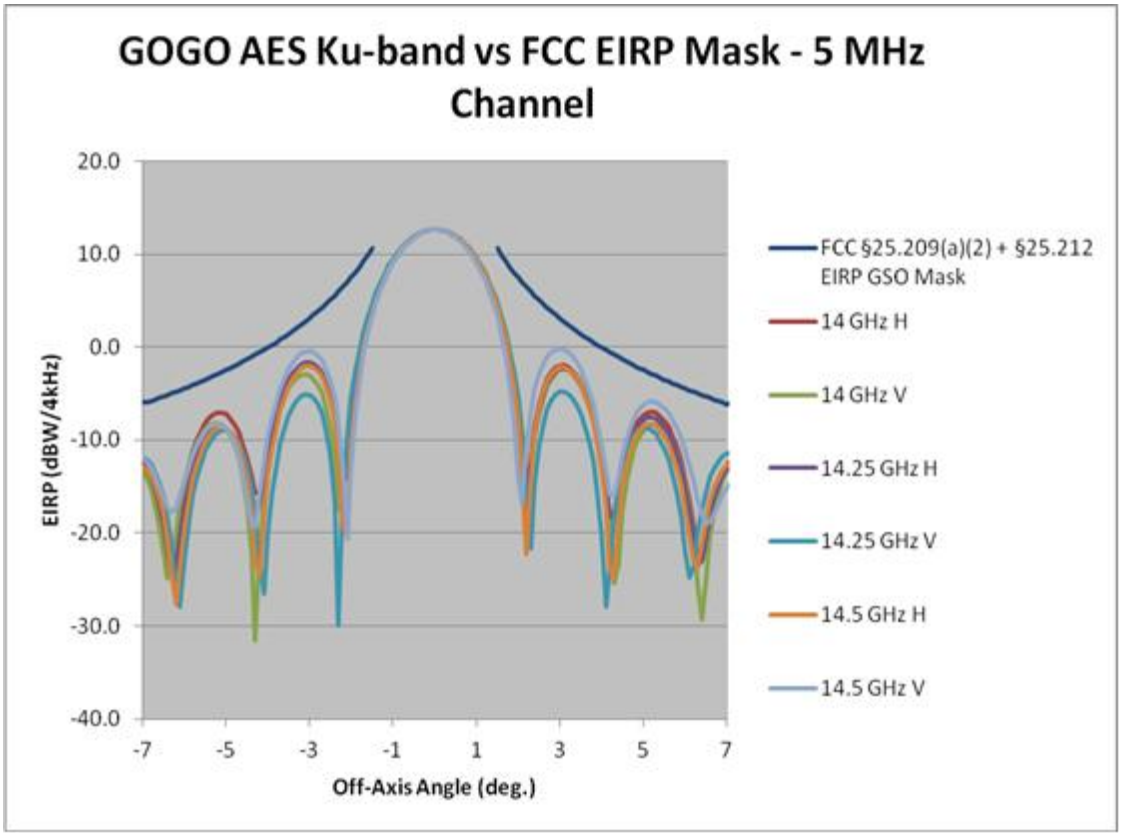


Figure 2. Maximum Off-axis EIRP Spectral Density of the Gogo Antenna

3.2. Protection of Potential NGSO FSS Systems

The Gogo AES antenna exceeds the off-axis EIRP spectral density values set forth in the Commission's rules in directions away from the geostationary arc, also derived by combining FCC rule parts §25.209(a)(4) and §25.212(c). This off-axis EIRP spectral density mask may be intended to protect Ku-band NGSO FSS systems. However, no systems of this type are presently planned or are operating. Gogo will enter into a coordination arrangement with any future Ku-band NGSO FSS system to protect such system from interference from the Gogo AES transmissions.

3.3. Protection of Terrestrial Radio Services

Gogo has examined current spectrum use in the 14.0 to 14.5 GHz band and has determined that there are no active FCC-licensed terrestrial services in this band in North America with which its AMSS service would potentially conflict. To the extent that fixed service users are identified in this band that require protection, Gogo will limit emissions to the levels stated in Recommendation ITU-R M.1643, Part B, either directly or through operational techniques that ensure that the maximum power flux-density (pfd) levels are not exceeded at locations where protection is required.

3.4. Protection of the Radio Astronomy Service

For purposes of protecting radio astronomy sites, consistent with Recommendation ITU-R M.1643, Part C, Gogo will limit aggregate pfd in the 14.47-14.5 GHz band as follows:

-221 dBW/m2/Hz (for protection of Green Bank, Arecibo and Socorro)

-189 dBW/m2/Hz (for protection of all other Radio Astronomy sites)

Gogo has negotiated a coordination agreement with the National Science Foundation obligating Gogo to limit aggregate pfd to the specified levels, and a copy of that agreement is attached.

3.5. Protection of Space Research Service

Gogo recognizes the utilization of the frequency band from 14.0-14.05 GHz (and the possible use of the band from 14.05-14.2 GHz) by the National Aeronautics and Space Administration (NASA) Tracking and Data Relay Satellite System (TDRSS) for space research operations conducted at Guam; White Sands, New Mexico; and when it becomes operational, Blossom Point, Maryland. Gogo is actively engaged in discussions with NASA to develop an appropriate coordination agreement regarding the protection of these current and future TDRSS sites, and will submit the final coordination agreement to the Commission once executed.

In the meantime, Gogo agrees not to operate Gogo AES antennas within the 14.0-14.2 GHz band within line of sight of NASA TDRSS facilities. This approach conforms to analogous requirements in the Commission's ESV and VMES rules.

3.6. Downlink Transmissions

Gogo seeks a waiver of the table of allocations to permit the Gogo AES antenna to receive transmissions from FSS spacecraft in the 11.7-12.2, 10.95-11.2, 11.45-11.7, and 12.25-12.75 GHz bands. All downlink transmissions to Gogo's AES terminals will operate within the space station authorizations and coordinated limits for downlink EIRP spectral density of the Intelsat and SES satellites, as agreed by the operators of adjacent satellites within +/- 6 degrees.

Gogo will accept interference from lawful operation of any station in the 11.7-12.2, 10.95-11.2, 11.45-11.7, and 12.25-12.75 GHz bands in accordance with the U.S. Table of Frequency Allocations, 47 C.F.R. §2.106. In addition, Gogo will immediately terminate Gogo AES operations upon notification that such operations are not permitted under the terms of a coordination agreement with, or are causing harmful interference to, any lawfully operating radio system in these bands in conformance with the U.S. Table of Frequency Allocations.

3.7. Adjacent Satellite Operators

Gogo has provided its satellite operators, Intelsat and SES, with sufficient technical information to conduct coordination with all adjacent satellites within ±6° of the satellites of interest. Attachments B and C and Amendment Exhibit A contain letters from these operators regarding the necessary coordination of the operation of the Gogo AES, including the uplink and downlink power density levels, with adjacent satellite networks within 6° of orbital separation from the satellites to be used in the Gogo

AMSS system. The Gogo AES will operate in conformance with existing coordination agreements with other satellite systems, and Gogo satellite operators will include the Gogo AES operations in all future satellite network coordination. Gogo agrees to comply with all coordination agreements reached by the satellite operators.

4. Conclusion

The requested authorization will allow Gogo to bring its extensive experience in pioneering ATG in-flight broadband connectivity and entertainment to a broader segment of the flying public. The Gogo AMSS system relies upon a network architecture and implementation technologies that have been previously authorized by the Commission, and which present no novel technical issues. Coordination has been completed with all satellite operators that have a potential to be affected by the proposed service, assuring that other authorized users will not be subject to harmful interference. Consistent with past Commission precedents, this application should be expeditiously granted.

APPENDIX A: Link Budget

APPENDIX A: Link Budget

Forward Link Budget

Hub	Woodbine, MD	
Required Eb/No	1.7	dB
Modulation	QPSK	
Info Rate	29360	Kbps
FEC Rate	½	
Carrier Rolloff	1.2	
Satellite SFD @ 0 dB/K	-94.9	dBW/m^2
Transponder Atten	6.0	dB
Transponder ID	US Coverage	

Hub Transmit

Frequency	14.3	GHz
Satellite G/T	6.2	dB/^{o}K
Antenna Diameter	9.2	m
Carrier EIRP	65.4	dBW
Ant. Input PFD	-34.1	dBW/4kHz
Path Loss	207.3	dB
Atm/Point/Pol Loss	0.7	dB

Aircraft Receive Terminal

Frequency	12.1	GHz
Satellite EIRP	46.0	dBW
Downlink PFD@ Beam Center	12.9	dBW/4kHz
Receive Gain	30.8	dB
Terminal G/T	11.0	dB/^{o}K
Path Loss	205.6	dB
Other Losses	0.6	dB

Transponder

Total OPBO	0.9	dB
Carrier OPBO	0.9	dB
C/No Thermal Up	92.3	dB-Hz
C/No Thermal Dn	78.6	dB-Hz
C/Io Total	82.8	dB-Hz
C/No+Io	77.1	dB-Hz
Add'l Link Margin	0.7	dB
% BW per cxr	99.9	%
% Power per cxr	82.0	%
Xpdr BW Alloc	36.0	MHz

Return Link Budget

Terminal	Gogo AES-1	
Required Eb/No	3.7	dB
Modulation	BPSK	
Info Rate	1500	Kbps
FEC Rate	½	
Carrier Spacing	1.35	
Carrier Spreading	2.0	
Satellite SFD @ 0 dB/K	-95.1	dBW/m^2
Transponder Atten	3.0	dB
Transponder ID	US Coverage	

Aircraft Transmit Terminal

Frequency	14.3	GHz
Satellite G/T	2.0	dB/^{o}K
Antenna Diameter	0.4	m
Carrier EIRP	44.4	dBW
Ant Input PFD	-16.3	dBW/4kHz
Path Loss	207.0	dB
Atm/Point/Pol Loss	0.7	dB

Hub Receive

Frequency	12.1	GHz
Satellite EIRP	49.3	dBW
Downlink PFD@ Beam Center	-0.9	dBW/4kHz
Hub G/T	37.3	dB/^{o}K
Path Loss	205.7	dB
Other Losses	0.6	dB

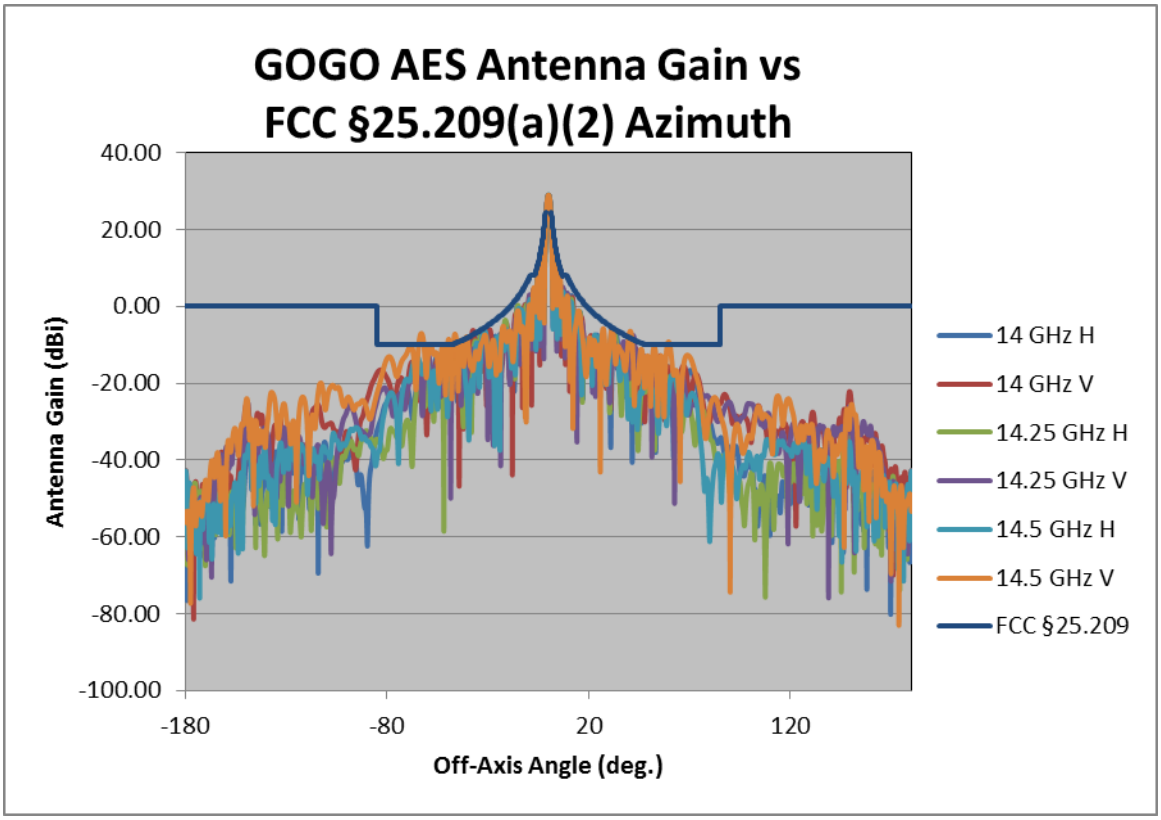
Transponder

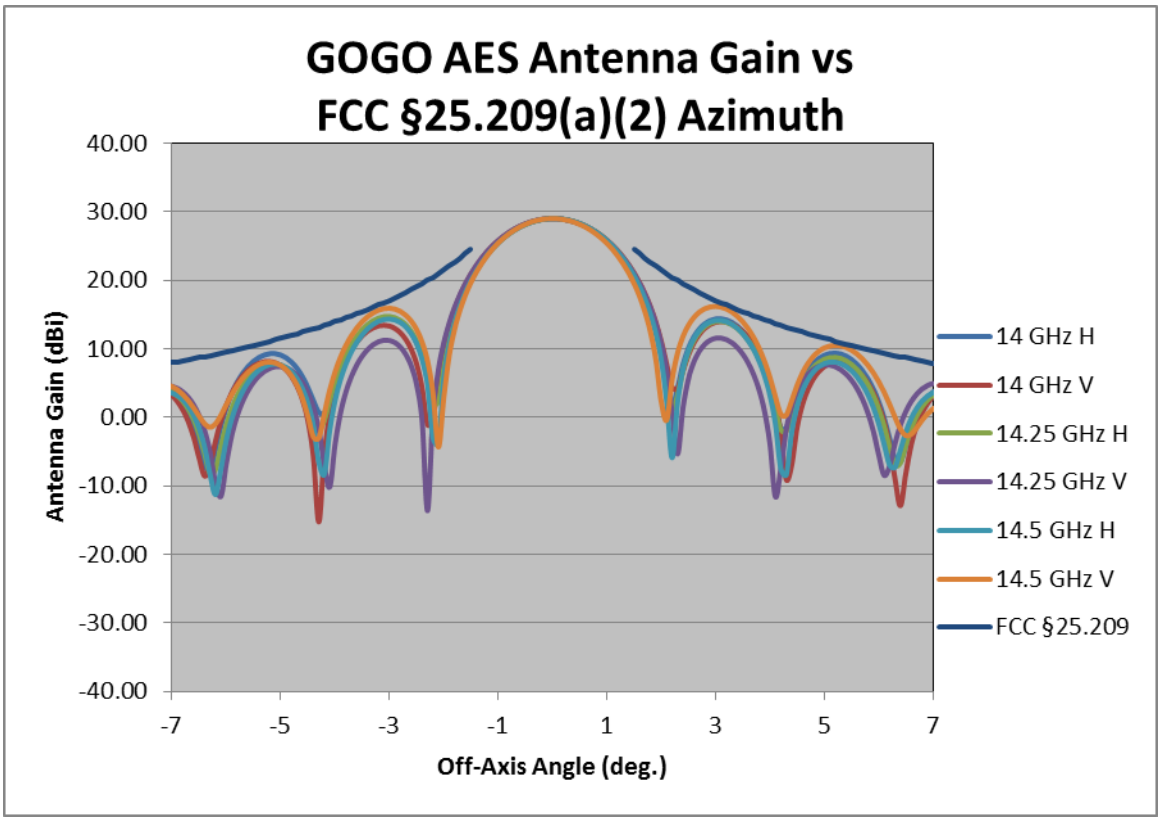
Total OPBO	4.0	dB
Carrier OPBO	22.5	dB
C/No Thermal Up	67.3	dB-Hz
C/No Thermal Dn	86.5	dB-Hz
C/Io Total	70.5	dB-Hz
C/No+Io	65.6	dB-Hz
Add"l Link Margin	0.2	dB
% BW per cxr	22.5	%
% Power per cxr	1.4	%
Xpdr BW Alloc	8.1	MHz

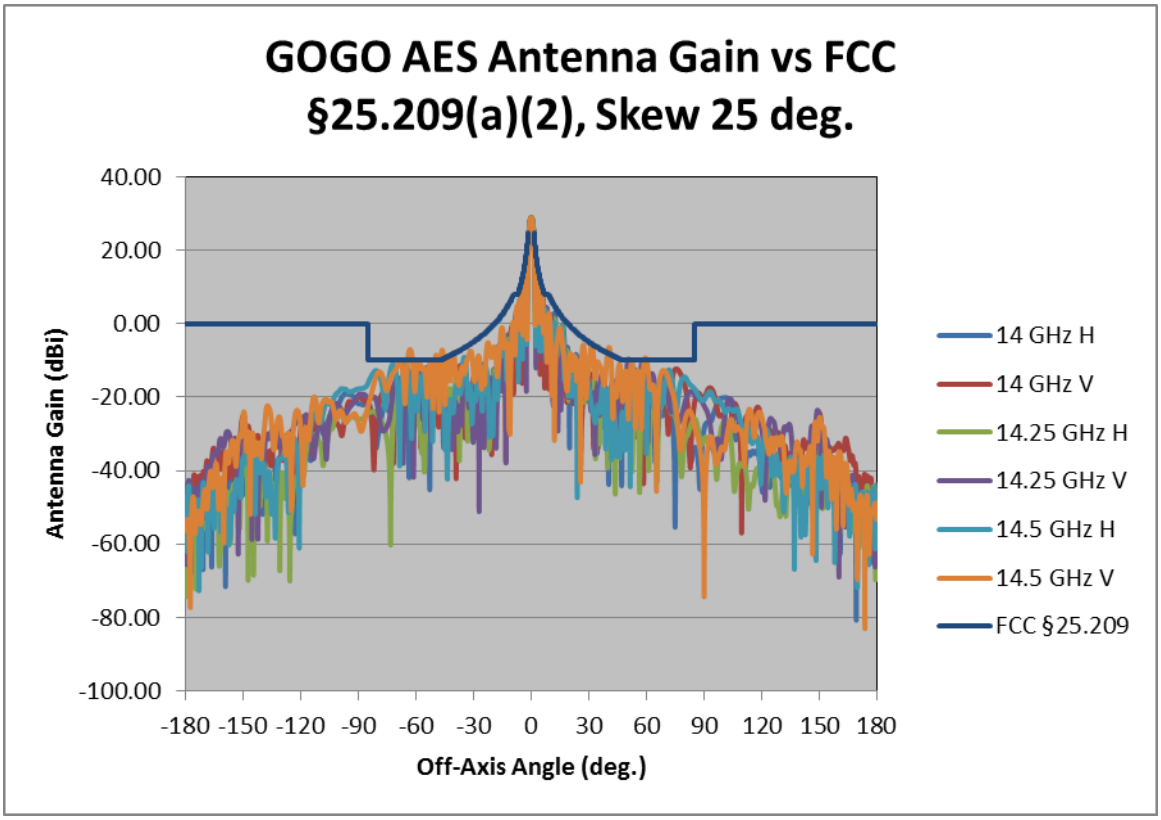
APPENDIX B: Antenna Patterns

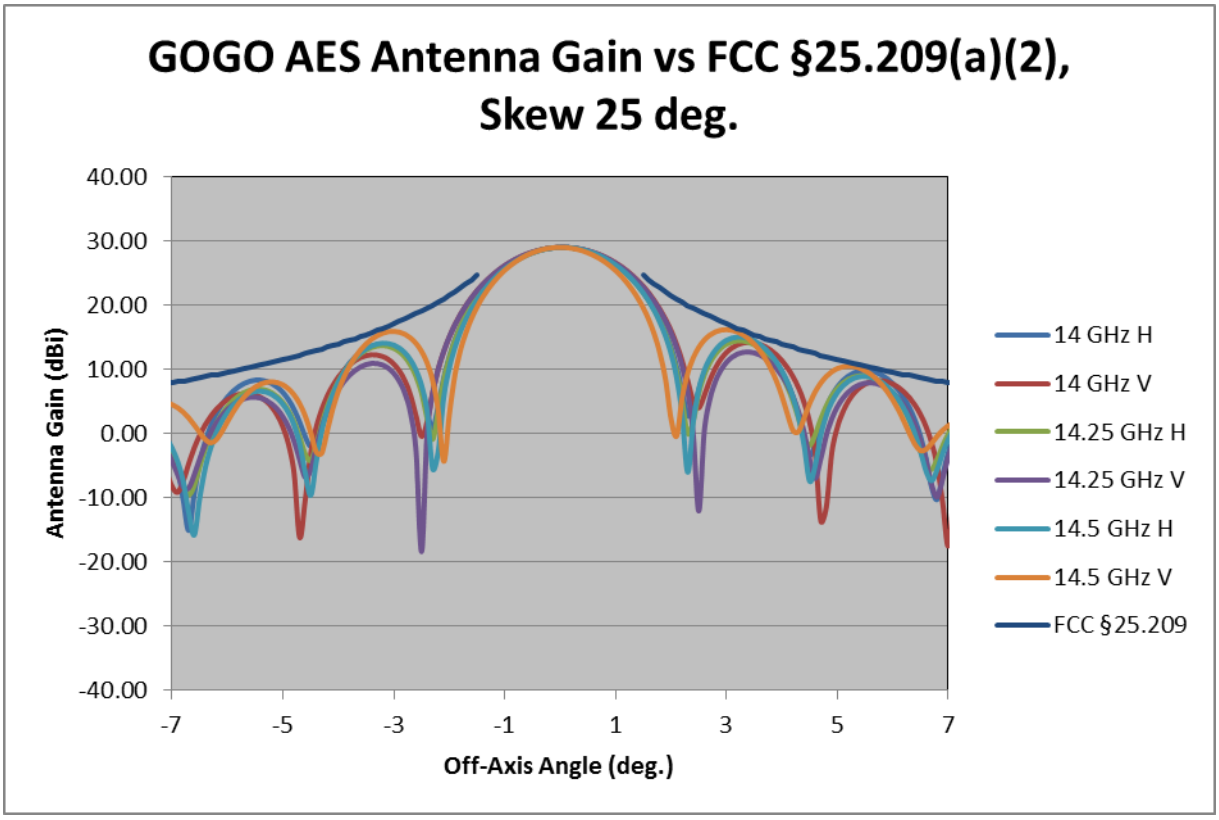
B.1 AeroSat Gain Patterns – Co-pol Azimuth

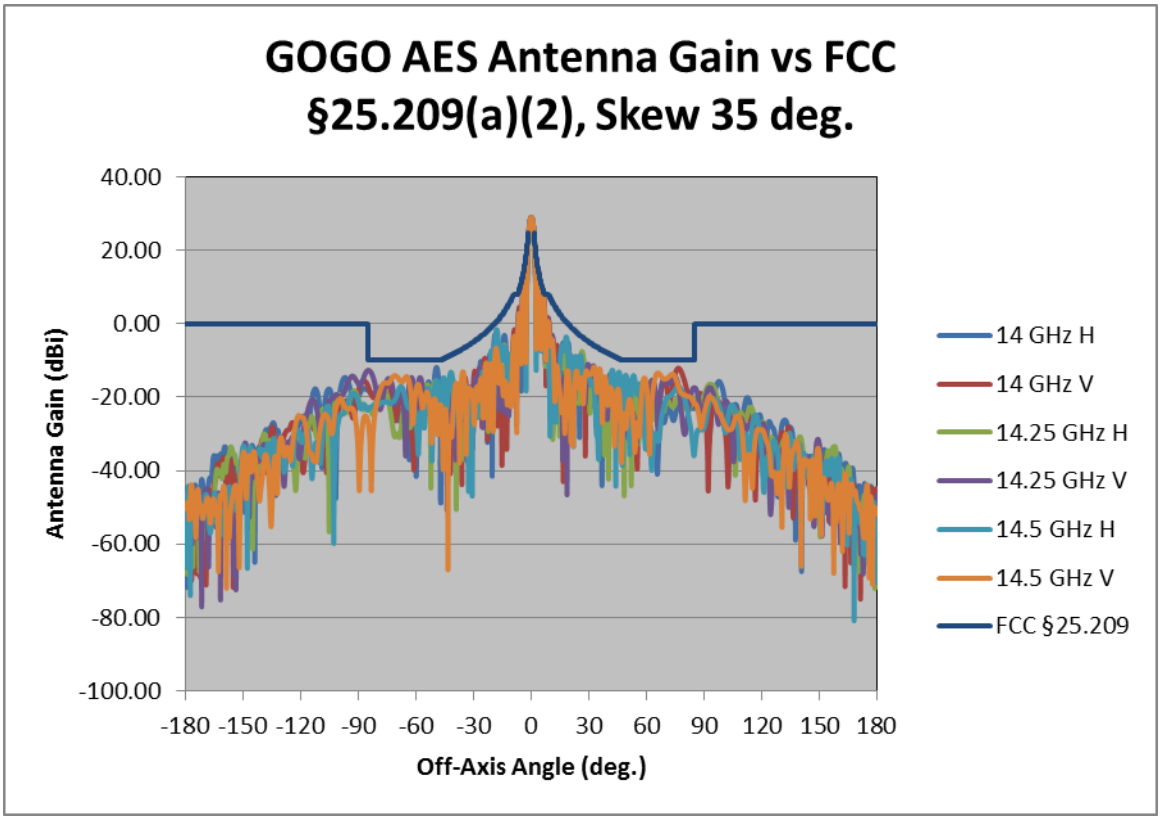
All pattern data contained in Appendix B was collected via measurements on a production antenna performed on calibrated antenna range. Provided are pattern data at bottom, middle and top of the transmit frequency band as required by §25.132(b)(1). Note, main beam gain for all plots is 29 dBi

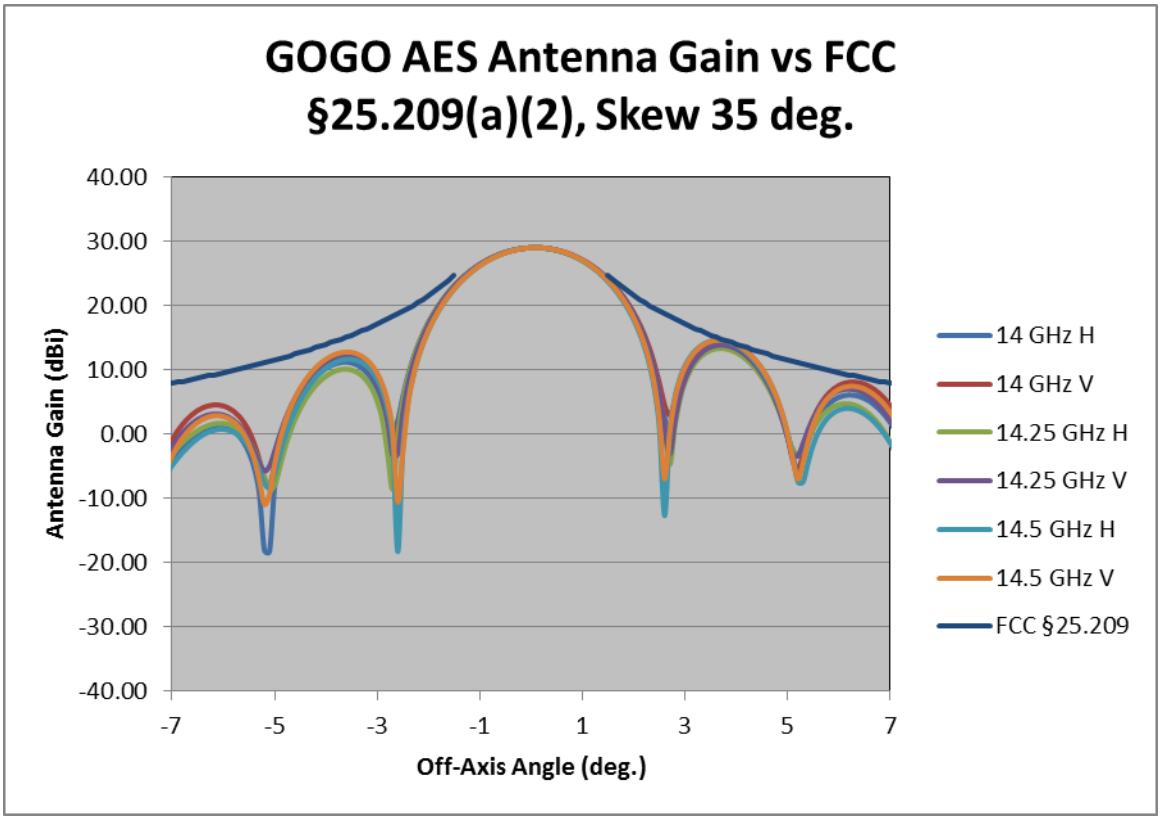

GOGO AES Antenna Gain vs
FCC §25.209(a)(2) Azimuth
Antenna Gain (dBi)
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
-180
-80
20
120
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

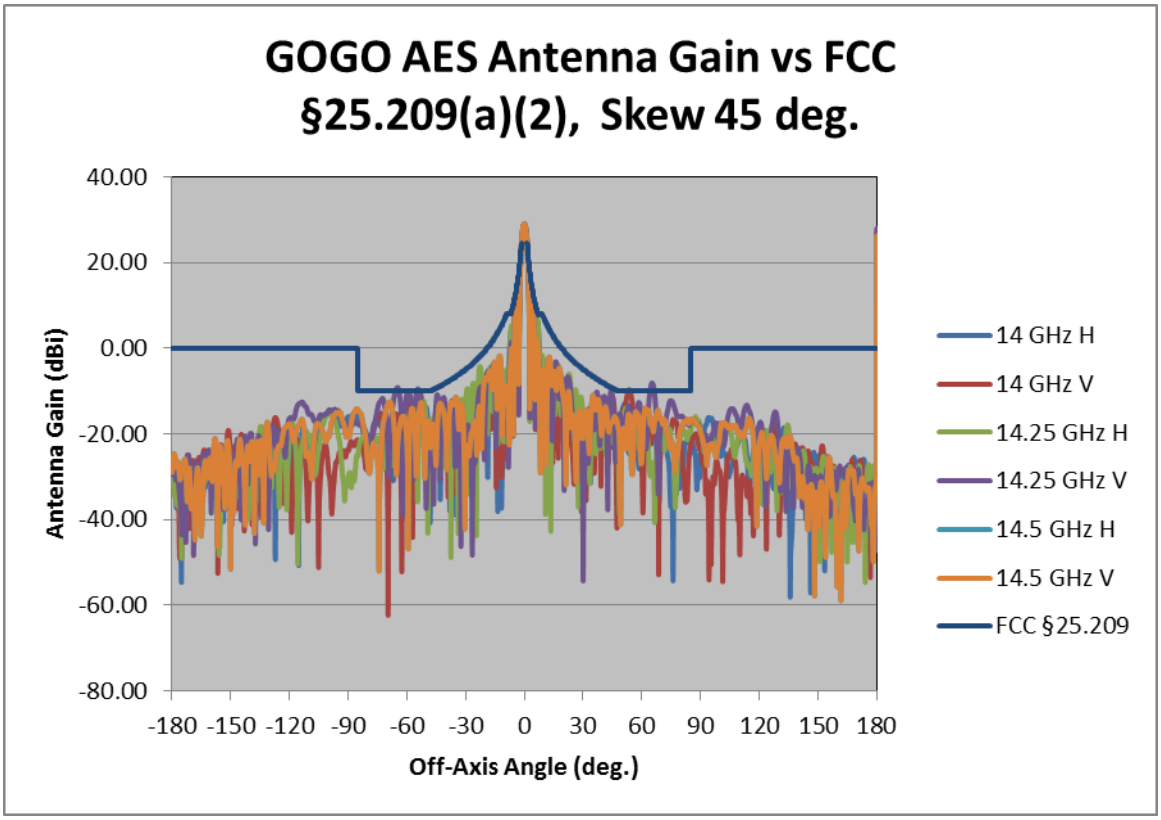

GOGO AES Antenna Gain vs
FCC §25.209(a)(2) Azimuth
Antenna Gain (dBi)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-7
-5
-3
-1
1
3
5
7
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

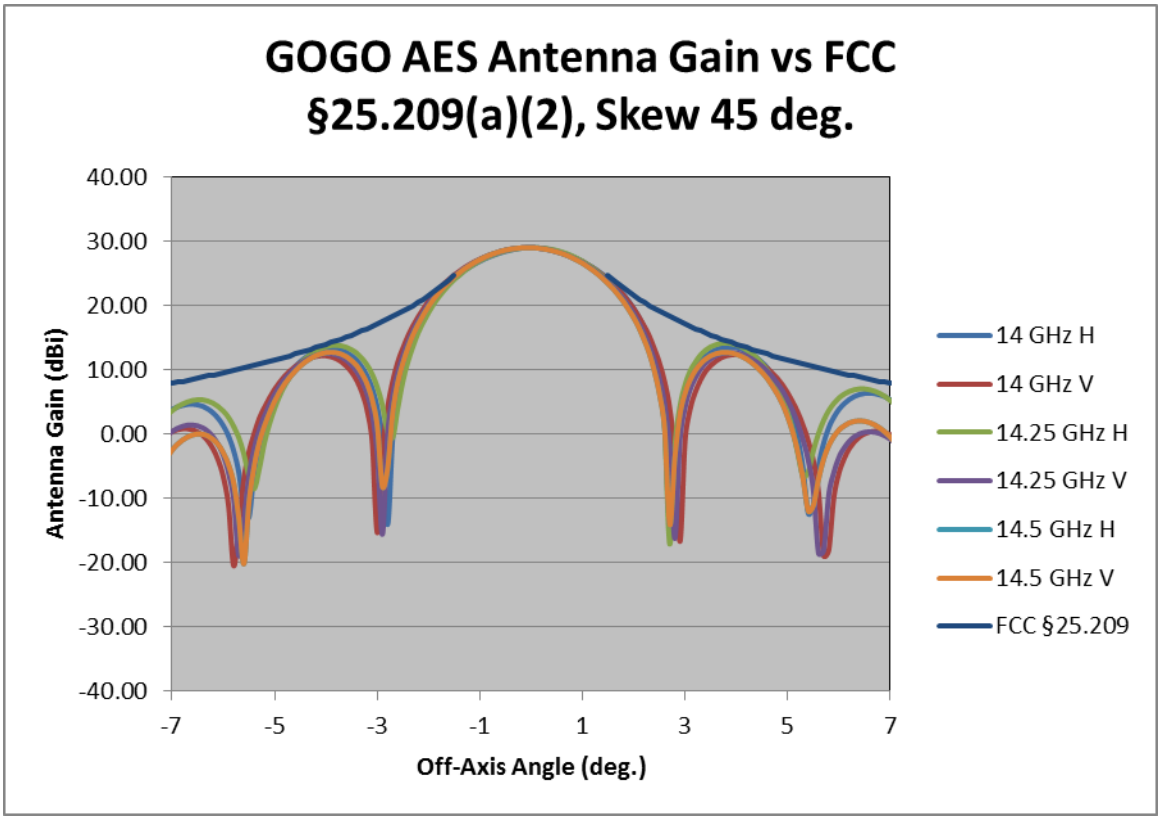

GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 25 deg.
Antenna Gain (dBi)
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
-180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

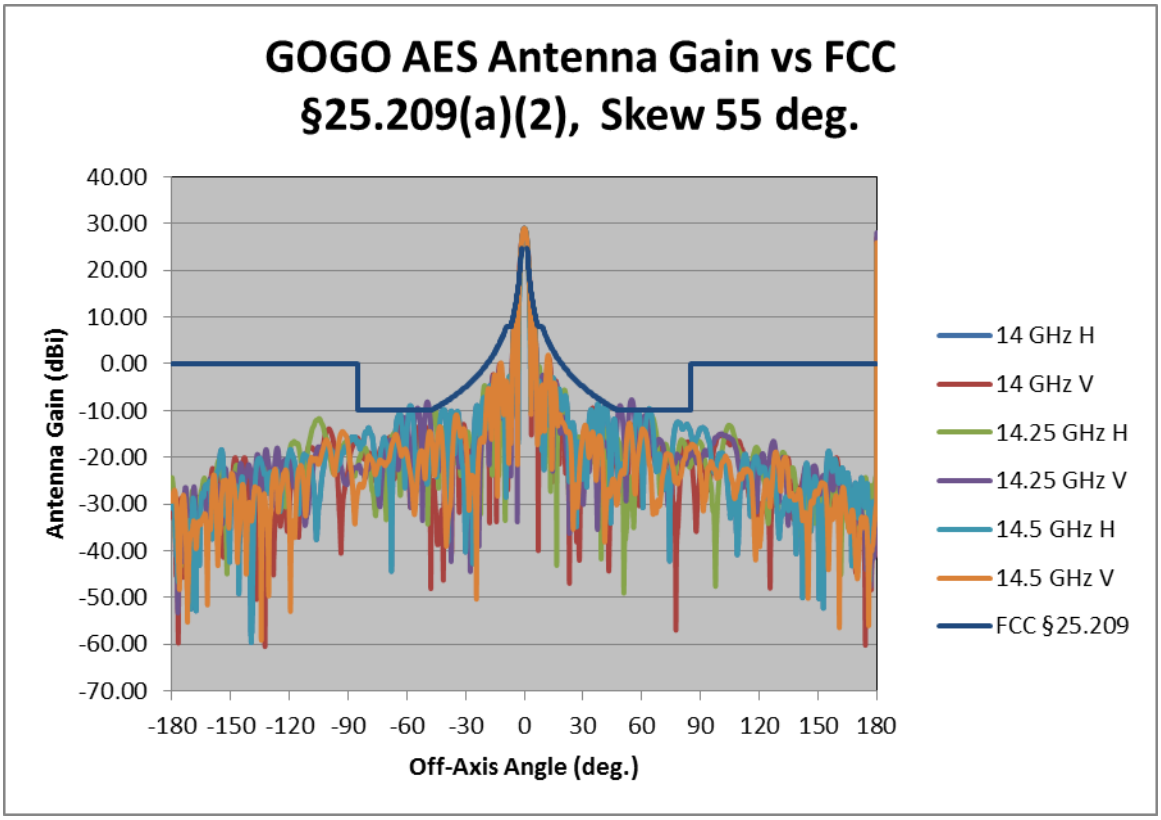

GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 25 deg.
Antenna Gain (dBi)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-7 -5 -3 -1 1 3 5 7
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

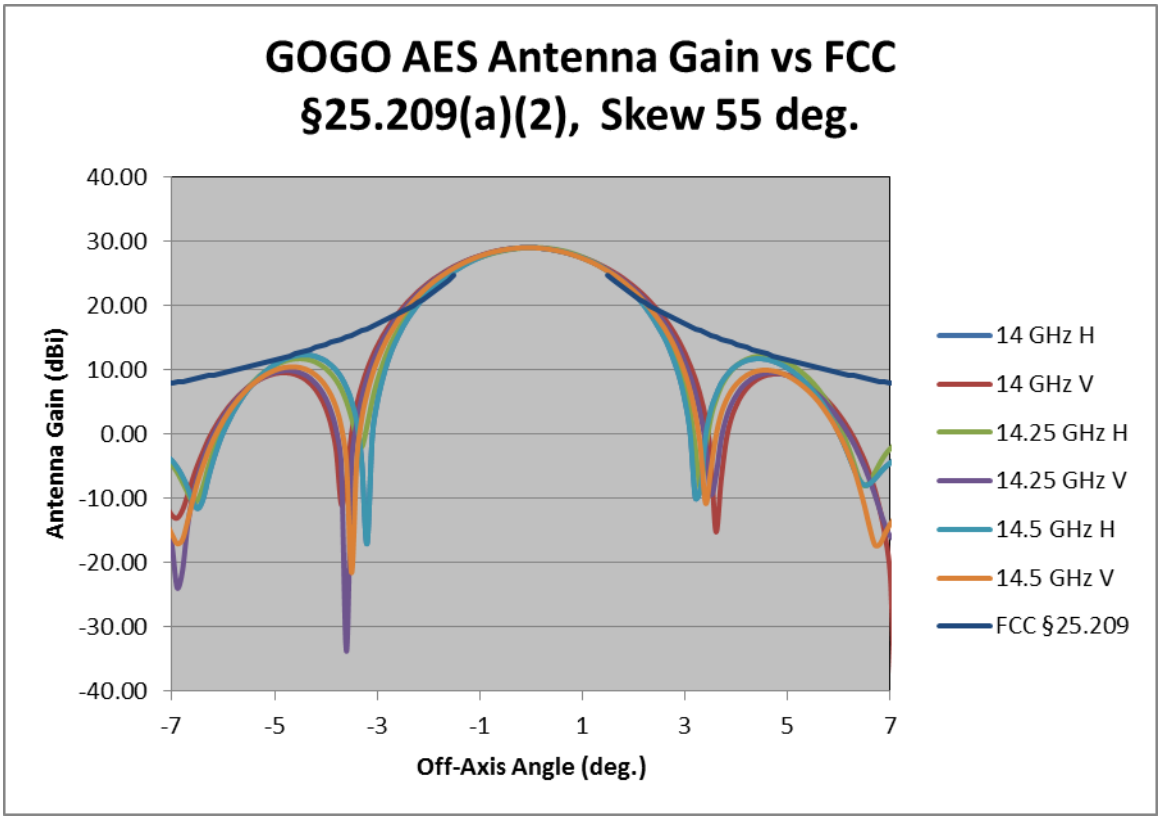

GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 35 deg.
Antenna Gain (dBi)
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
-180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209


GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 35 deg.
Antenna Gain (dBi)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-7 -5 -3 -1 1 3 5 7
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

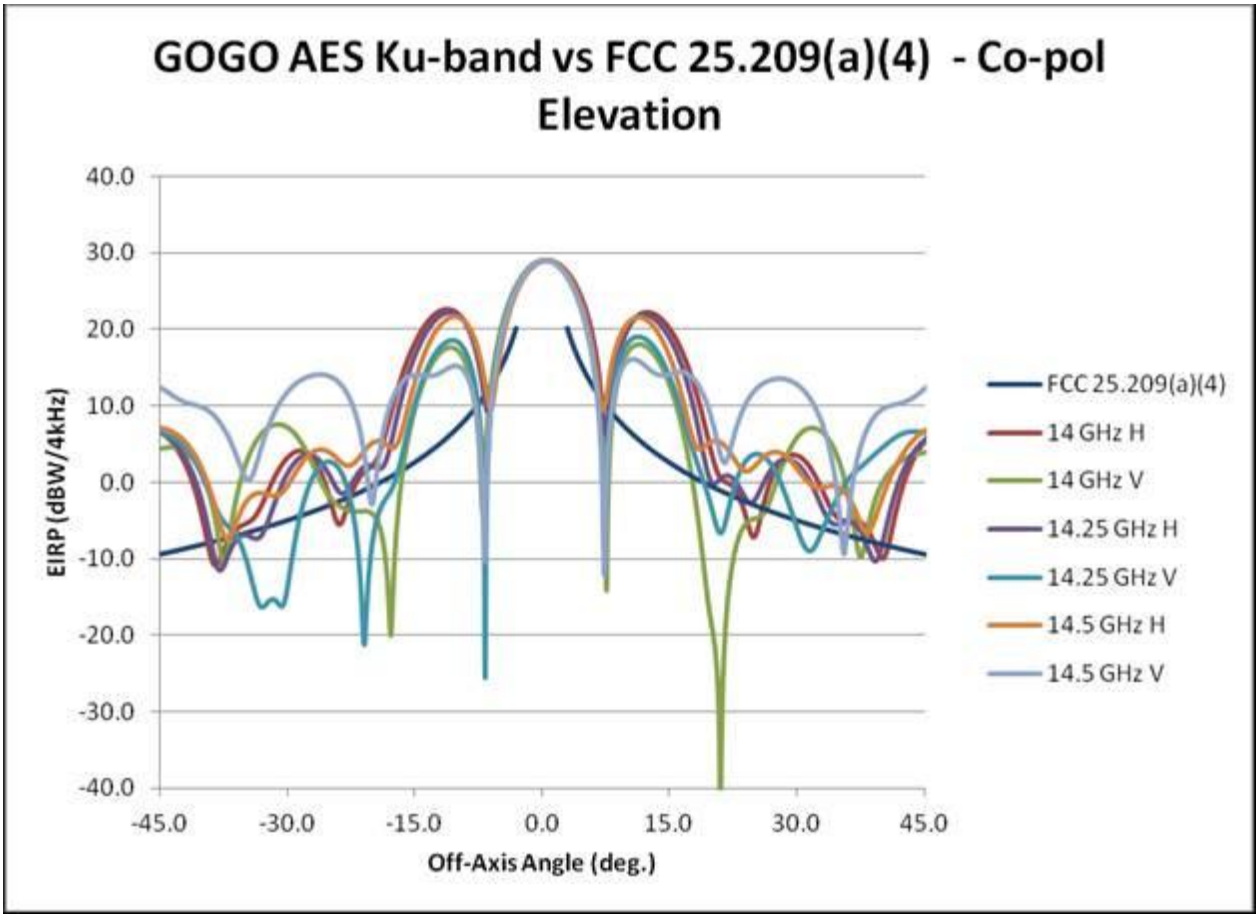

GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 45 deg.
Antenna Gain (dBi)
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209


GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 45 deg.
Antenna Gain (dBi)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-7 -5 -3 -1 1 3 5 7
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

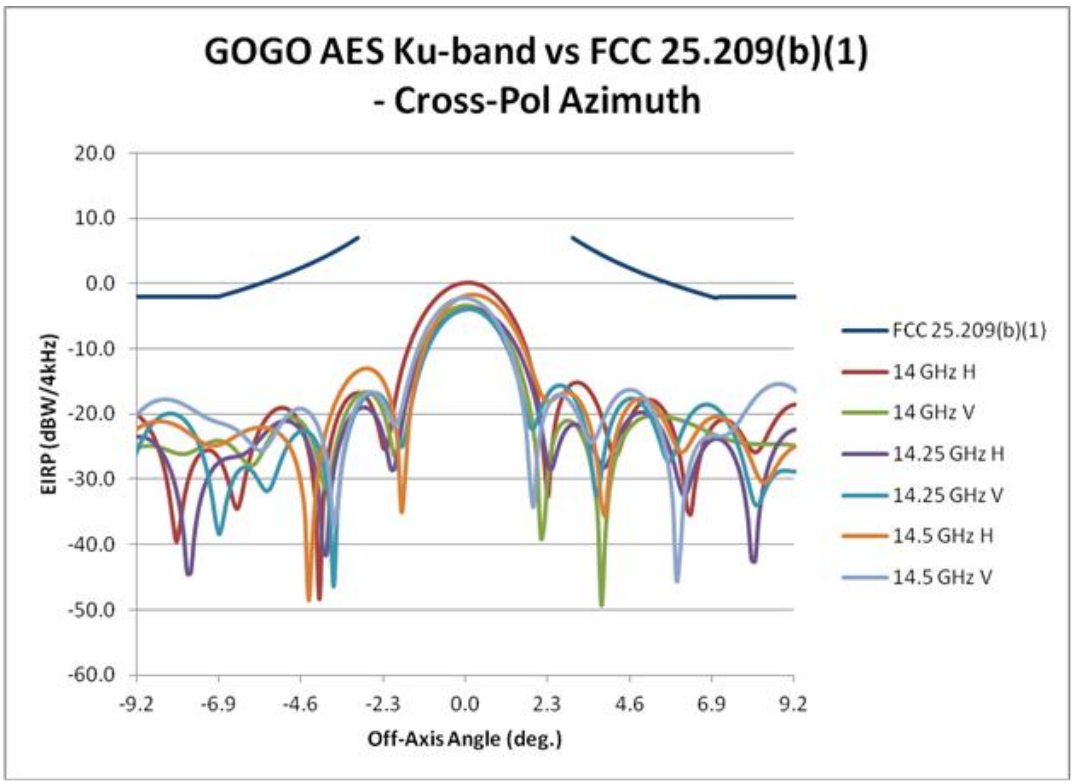

GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 55 deg.
Antenna Gain (dBi)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
-180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

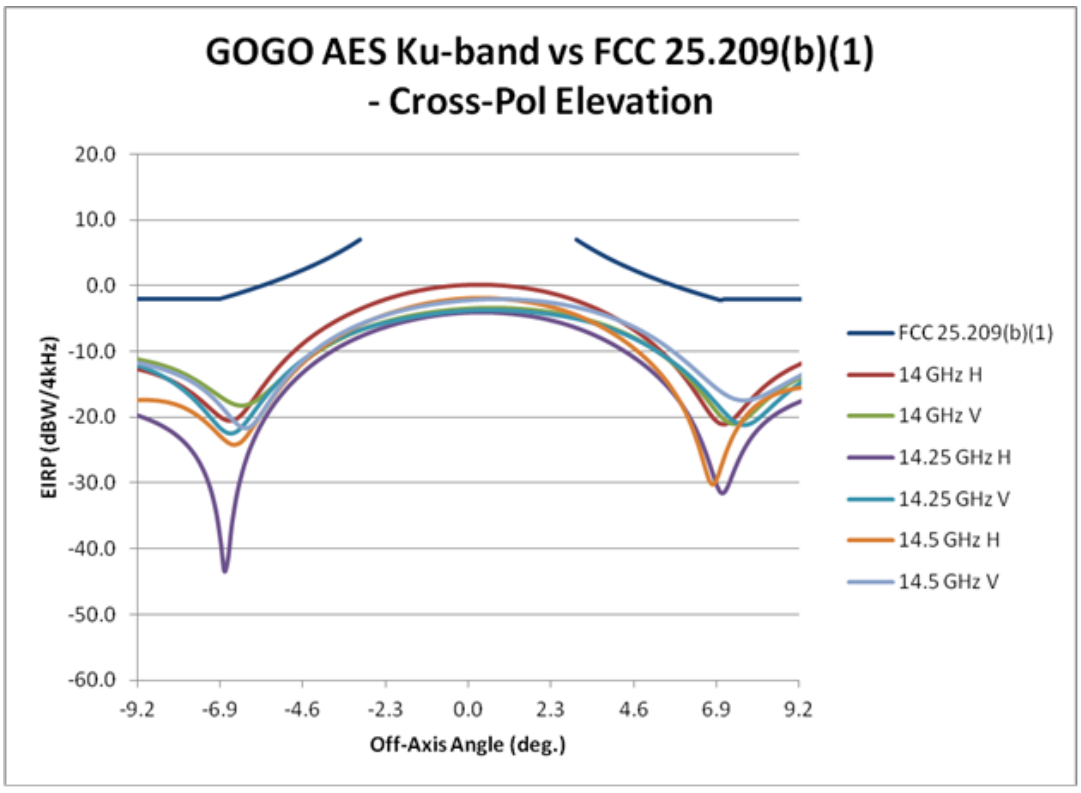

GOGO AES Antenna Gain vs FCC §25.209(a)(2), Skew 55 deg.
Antenna Gain (dBi)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-7 -5 -3 -1 1 3 5 7
Off-Axis Angle (deg.)
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V
FCC §25.209

B.2 – AeroSat Gain Patterns – Co-Pol Elevation



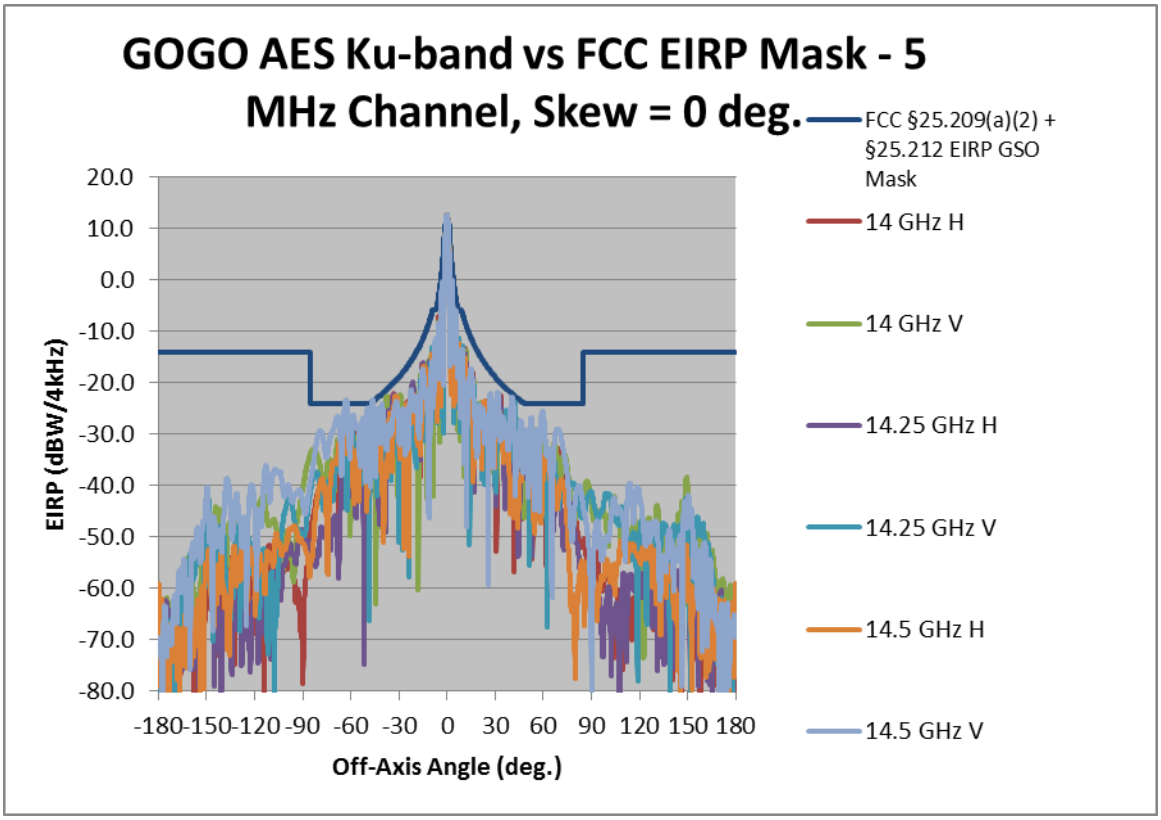
B.3 AeroSat Gain Patterns – Cross-Pol

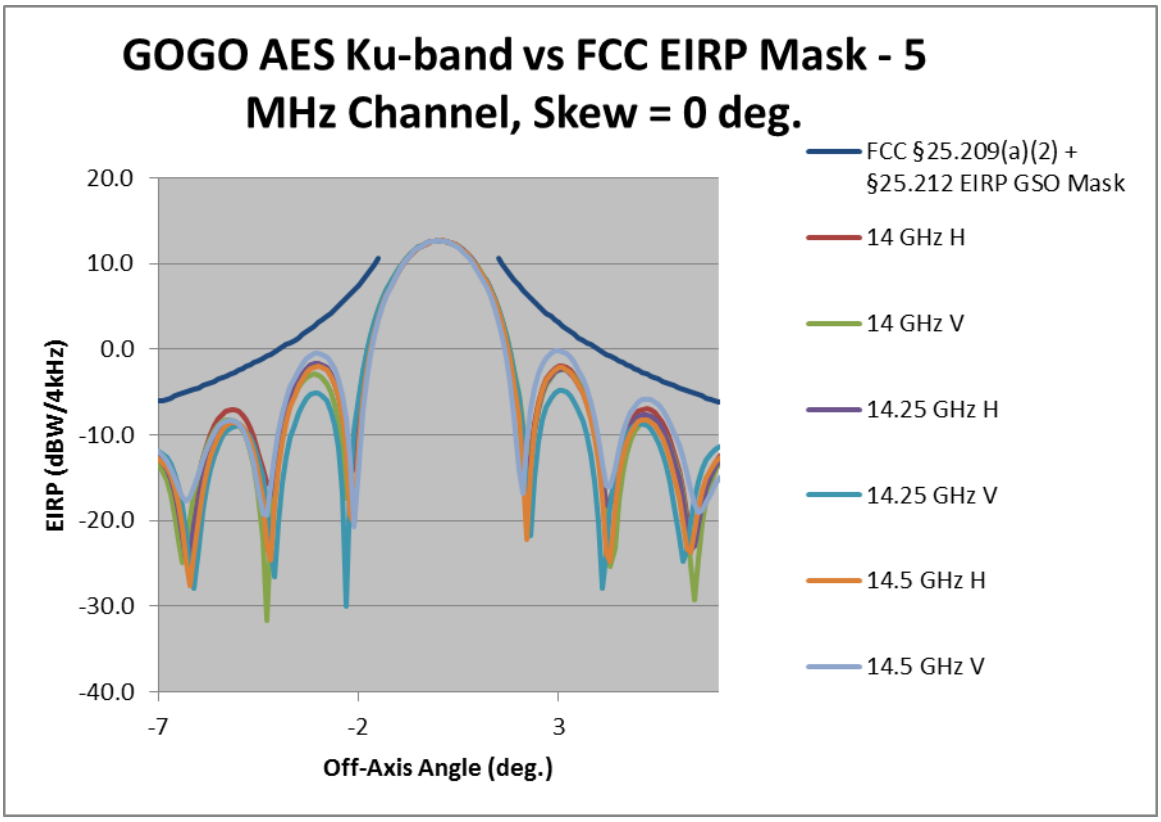


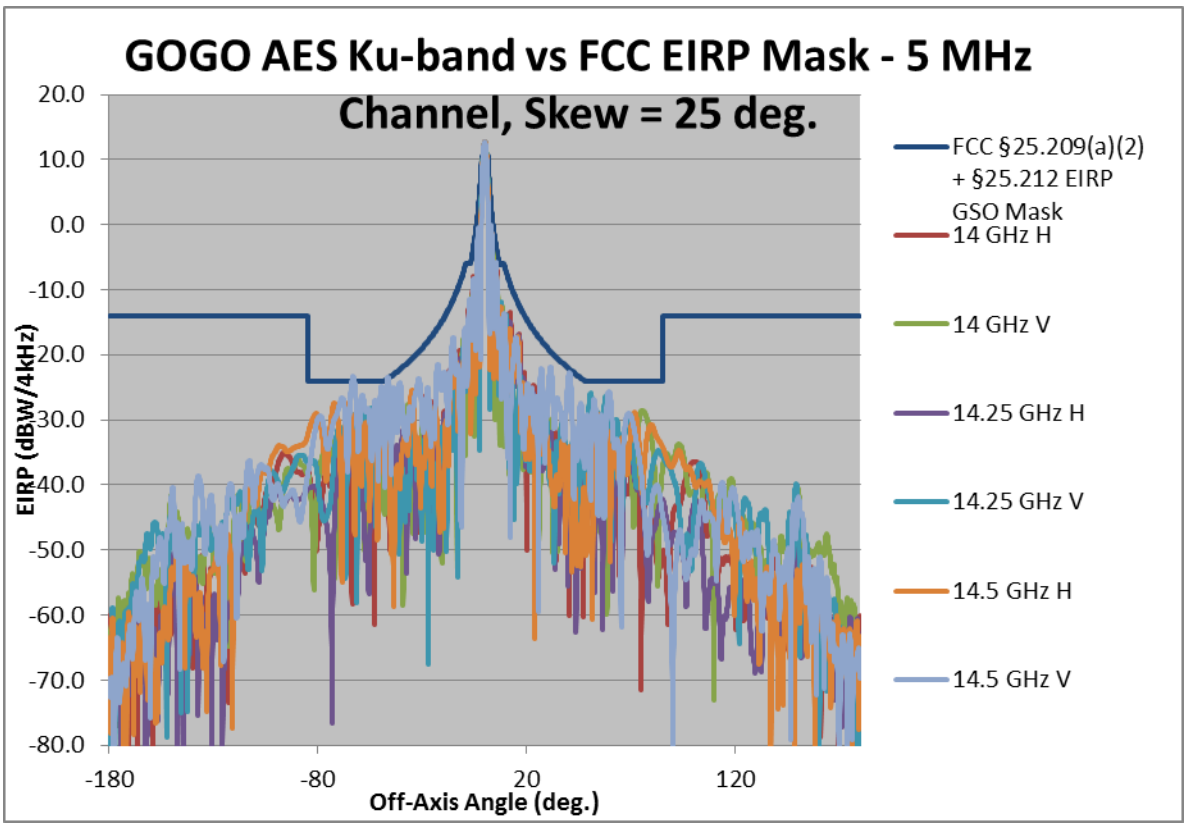


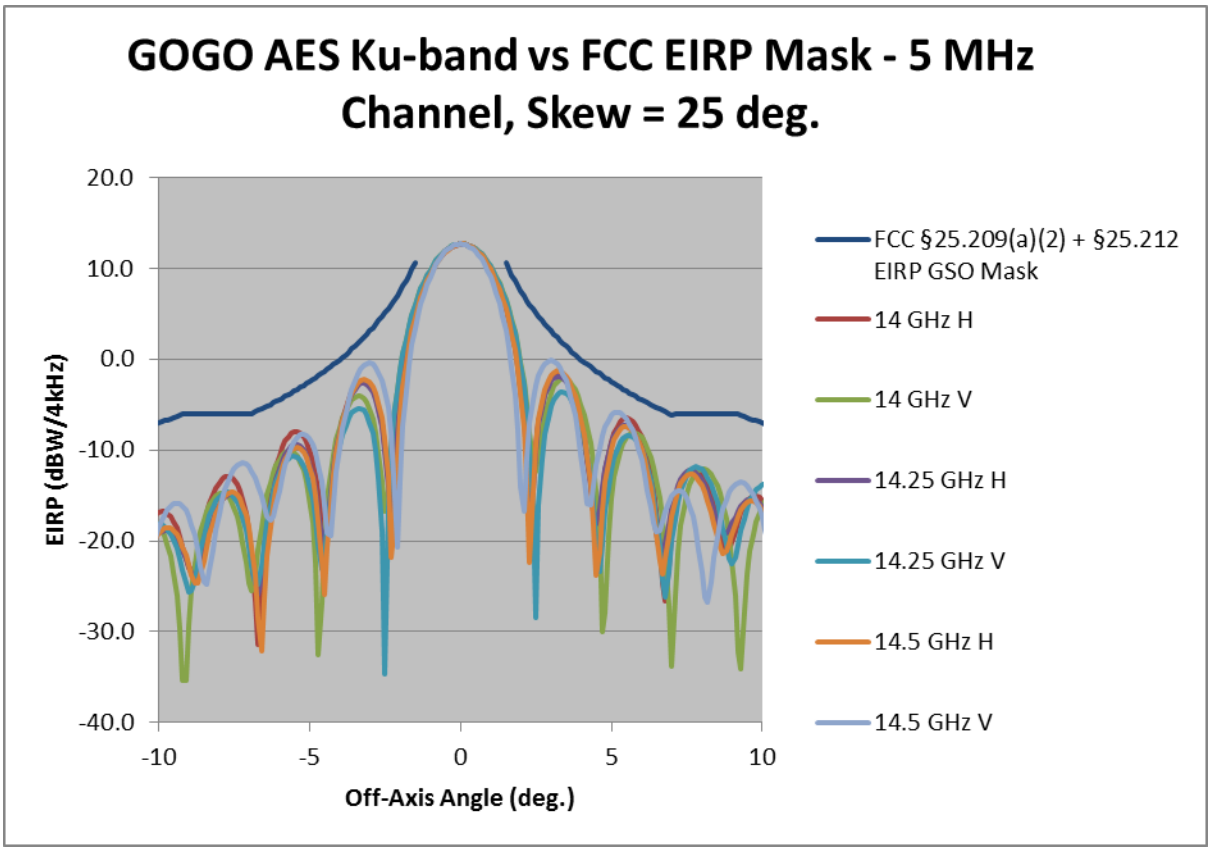
APPENDIX C: EIRP Spectral Density Plots

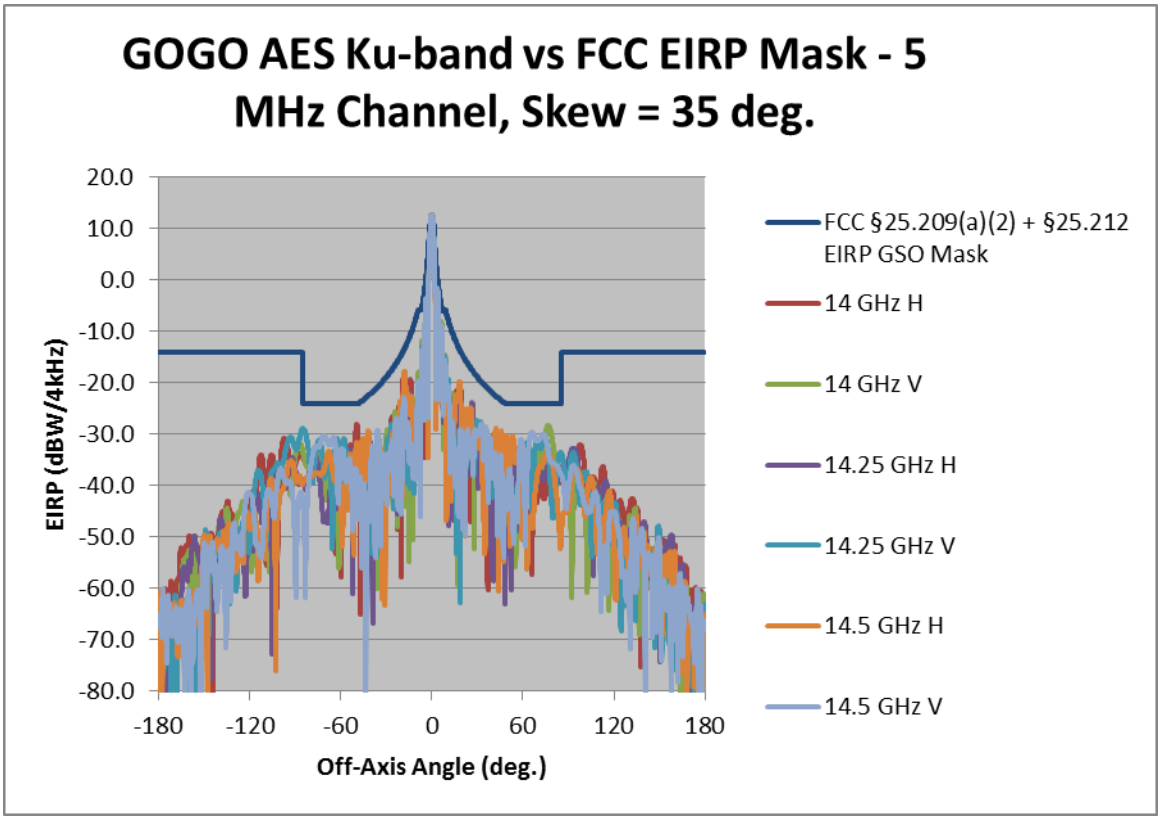
APPENDIX C: EIRP Spectral Density Plots

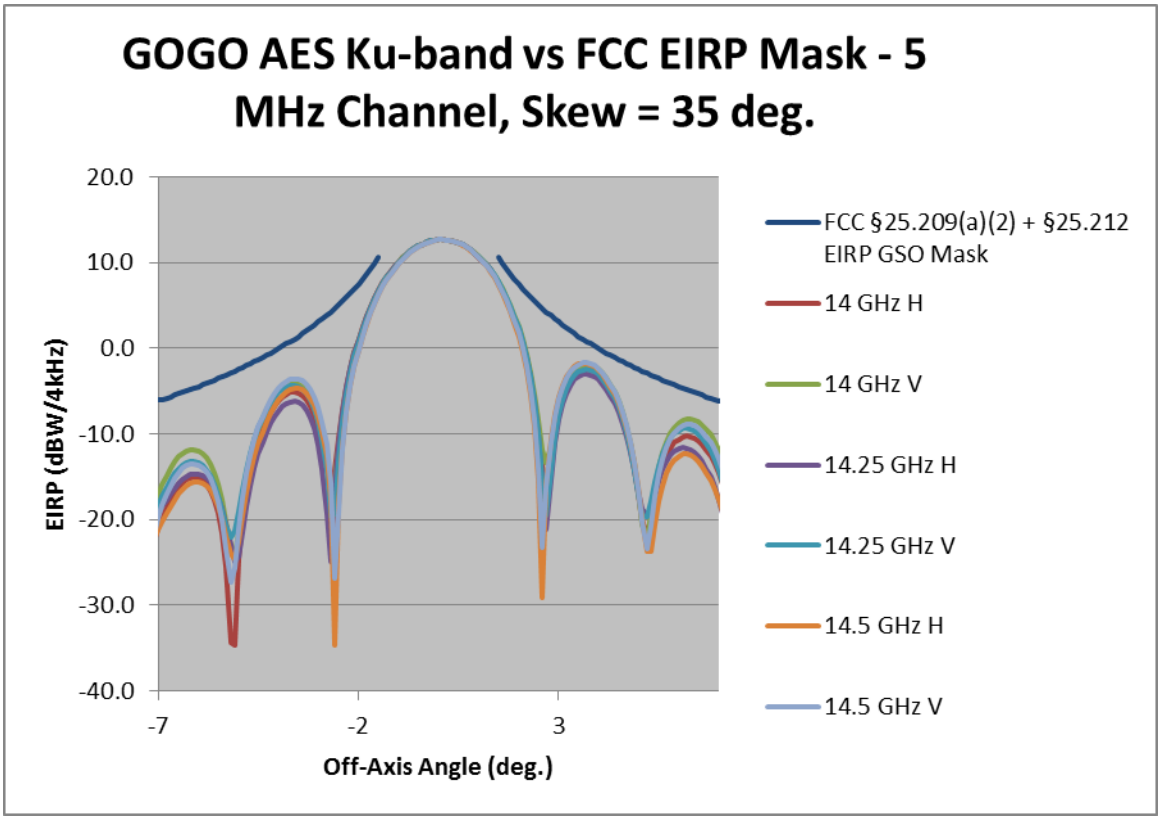


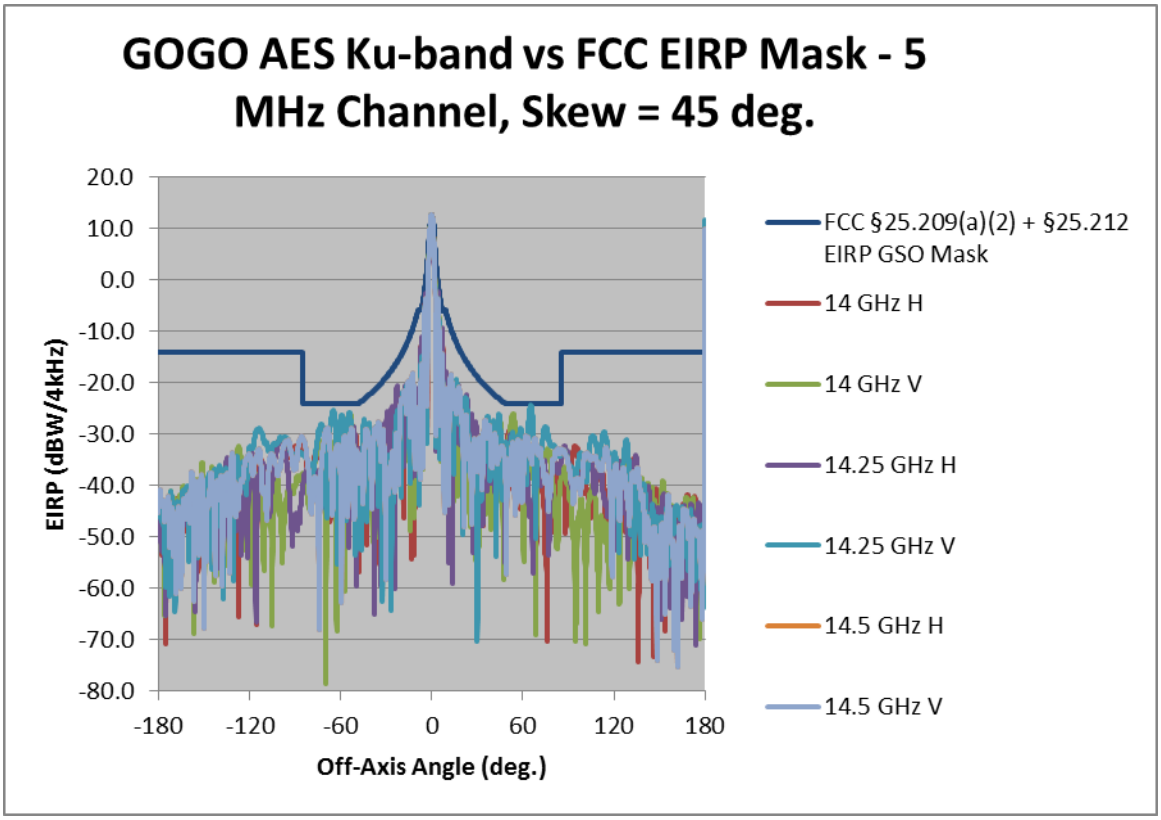


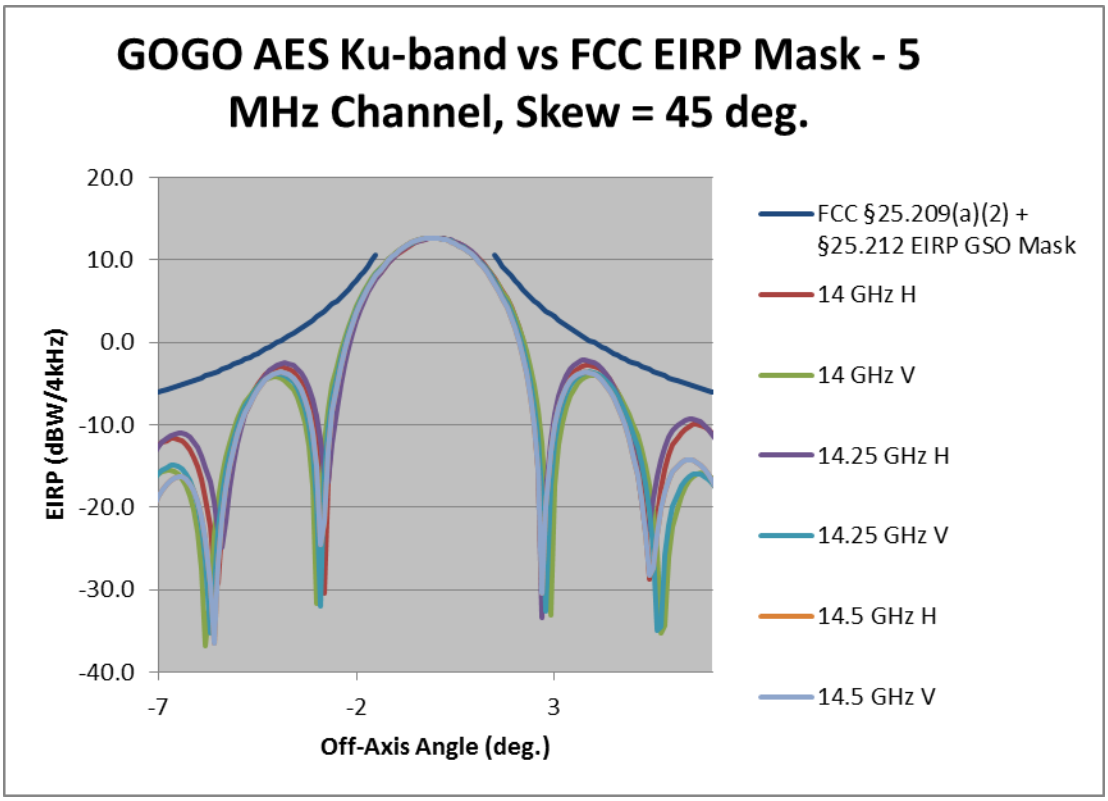

GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 25 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-180
-80
20
120
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V

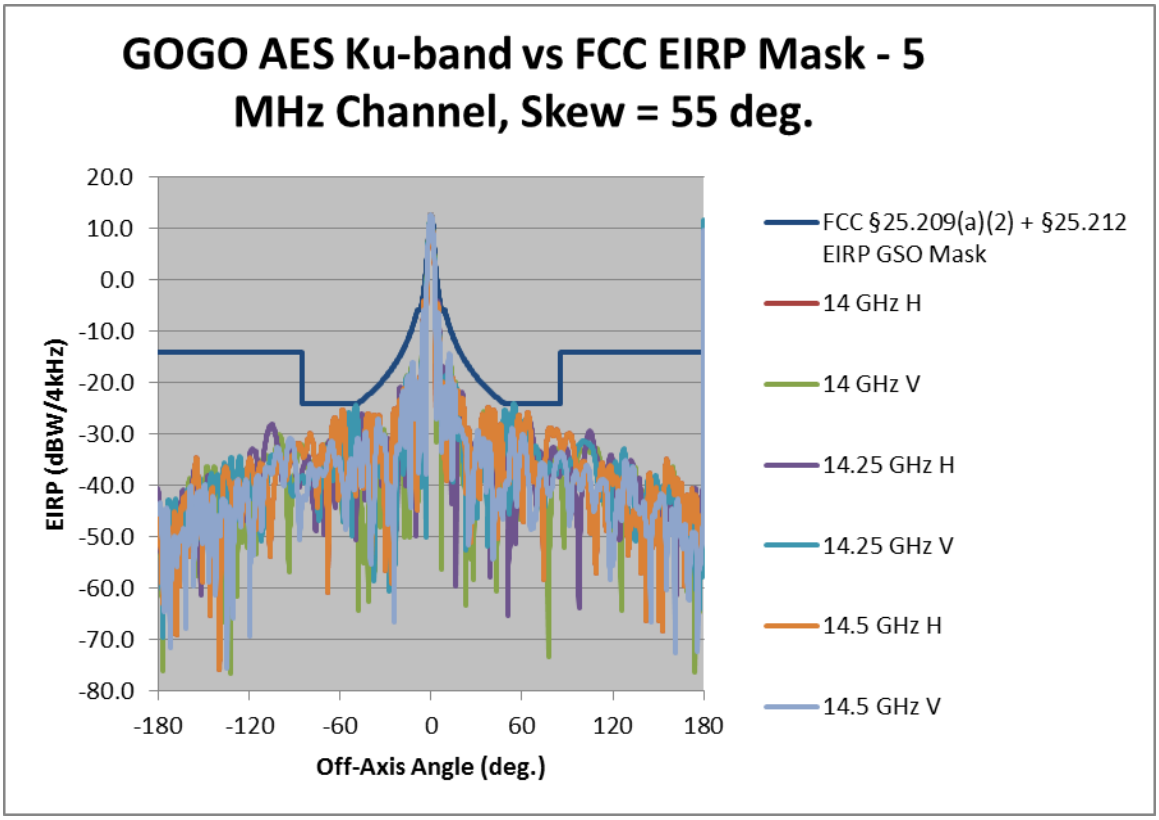

GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 25 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-10
-5
0
5
10
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V

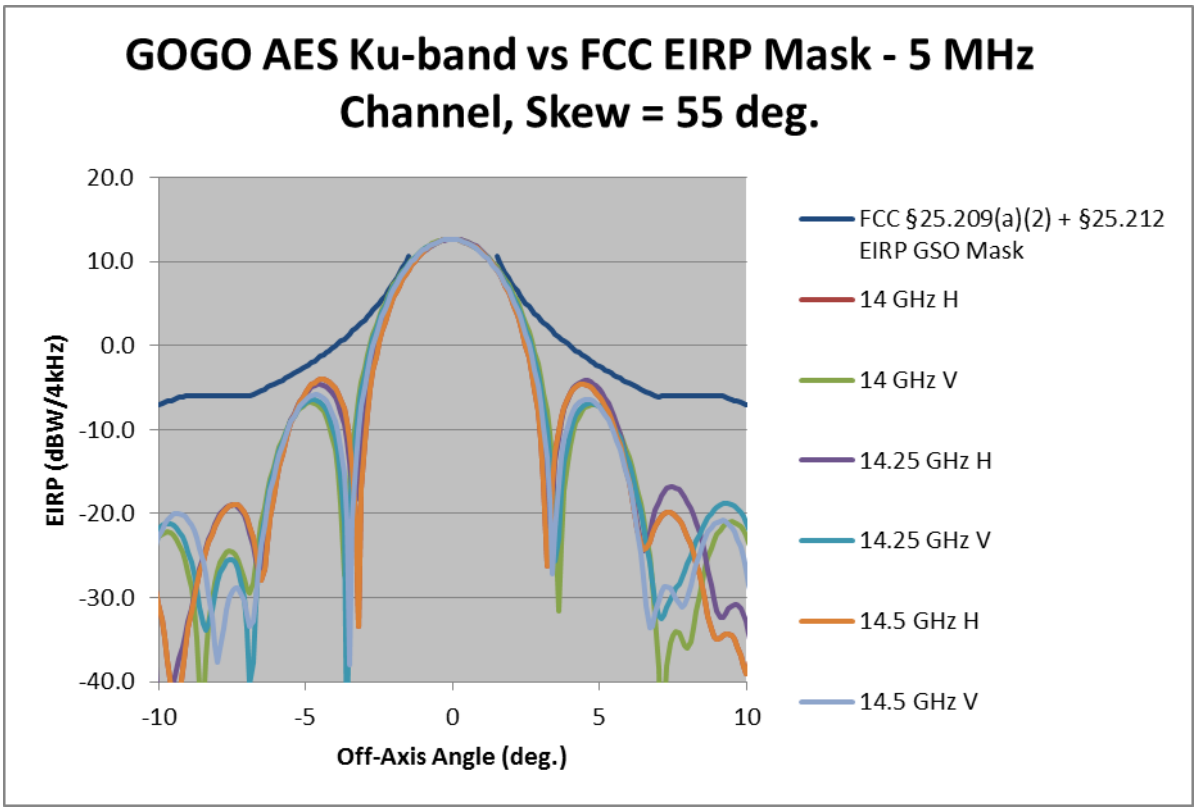

GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 35 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-180
-120
-60
0
60
120
180
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V

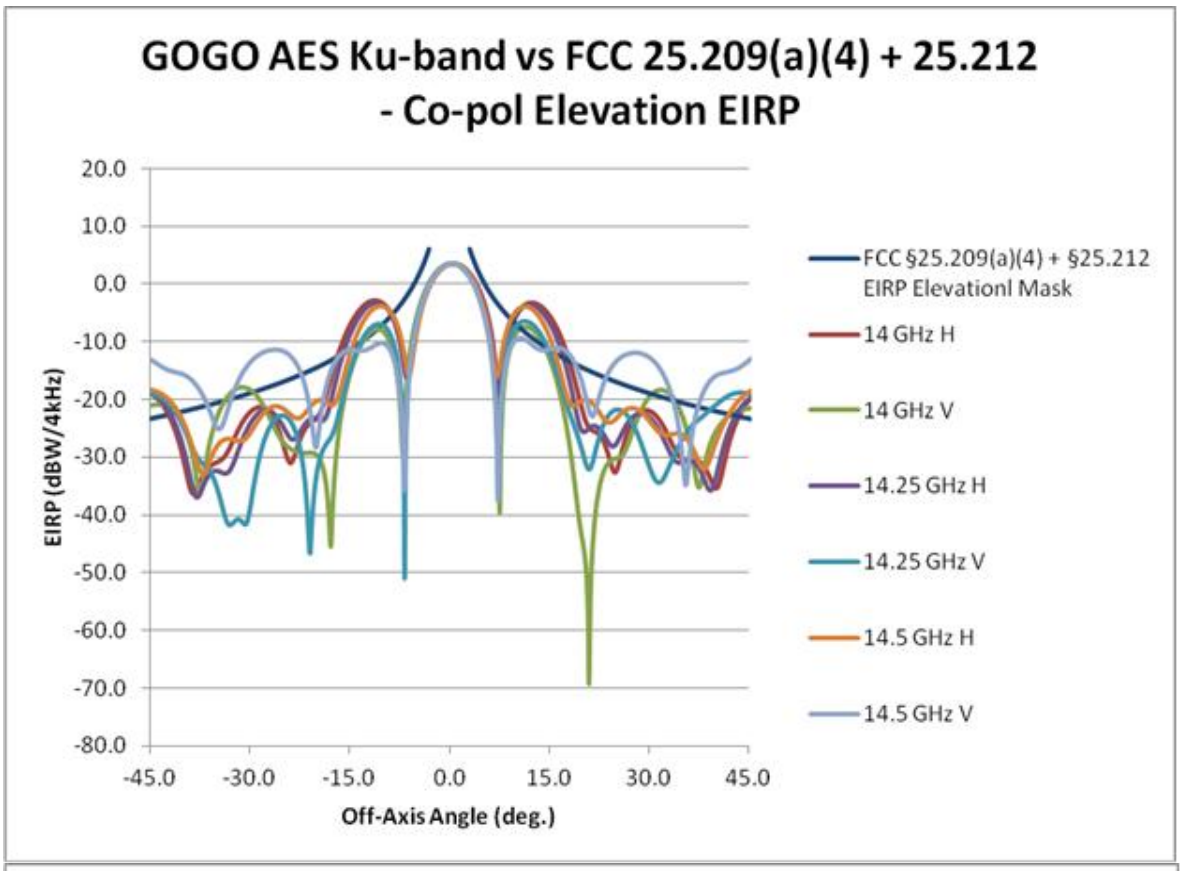

GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 35 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-7
-2
3
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V

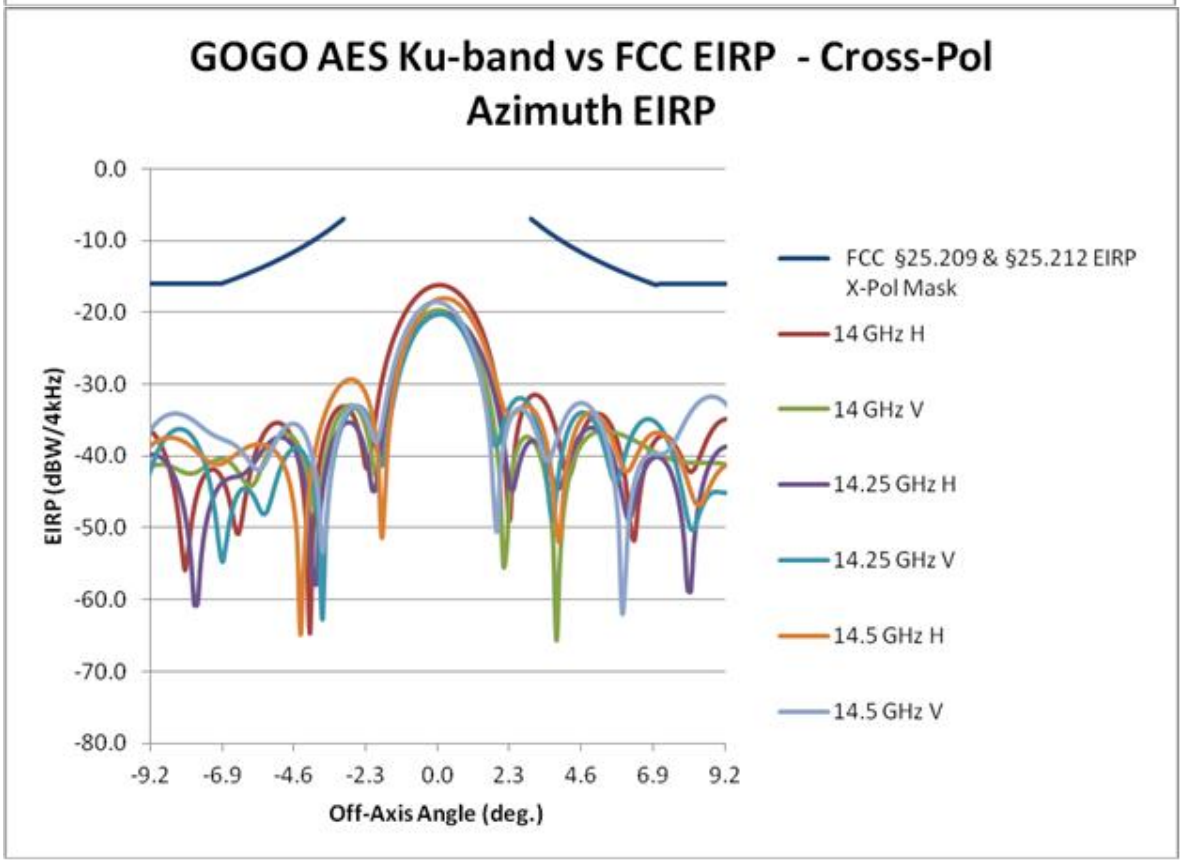

GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 45 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-180
-120
-60
0
60
120
180
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V


GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 45 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-7
-2
3
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V

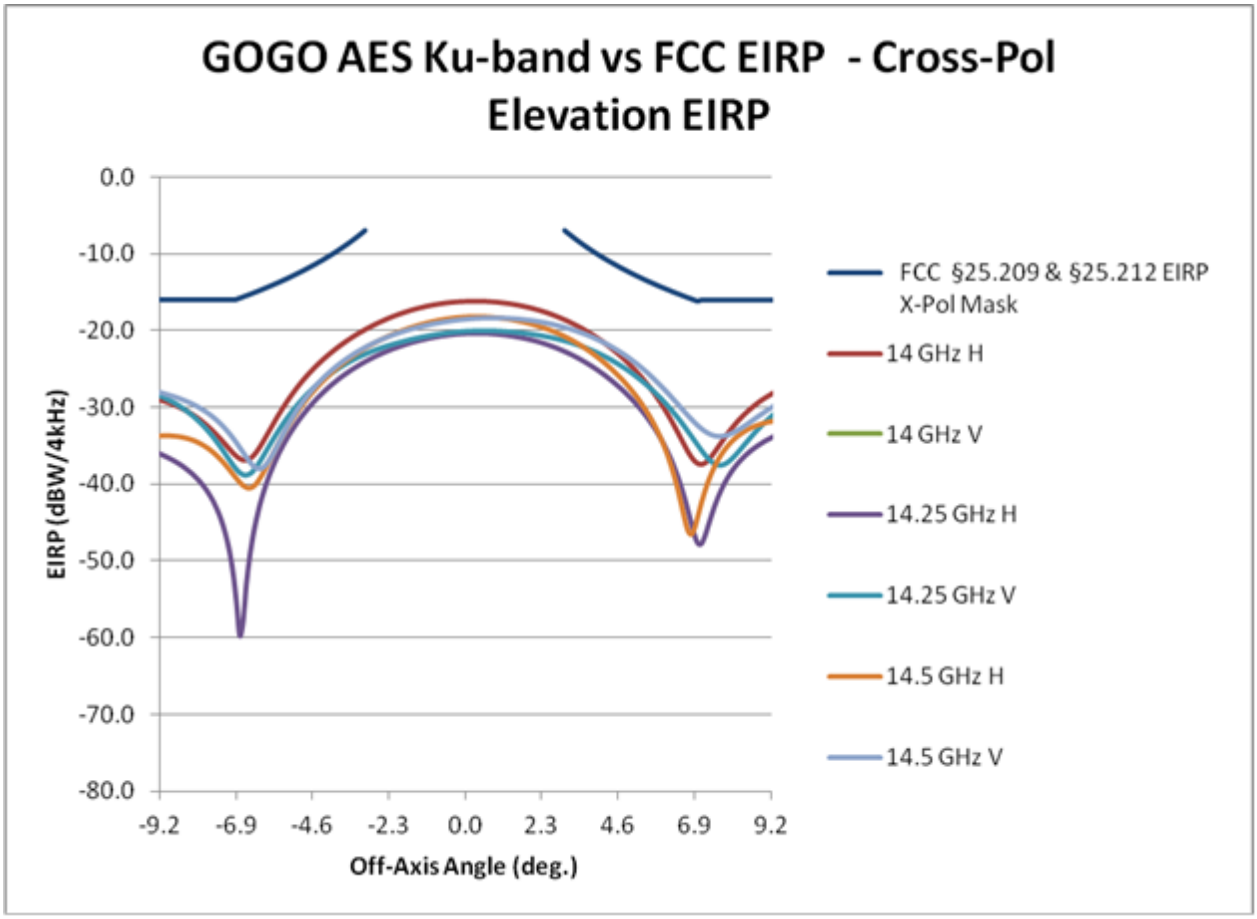

GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 55 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-180
-120
-60
0
60
120
180
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V


GOGO AES Ku-band vs FCC EIRP Mask - 5 MHz Channel, Skew = 55 deg.
EIRP (dBW/4kHz)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-10
-5
0
5
10
Off-Axis Angle (deg.)
FCC §25.209(a)(2) + §25.212 EIRP GSO Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V


GOGO AES Ku-band vs FCC 25.209(a)(4) + 25.212
- Co-pol Elevation EIRP
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
EIRP (dBW/4kHz)
-45.0
-30.0
-15.0
0.0
15.0
30.0
45.0
Off-Axis Angle (deg.)
FCC §25.209(a)(4) + §25.212 EIRP Elevationl Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V


GOGO AES Ku-band vs FCC EIRP - Cross-Pol
Azimuth EIRP
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
EIRP (dBW/4kHz)
-9.2
-6.9
-4.6
-2.3
0.0
2.3
4.6
6.9
9.2
Off-Axis Angle (deg.)
FCC §25.209 & §25.212 EIRP X-Pol Mask
14 GHz H
14 GHz V
14.25 GHz H
14.25 GHz V
14.5 GHz H
14.5 GHz V

APPENDIX C: EIRP Spectral Density Plots



APPENDIX D: Antenna Gain and EIRP Tables

APPENDIX D: Antenna Gain and EIRP Tables

Co Pol Azimuth	Antenna Gain (dBi)									Off-Axis EIRP (dBW/4 kHz)						
Off-Axis Angle	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Off-Axis Angle	FCC §25.209	FCC §25.209(a)(2) + §25.212 EIRP GSO Mask, Skew = 0 deg	FCC §25.209(a)(4) + §25.212 EIRP non-GSO Mask, Skew = 0 deg	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Meets Mask
-180	-50.2	-42.7	-50.8	-47.2	-42.7	-53.4	-180	0.0	-14.0	-14.0	-66.6	-59.0	-67.1	-63.5	-59.1	-69.7	Y
-175	-47.2	-45.6	-47.0	-50.9	-55.0	-57.0	-175	0.0	-14.0	-14.0	-63.5	-61.9	-63.3	-67.2	-71.3	-73.4	Y
-170	-48.3	-46.2	-58.0	-58.9	-49.9	-45.1	-170	0.0	-14.0	-14.0	-64.6	-62.6	-74.4	-75.3	-66.3	-61.5	Y
-165	-47.2	-39.7	-56.2	-42.0	-55.4	-41.1	-165	0.0	-14.0	-14.0	-63.5	-56.0	-72.5	-58.4	-71.7	-57.4	Y
-160	-48.8	-38.0	-50.5	-37.0	-51.8	-52.3	-160	0.0	-14.0	-14.0	-65.1	-54.4	-66.8	-53.3	-68.1	-68.7	Y
-155	-53.4	-47.5	-62.9	-36.6	-47.4	-32.5	-155	0.0	-14.0	-14.0	-69.7	-63.9	-79.2	-53.0	-63.7	-48.8	Y
-150	-38.4	-25.7	-34.1	-28.2	-39.2	-24.6	-150	0.0	-14.0	-14.0	-54.7	-42.0	-50.5	-44.5	-55.5	-40.9	Y
-145	-54.2	-30.5	-49.3	-40.3	-47.5	-29.9	-145	0.0	-14.0	-14.0	-70.5	-46.9	-65.7	-56.6	-63.9	-46.2	Y
-140	-41.0	-35.4	-51.6	-32.6	-42.1	-33.5	-140	0.0	-14.0	-14.0	-57.4	-51.7	-67.9	-48.9	-58.4	-49.8	Y
-135	-37.8	-31.0	-48.3	-49.1	-44.8	-28.7	-135	0.0	-14.0	-14.0	-54.2	-47.4	-64.7	-65.5	-61.2	-45.1	Y
-130	-39.4	-33.7	-38.5	-34.4	-37.5	-29.4	-130	0.0	-14.0	-14.0	-55.7	-50.0	-54.8	-50.8	-53.9	-45.7	Y
-125	-44.8	-37.7	-50.5	-35.3	-44.9	-50.9	-125	0.0	-14.0	-14.0	-61.1	-54.0	-66.8	-51.6	-61.2	-67.2	Y
-120	-42.8	-37.5	-45.7	-36.3	-42.5	-28.4	-120	0.0	-14.0	-14.0	-59.1	-53.8	-62.1	-52.6	-58.8	-44.8	Y
-115	-44.2	-25.7	-45.0	-36.7	-39.3	-26.5	-115	0.0	-14.0	-14.0	-60.6	-42.1	-61.4	-53.1	-55.6	-42.9	Y
-110	-38.7	-30.9	-57.4	-41.7	-38.1	-24.9	-110	0.0	-14.0	-14.0	-55.0	-47.3	-73.8	-58.0	-54.4	-41.2	Y
-105	-41.4	-32.6	-43.8	-39.2	-34.8	-21.3	-105	0.0	-14.0	-14.0	-57.7	-49.0	-60.1	-55.5	-51.2	-37.6	Y
-100	-39.7	-32.5	-37.3	-27.3	-35.1	-24.0	-100	0.0	-14.0	-14.0	-56.1	-48.9	-53.7	-43.6	-51.4	-40.4	Y
-95	-43.6	-38.9	-37.7	-31.0	-31.6	-25.4	-95	0.0	-14.0	-14.0	-59.9	-55.2	-54.0	-47.3	-47.9	-41.8	Y
-90	-59.2	-24.1	-32.5	-33.7	-35.1	-27.0	-90	0.0	-14.0	-14.0	-75.5	-40.5	-48.8	-50.1	-51.4	-43.4	Y
-85	-32.3	-17.3	-34.6	-24.4	-39.0	-22.4	-85	-10.0	-24.0	-24.0	-48.6	-33.6	-50.9	-40.7	-55.3	-38.8	Y
-80	-25.3	-18.8	-37.2	-22.4	-24.4	-13.5	-80	-10.0	-24.0	-24.0	-41.6	-35.1	-53.5	-38.7	-40.7	-29.8	Y
-75	-26.0	-20.7	-34.1	-23.9	-32.1	-18.1	-75	-10.0	-24.0	-24.0	-42.3	-37.0	-50.4	-40.2	-48.4	-34.5	Y
-70	-21.1	-21.8	-29.6	-22.0	-19.1	-11.8	-70	-10.0	-24.0	-24.0	-37.5	-38.1	-45.9	-38.3	-35.4	-28.1	Y
-65	-20.3	-22.8	-20.8	-16.3	-13.0	-14.2	-65	-10.0	-24.0	-24.0	-36.6	-39.1	-37.1	-32.7	-29.3	-30.5	Y
-60	-17.8	-28.3	-20.4	-12.3	-14.5	-14.5	-60	-10.0	-24.0	-24.0	-34.2	-44.6	-36.7	-28.6	-30.9	-30.8	Y

-55	-13.0	-13.9	-15.2	-17.6	-26.5	-14.6	-55	-10.0	-24.0	-24.0	-29.3	-30.2	-31.5	-34.0	-42.9	-31.0	Y
-50	-15.6	-23.2	-15.0	-12.9	-28.6	-9.7	-50	-10.0	-24.0	-24.0	-31.9	-39.5	-31.4	-29.2	-44.9	-26.1	Y
-48	-15.1	-17.5	-17.1	-22.5	-15.5	-24.1	-48	-10.0	-24.0	-24.0	-31.4	-33.9	-33.4	-38.8	-31.9	-40.4	Y
-45	-24.7	-17.5	-14.5	-13.7	-15.3	-19.6	-45	-9.3	-23.3	-23.3	-41.0	-33.9	-30.8	-30.0	-31.6	-36.0	Y
-40	-13.7	-15.1	-17.9	-16.7	-27.1	-9.4	-40	-8.1	-22.1	-22.1	-30.1	-31.5	-34.3	-33.0	-43.5	-25.7	Y
-35	-14.7	-10.1	-16.2	-21.8	-11.6	-13.7	-35	-6.6	-20.6	-20.6	-31.1	-26.4	-32.6	-38.1	-27.9	-30.0	Y
-30	-15.1	-9.7	-20.9	-28.8	-13.6	-13.8	-30	-4.9	-18.9	-18.9	-31.4	-26.1	-37.2	-45.2	-29.9	-30.2	Y
-25	-15.8	-18.3	-24.2	-15.3	-8.5	-13.7	-25	-2.9	-16.9	-16.9	-32.2	-34.7	-40.5	-31.6	-24.8	-30.1	Y
-20	-8.6	-8.7	-8.2	-13.1	-7.1	-7.6	-20	-0.5	-14.5	-14.5	-24.9	-25.1	-24.5	-29.5	-23.5	-24.0	Y
-15	-1.6	-11.1	0.1	-6.6	-0.7	-1.2	-15	2.6	-11.4	-11.4	-18.0	-27.4	-16.2	-22.9	-17.0	-17.5	Y
-10	-2.3	0.4	-0.9	-0.9	-3.0	-2.3	-10	7.0	-7.0	-7.0	-18.6	-16.0	-17.2	-17.2	-19.3	-18.7	Y
-9.9	-1.5	1.3	-0.6	0.2	-2.1	-1.5	-9.9	7.1	-6.9	-6.9	-17.8	-15.1	-17.0	-16.2	-18.5	-17.8	Y
-9.8	-0.8	1.9	-0.3	1.1	-1.2	-0.8	-9.8	7.2	-6.8	-6.8	-17.1	-14.4	-16.6	-15.3	-17.6	-17.1	Y
-9.7	-0.1	2.4	0.1	1.8	-0.4	-0.2	-9.7	7.3	-6.7	-6.7	-16.4	-13.9	-16.2	-14.6	-16.7	-16.6	Y
-9.6	0.5	2.7	0.4	2.3	0.3	0.2	-9.6	7.4	-6.6	-6.6	-15.8	-13.6	-15.9	-14.0	-16.0	-16.2	Y
-9.5	1.0	2.8	0.7	2.7	0.9	0.4	-9.5	7.6	-6.4	-6.4	-15.3	-13.5	-15.6	-13.6	-15.4	-15.9	Y
-9.4	1.3	2.8	0.9	3.0	1.4	0.5	-9.4	7.7	-6.3	-6.3	-15.0	-13.5	-15.4	-13.3	-14.9	-15.9	Y
-9.3	1.4	2.6	1.0	3.1	1.7	0.4	-9.3	7.8	-6.2	-6.2	-14.9	-13.8	-15.3	-13.2	-14.6	-15.9	Y
-9.2	1.4	2.1	1.0	3.1	1.9	0.1	-9.2	8.0	-6.0	-6.1	-14.9	-14.2	-15.4	-13.3	-14.5	-16.2	Y
-9.1	1.3	1.5	0.8	2.9	1.9	-0.3	-9.1	8.0	-6.0	-6.0	-15.1	-14.9	-15.6	-13.5	-14.4	-16.7	Y
-9	0.9	0.6	0.4	2.5	1.7	-1.0	-9	8.0	-6.0	-5.9	-15.5	-15.8	-15.9	-13.8	-14.6	-17.3	Y
-8.9	0.3	-0.7	-0.1	2.0	1.4	-1.9	-8.9	8.0	-6.0	-5.7	-16.0	-17.0	-16.5	-14.4	-14.9	-18.2	Y
-8.8	-0.5	-2.4	-0.9	1.2	0.9	-3.1	-8.8	8.0	-6.0	-5.6	-16.8	-18.7	-17.2	-15.2	-15.5	-19.5	Y
-8.7	-1.5	-4.8	-1.9	0.1	0.1	-4.7	-8.7	8.0	-6.0	-5.5	-17.8	-21.1	-18.2	-16.2	-16.2	-21.0	Y
-8.6	-2.6	-8.5	-3.2	-1.3	-0.9	-6.5	-8.6	8.0	-6.0	-5.4	-19.0	-24.8	-19.5	-17.6	-17.3	-22.9	Y
-8.5	-3.9	-15.6	-4.6	-3.2	-2.3	-8.2	-8.5	8.0	-6.0	-5.2	-20.2	-31.9	-20.9	-19.5	-18.6	-24.5	Y
-8.4	-4.8	-25.7	-6.0	-5.6	-3.9	-8.5	-8.4	8.0	-6.0	-5.1	-21.2	-42.0	-22.3	-22.0	-20.3	-24.8	Y
-8.3	-5.0	-11.3	-6.7	-8.8	-5.8	-6.9	-8.3	8.0	-6.0	-5.0	-21.3	-27.6	-23.0	-25.1	-22.2	-23.2	Y
-8.2	-4.1	-6.1	-6.0	-11.1	-7.5	-4.6	-8.2	8.0	-6.0	-4.8	-20.4	-22.5	-22.4	-27.4	-23.8	-20.9	Y
-8.1	-2.6	-3.0	-4.5	-9.2	-7.6	-2.5	-8.1	8.0	-6.0	-4.7	-18.9	-19.4	-20.8	-25.5	-23.9	-18.8	Y
-8	-1.0	-0.8	-2.7	-5.8	-6.0	-0.7	-8	8.0	-6.0	-4.6	-17.4	-17.2	-19.0	-22.1	-22.3	-17.0	Y
-7.9	0.4	0.8	-1.0	-3.0	-3.8	0.8	-7.9	8.0	-6.0	-4.4	-15.9	-15.6	-17.4	-19.3	-20.1	-15.5	Y
-7.8	1.6	2.0	0.4	-0.9	-1.9	2.0	-7.8	8.0	-6.0	-4.3	-14.7	-14.3	-16.0	-17.2	-18.2	-14.3	Y
-7.7	2.6	2.9	1.5	0.8	-0.3	3.0	-7.7	8.0	-6.0	-4.2	-13.7	-13.4	-14.8	-15.6	-16.6	-13.4	Y
-7.6	3.4	3.6	2.4	2.0	1.0	3.7	-7.6	8.0	-6.0	-4.0	-13.0	-12.8	-13.9	-14.3	-15.3	-12.6	Y

-7.5	3.9	4.0	3.1	3.0	2.0	4.3	-7.5	8.0	-6.0	-3.9	-12.4	-12.3	-13.2	-13.3	-14.3	-12.1	Y
-7.4	4.3	4.3	3.6	3.7	2.8	4.7	-7.4	8.0	-6.0	-3.7	-12.0	-12.1	-12.7	-12.6	-13.6	-11.7	Y
-7.3	4.5	4.3	3.9	4.2	3.3	4.9	-7.3	8.0	-6.0	-3.6	-11.8	-12.0	-12.4	-12.1	-13.1	-11.5	Y
-7.2	4.5	4.2	4.0	4.5	3.6	4.9	-7.2	8.0	-6.0	-3.4	-11.8	-12.2	-12.3	-11.8	-12.8	-11.4	Y
-7.1	4.3	3.8	3.9	4.6	3.7	4.8	-7.1	8.0	-6.0	-3.3	-12.0	-12.5	-12.4	-11.7	-12.7	-11.5	Y
-7	3.9	3.2	3.6	4.5	3.5	4.5	-7	8.0	-6.0	-3.1	-12.5	-13.2	-12.7	-11.8	-12.8	-11.8	Y
-6.9	3.2	2.3	3.1	4.2	3.2	4.0	-6.9	8.0	-6.0	-3.0	-13.2	-14.1	-13.2	-12.1	-13.2	-12.3	Y
-6.8	2.2	1.0	2.3	3.7	2.5	3.3	-6.8	8.2	-5.8	-2.8	-14.2	-15.3	-14.0	-12.6	-13.8	-13.0	Y
-6.7	0.8	-0.7	1.2	2.9	1.6	2.4	-6.7	8.3	-5.7	-2.7	-15.6	-17.0	-15.2	-13.4	-14.7	-13.9	Y
-6.6	-1.2	-3.0	-0.4	1.8	0.3	1.3	-6.6	8.5	-5.5	-2.5	-17.5	-19.3	-16.7	-14.6	-16.1	-15.0	Y
-6.5	-3.8	-6.0	-2.5	0.2	-1.7	0.1	-6.5	8.7	-5.3	-2.3	-20.2	-22.4	-18.8	-16.1	-18.0	-16.2	Y
-6.4	-7.0	-8.6	-5.4	-2.0	-4.4	-1.0	-6.4	8.8	-5.2	-2.2	-23.3	-24.9	-21.7	-18.3	-20.7	-17.3	Y
-6.3	-7.9	-7.0	-8.2	-5.1	-8.4	-1.5	-6.3	9.0	-5.0	-2.0	-24.2	-23.3	-24.5	-21.5	-24.7	-17.8	Y
-6.2	-4.6	-3.5	-7.6	-9.7	-11.3	-0.9	-6.2	9.2	-4.8	-1.8	-21.0	-19.8	-23.9	-26.0	-27.6	-17.3	Y
-6.1	-1.2	-0.5	-4.2	-11.5	-7.5	0.3	-6.1	9.4	-4.6	-1.6	-17.6	-16.8	-20.5	-27.9	-23.8	-16.0	Y
-6	1.5	1.8	-1.1	-6.6	-3.2	1.9	-6	9.5	-4.5	-1.5	-14.9	-14.5	-17.4	-23.0	-19.6	-14.5	Y
-5.9	3.5	3.6	1.3	-2.6	-0.2	3.4	-5.9	9.7	-4.3	-1.3	-12.8	-12.8	-15.0	-18.9	-16.5	-13.0	Y
-5.8	5.1	5.0	3.2	0.3	2.1	4.6	-5.8	9.9	-4.1	-1.1	-11.2	-11.4	-13.2	-16.1	-14.3	-11.7	Y
-5.7	6.4	6.0	4.6	2.3	3.8	5.7	-5.7	10.1	-3.9	-0.9	-9.9	-10.3	-11.7	-14.0	-12.5	-10.6	Y
-5.6	7.4	6.9	5.7	3.9	5.1	6.6	-5.6	10.3	-3.7	-0.7	-8.9	-9.5	-10.6	-12.4	-11.2	-9.7	Y
-5.5	8.2	7.5	6.6	5.1	6.1	7.2	-5.5	10.5	-3.5	-0.5	-8.2	-8.9	-9.8	-11.2	-10.2	-9.1	Y
-5.4	8.7	7.9	7.2	6.0	6.9	7.7	-5.4	10.7	-3.3	-0.3	-7.6	-8.4	-9.1	-10.3	-9.5	-8.6	Y
-5.3	9.1	8.1	7.6	6.7	7.4	8.0	-5.3	10.9	-3.1	-0.1	-7.2	-8.2	-8.7	-9.6	-8.9	-8.4	Y
-5.2	9.3	8.1	7.8	7.2	7.7	8.1	-5.2	11.1	-2.9	0.1	-7.1	-8.2	-8.5	-9.2	-8.6	-8.3	Y
-5.1	9.3	8.0	7.8	7.4	7.8	7.9	-5.1	11.3	-2.7	0.3	-7.1	-8.4	-8.5	-9.0	-8.6	-8.4	Y
-5	9.1	7.6	7.6	7.4	7.6	7.6	-5	11.5	-2.5	0.5	-7.3	-8.8	-8.8	-8.9	-8.7	-8.8	Y
-4.9	8.7	6.9	7.1	7.2	7.3	6.9	-4.9	11.7	-2.3	0.7	-7.7	-9.4	-9.2	-9.1	-9.1	-9.4	Y
-4.8	8.0	5.9	6.4	6.8	6.6	6.0	-4.8	12.0	-2.0	1.0	-8.3	-10.4	-10.0	-9.6	-9.7	-10.3	Y
-4.7	7.1	4.5	5.3	6.1	5.6	4.7	-4.7	12.2	-1.8	1.2	-9.2	-11.8	-11.0	-10.3	-10.7	-11.7	Y
-4.6	5.9	2.5	3.8	5.0	4.2	2.8	-4.6	12.4	-1.6	1.4	-10.4	-13.8	-12.5	-11.3	-12.2	-13.6	Y
-4.5	4.3	-0.5	1.9	3.6	2.0	0.1	-4.5	12.7	-1.3	1.7	-12.0	-16.8	-14.5	-12.8	-14.3	-16.2	Y
-4.4	2.4	-5.8	-0.5	1.4	-1.3	-2.9	-4.4	12.9	-1.1	1.9	-13.9	-22.1	-16.8	-14.9	-17.6	-19.2	Y
-4.3	0.7	-15.3	-1.9	-1.7	-6.5	-3.1	-4.3	13.2	-0.8	2.2	-15.6	-31.6	-18.2	-18.1	-22.9	-19.4	Y
-4.2	0.6	-5.4	-0.5	-6.9	-8.3	0.5	-4.2	13.4	-0.6	2.4	-15.7	-21.8	-16.8	-23.2	-24.7	-15.9	Y
-4.1	2.5	0.4	2.5	-10.2	-1.9	3.9	-4.1	13.7	-0.3	2.7	-13.9	-15.9	-13.9	-26.5	-18.3	-12.4	Y

-4	4.9	4.0	5.2	-3.9	2.5	6.6	-4	13.9	-0.1	2.9	-11.5	-12.4	-11.2	-20.2	-13.8	-9.7	Y
-3.9	7.1	6.5	7.4	0.7	5.6	8.8	-3.9	14.2	0.2	3.2	-9.3	-9.9	-8.9	-15.7	-10.8	-7.5	Y
-3.8	8.9	8.4	9.2	3.8	7.8	10.5	-3.8	14.5	0.5	3.5	-7.4	-8.0	-7.1	-12.6	-8.5	-5.8	Y
-3.7	10.4	9.8	10.7	6.0	9.6	11.9	-3.7	14.8	0.8	3.8	-5.9	-6.5	-5.7	-10.4	-6.8	-4.4	Y
-3.6	11.6	11.0	11.8	7.7	11.0	13.0	-3.6	15.1	1.1	4.1	-4.7	-5.3	-4.5	-8.7	-5.4	-3.3	Y
-3.5	12.6	11.9	12.8	8.9	12.1	14.0	-3.5	15.4	1.4	4.4	-3.7	-4.4	-3.5	-7.4	-4.3	-2.4	Y
-3.4	13.4	12.6	13.5	9.9	12.9	14.7	-3.4	15.7	1.7	4.7	-2.9	-3.8	-2.8	-6.4	-3.4	-1.6	Y
-3.3	14.0	13.1	14.1	10.6	13.6	15.2	-3.3	16.0	2.0	5.0	-2.4	-3.3	-2.2	-5.7	-2.8	-1.1	Y
-3.2	14.4	13.3	14.5	11.0	14.0	15.6	-3.2	16.4	2.4	5.4	-2.0	-3.0	-1.9	-5.3	-2.3	-0.7	Y
-3.1	14.6	13.4	14.7	11.2	14.3	15.9	-3.1	16.7	2.7	5.7	-1.8	-2.9	-1.7	-5.1	-2.1	-0.5	Y
-3	14.6	13.3	14.7	11.2	14.3	15.9	-3	17.1	3.1	6.1	-1.7	-3.0	-1.6	-5.1	-2.0	-0.4	Y
-2.9	14.4	13.0	14.5	10.9	14.2	15.8	-2.9	17.4	3.4		-1.9	-3.4	-1.8	-5.4	-2.1	-0.6	Y
-2.8	14.0	12.3	14.1	10.2	13.8	15.5	-2.8	17.8	3.8		-2.3	-4.0	-2.2	-6.1	-2.5	-0.9	Y
-2.7	13.3	11.4	13.5	9.2	13.2	14.9	-2.7	18.2	4.2		-3.0	-5.0	-2.9	-7.2	-3.1	-1.4	Y
-2.6	12.3	9.9	12.5	7.5	12.2	14.0	-2.6	18.6	4.6		-4.0	-6.4	-3.8	-8.9	-4.1	-2.3	Y
-2.5	10.9	7.7	11.1	4.7	10.7	12.8	-2.5	19.1	5.1		-5.5	-8.6	-5.3	-11.6	-5.6	-3.5	Y
-2.4	8.7	4.3	9.0	-0.4	8.5	11.0	-2.4	19.5	5.5		-7.6	-12.0	-7.3	-16.8	-7.8	-5.4	Y
-2.3	5.6	-1.1	5.9	-13.6	4.8	8.2	-2.3	20.0	6.0		-10.7	-17.4	-10.4	-30.0	-11.5	-8.1	Y
-2.2	2.0	-0.3	1.9	0.4	-3.0	3.6	-2.2	20.4	6.4		-14.3	-16.6	-14.5	-15.9	-19.4	-12.8	Y
-2.1	3.3	6.0	2.3	6.9	-3.9	-4.4	-2.1	20.9	6.9		-13.0	-10.3	-14.0	-9.4	-20.2	-20.7	Y
-2	7.9	10.3	7.3	10.9	5.7	2.9	-2	21.5	7.5		-8.4	-6.0	-9.1	-5.5	-10.7	-13.4	Y
-1.9	11.7	13.4	11.3	13.8	10.5	9.0	-1.9	22.0	8.0		-4.6	-2.9	-5.1	-2.6	-5.8	-7.3	Y
-1.8	14.6	15.9	14.2	16.1	13.8	12.9	-1.8	22.6	8.6		-1.8	-0.5	-2.1	-0.3	-2.5	-3.4	Y
-1.7	16.8	17.8	16.6	18.0	16.3	15.7	-1.7	23.2	9.2		0.5	1.5	0.3	1.6	-0.1	-0.6	Y
-1.6	18.7	19.5	18.5	19.6	18.3	17.9	-1.6	23.9	9.9		2.4	3.2	2.2	3.2	2.0	1.6	Y
-1.5	20.3	20.9	20.1	21.0	20.0	19.7	-1.5	24.6	10.6		4.0	4.6	3.8	4.6	3.6	3.4	Y
-1.4	21.7	22.2	21.5	22.2	21.4	21.2	-1.4				5.3	5.8	5.2	5.9	5.0	4.9	Y
-1.3	22.8	23.3	22.7	23.3	22.6	22.5	-1.3				6.5	6.9	6.4	6.9	6.3	6.2	Y
-1.2	23.9	24.2	23.8	24.2	23.7	23.6	-1.2				7.5	7.9	7.4	7.9	7.3	7.3	Y
-1.1	24.8	25.0	24.7	25.0	24.6	24.6	-1.1				8.4	8.7	8.3	8.7	8.3	8.2	Y
-1	25.6	25.8	25.5	25.8	25.4	25.4	-1				9.2	9.4	9.1	9.4	9.1	9.1	Y
-0.9	26.2	26.4	26.2	26.4	26.1	26.2	-0.9				9.9	10.1	9.8	10.1	9.8	9.8	Y
-0.8	26.8	27.0	26.8	27.0	26.8	26.8	-0.8				10.5	10.6	10.5	10.7	10.4	10.4	Y
-0.7	27.4	27.5	27.3	27.5	27.3	27.3	-0.7				11.0	11.1	11.0	11.1	11.0	11.0	Y
-0.6	27.8	27.9	27.8	27.9	27.7	27.8	-0.6				11.5	11.5	11.4	11.6	11.4	11.4	Y

-0.5	28.2	28.2	28.1	28.2	28.1	28.2	-0.5				11.8	11.9	11.8	11.9	11.8	11.8	Y
-0.4	28.5	28.5	28.4	28.5	28.4	28.5	-0.4				12.1	12.2	12.1	12.2	12.1	12.1	Y
-0.3	28.7	28.7	28.7	28.7	28.7	28.7	-0.3				12.4	12.4	12.3	12.4	12.3	12.4	Y
-0.2	28.9	28.9	28.8	28.9	28.8	28.9	-0.2				12.5	12.5	12.5	12.5	12.5	12.5	Y
-0.1	29.0	29.0	29.0	29.0	29.0	29.0	-0.1				12.6	12.6	12.6	12.6	12.6	12.6	Y
0	29.0	29.0	29.0	29.0	29.0	29.0	0				12.7	12.7	12.7	12.7	12.7	12.7	Y
0.1	29.0	29.0	29.0	29.0	29.0	29.0	0.1				12.6	12.6	12.6	12.6	12.6	12.6	Y
0.2	28.9	28.9	28.9	28.9	28.9	28.9	0.2				12.6	12.6	12.6	12.5	12.6	12.5	Y
0.3	28.7	28.7	28.8	28.7	28.8	28.7	0.3				12.4	12.4	12.4	12.4	12.4	12.4	Y
0.4	28.5	28.5	28.6	28.5	28.5	28.5	0.4				12.2	12.2	12.2	12.2	12.2	12.1	Y
0.5	28.3	28.3	28.3	28.2	28.3	28.2	0.5				11.9	11.9	11.9	11.9	11.9	11.8	Y
0.6	27.9	27.9	27.9	27.9	27.9	27.8	0.6				11.6	11.6	11.6	11.6	11.6	11.4	Y
0.7	27.5	27.5	27.5	27.5	27.5	27.3	0.7				11.2	11.2	11.2	11.1	11.2	11.0	Y
0.8	27.0	27.0	27.0	27.0	27.0	26.8	0.8				10.7	10.7	10.7	10.7	10.7	10.4	Y
0.9	26.4	26.5	26.5	26.4	26.4	26.1	0.9				10.1	10.2	10.1	10.1	10.1	9.8	Y
1	25.8	25.9	25.8	25.8	25.8	25.4	1				9.4	9.5	9.5	9.4	9.4	9.0	Y
1.1	25.0	25.1	25.1	25.0	25.0	24.5	1.1				8.7	8.8	8.7	8.7	8.7	8.2	Y
1.2	24.2	24.3	24.2	24.2	24.1	23.5	1.2				7.8	8.0	7.9	7.9	7.8	7.2	Y
1.3	23.2	23.4	23.2	23.3	23.1	22.4	1.3				6.8	7.0	6.9	6.9	6.8	6.1	Y
1.4	22.0	22.3	22.1	22.2	22.0	21.1	1.4				5.7	6.0	5.8	5.8	5.6	4.7	Y
1.5	20.7	21.1	20.9	21.0	20.6	19.5	1.5	24.6	10.6		4.4	4.7	4.5	4.6	4.3	3.2	Y
1.6	19.2	19.7	19.4	19.6	19.1	17.7	1.6	23.9	9.9		2.9	3.3	3.0	3.2	2.8	1.3	Y
1.7	17.5	18.1	17.6	17.9	17.3	15.4	1.7	23.2	9.2		1.1	1.7	1.3	1.6	0.9	-0.9	Y
1.8	15.4	16.1	15.6	16.0	15.1	12.5	1.8	22.6	8.6		-1.0	-0.2	-0.8	-0.3	-1.3	-3.9	Y
1.9	12.7	13.9	13.0	13.7	12.2	8.4	1.9	22.0	8.0		-3.6	-2.5	-3.3	-2.7	-4.1	-7.9	Y
2	9.3	11.1	9.7	10.7	8.4	2.3	2	21.5	7.5		-7.0	-5.3	-6.6	-5.6	-8.0	-14.1	Y
2.1	5.0	7.7	5.4	6.7	2.3	-0.4	2.1	20.9	6.9		-11.4	-8.7	-10.9	-9.6	-14.1	-16.7	Y
2.2	1.6	4.4	1.2	0.6	-5.9	5.6	2.2	20.4	6.4		-14.7	-12.0	-15.1	-15.7	-22.2	-10.8	Y
2.3	4.3	4.2	3.2	-5.4	2.2	9.4	2.3	20.0	6.0		-12.1	-12.1	-13.1	-21.7	-14.2	-7.0	Y
2.4	7.7	6.7	6.9	1.3	7.0	11.8	2.4	19.5	5.5		-8.7	-9.6	-9.5	-15.0	-9.4	-4.5	Y
2.5	10.1	9.1	9.5	5.6	9.7	13.4	2.5	19.1	5.1		-6.3	-7.3	-6.9	-10.8	-6.6	-2.9	Y
2.6	11.7	10.8	11.2	8.1	11.5	14.6	2.6	18.6	4.6		-4.6	-5.5	-5.1	-8.3	-4.9	-1.8	Y
2.7	12.9	12.1	12.4	9.6	12.7	15.3	2.7	18.2	4.2		-3.5	-4.2	-3.9	-6.7	-3.7	-1.0	Y
2.8	13.6	13.0	13.2	10.6	13.4	15.8	2.8	17.8	3.8		-2.7	-3.4	-3.1	-5.7	-2.9	-0.5	Y
2.9	14.1	13.5	13.7	11.2	13.9	16.1	2.9	17.4	3.4		-2.2	-2.8	-2.6	-5.1	-2.4	-0.2	Y

3	14.3	13.9	14.0	11.5	14.1	16.2	3	17.1	3.1	6.1	-2.0	-2.5	-2.4	-4.8	-2.2	-0.2	Y
3.1	14.4	14.0	14.0	11.6	14.1	16.1	3.1	16.7	2.7	5.7	-2.0	-2.4	-2.3	-4.8	-2.2	-0.3	Y
3.2	14.2	13.9	13.9	11.3	14.0	15.8	3.2	16.4	2.4	5.4	-2.1	-2.4	-2.5	-5.0	-2.4	-0.5	Y
3.3	13.8	13.6	13.5	10.9	13.6	15.4	3.3	16.0	2.0	5.0	-2.5	-2.7	-2.8	-5.5	-2.8	-1.0	Y
3.4	13.3	13.2	13.0	10.2	13.0	14.7	3.4	15.7	1.7	4.7	-3.0	-3.2	-3.4	-6.2	-3.3	-1.6	Y
3.5	12.5	12.5	12.2	9.2	12.2	13.9	3.5	15.4	1.4	4.4	-3.8	-3.8	-4.1	-7.1	-4.1	-2.4	Y
3.6	11.6	11.7	11.2	7.9	11.2	12.9	3.6	15.1	1.1	4.1	-4.8	-4.7	-5.1	-8.4	-5.2	-3.4	Y
3.7	10.3	10.6	10.0	6.2	9.9	11.6	3.7	14.8	0.8	3.8	-6.0	-5.8	-6.3	-10.1	-6.5	-4.7	Y
3.8	8.8	9.2	8.5	4.0	8.2	10.1	3.8	14.5	0.5	3.5	-7.5	-7.1	-7.9	-12.3	-8.1	-6.2	Y
3.9	6.8	7.4	6.5	0.9	6.1	8.2	3.9	14.2	0.2	3.2	-9.5	-8.9	-9.8	-15.4	-10.3	-8.2	Y
4	4.4	5.2	4.1	-3.9	3.2	5.8	4	13.9	-0.1	2.9	-11.9	-11.1	-12.2	-20.2	-13.1	-10.5	Y
4.1	1.4	2.1	1.1	-11.6	-0.9	3.0	4.1	13.7	-0.3	2.7	-15.0	-14.2	-15.2	-27.9	-17.3	-13.3	Y
4.2	-1.5	-2.4	-1.8	-7.5	-7.5	0.5	4.2	13.4	-0.6	2.4	-17.9	-18.7	-18.1	-23.9	-23.9	-15.9	Y
4.3	-1.6	-9.1	-2.0	-1.8	-8.4	0.3	4.3	13.2	-0.8	2.2	-17.9	-25.4	-18.4	-18.1	-24.7	-16.0	Y
4.4	0.9	-6.9	0.4	1.5	-2.2	2.4	4.4	12.9	-1.1	1.9	-15.4	-23.3	-15.9	-14.8	-18.5	-13.9	Y
4.5	3.4	-1.4	2.9	3.7	1.5	4.7	4.5	12.7	-1.3	1.7	-12.9	-17.8	-13.4	-12.6	-14.8	-11.7	Y
4.6	5.4	1.9	4.8	5.2	3.9	6.5	4.6	12.4	-1.6	1.4	-11.0	-14.4	-11.5	-11.1	-12.4	-9.8	Y
4.7	6.8	4.1	6.2	6.3	5.5	7.9	4.7	12.2	-1.8	1.2	-9.5	-12.2	-10.1	-10.1	-10.8	-8.5	Y
4.8	7.8	5.6	7.3	7.0	6.6	8.9	4.8	12.0	-2.0	1.0	-8.5	-10.7	-9.1	-9.3	-9.7	-7.4	Y
4.9	8.6	6.7	8.0	7.4	7.4	9.6	4.9	11.7	-2.3	0.7	-7.8	-9.7	-8.3	-8.9	-8.9	-6.7	Y
5	9.1	7.4	8.5	7.6	7.8	10.1	5	11.5	-2.5	0.5	-7.3	-9.0	-7.9	-8.7	-8.5	-6.2	Y
5.1	9.3	7.8	8.7	7.6	8.1	10.4	5.1	11.3	-2.7	0.3	-7.0	-8.5	-7.6	-8.7	-8.3	-5.9	Y
5.2	9.4	8.0	8.7	7.4	8.1	10.5	5.2	11.1	-2.9	0.1	-7.0	-8.3	-7.6	-8.9	-8.3	-5.8	Y
5.3	9.2	8.1	8.6	7.0	7.8	10.4	5.3	10.9	-3.1	-0.1	-7.1	-8.3	-7.7	-9.4	-8.5	-5.9	Y
5.4	8.9	7.9	8.2	6.3	7.4	10.2	5.4	10.7	-3.3	-0.3	-7.4	-8.5	-8.1	-10.0	-8.9	-6.1	Y
5.5	8.4	7.5	7.7	5.4	6.8	9.8	5.5	10.5	-3.5	-0.5	-7.9	-8.9	-8.6	-10.9	-9.6	-6.5	Y
5.6	7.7	6.9	7.0	4.2	5.9	9.2	5.6	10.3	-3.7	-0.7	-8.6	-9.5	-9.4	-12.1	-10.4	-7.1	Y
5.7	6.8	6.1	6.0	2.7	4.8	8.5	5.7	10.1	-3.9	-0.9	-9.5	-10.3	-10.3	-13.7	-11.6	-7.8	Y
5.8	5.6	5.0	4.8	0.7	3.3	7.6	5.8	9.9	-4.1	-1.1	-10.7	-11.4	-11.6	-15.7	-13.0	-8.7	Y
5.9	4.2	3.6	3.2	-2.0	1.5	6.5	5.9	9.7	-4.3	-1.3	-12.2	-12.8	-13.1	-18.3	-14.9	-9.8	Y
6	2.3	1.8	1.2	-5.4	-0.9	5.2	6	9.5	-4.5	-1.5	-14.1	-14.6	-15.1	-21.7	-17.2	-11.1	Y
6.1	-0.1	-0.6	-1.2	-8.5	-3.9	3.7	6.1	9.4	-4.6	-1.6	-16.4	-17.0	-17.6	-24.8	-20.2	-12.7	Y
6.2	-3.0	-4.0	-4.3	-7.2	-6.9	1.9	6.2	9.2	-4.8	-1.8	-19.4	-20.3	-20.6	-23.5	-23.3	-14.4	Y
6.3	-6.0	-8.9	-7.0	-3.9	-7.3	0.0	6.3	9.0	-5.0	-2.0	-22.4	-25.3	-23.3	-20.2	-23.6	-16.3	Y
6.4	-6.5	-12.9	-6.7	-1.1	-4.8	-1.7	6.4	8.8	-5.2	-2.2	-22.9	-29.2	-23.0	-17.5	-21.1	-18.1	Y

6.5	-4.1	-8.2	-4.1	0.9	-2.2	-2.7	6.5	8.7	-5.3	-2.3	-20.5	-24.5	-20.4	-15.5	-18.5	-19.0	Y
6.6	-1.6	-4.0	-1.7	2.3	-0.2	-2.5	6.6	8.5	-5.5	-2.5	-17.9	-20.3	-18.0	-14.0	-16.5	-18.8	Y
6.7	0.4	-1.2	0.2	3.4	1.3	-1.5	6.7	8.3	-5.7	-2.7	-15.9	-17.6	-16.1	-13.0	-15.0	-17.9	Y
6.8	1.9	0.7	1.6	4.1	2.4	-0.4	6.8	8.2	-5.8	-2.8	-14.5	-15.6	-14.8	-12.2	-14.0	-16.8	Y
6.9	2.9	2.0	2.5	4.6	3.1	0.5	6.9	8.0	-6.0	-3.0	-13.4	-14.3	-13.8	-11.7	-13.2	-15.8	Y
7	3.7	3.0	3.2	4.9	3.6	1.2	7	7.9	-6.1	-3.1	-12.7	-13.3	-13.1	-11.4	-12.7	-15.1	Y
7.1	4.1	3.7	3.6	5.0	3.8	1.7	7.1	8.0	-6.0	-3.3	-12.2	-12.7	-12.7	-11.3	-12.5	-14.7	Y
7.2	4.4	4.1	3.8	4.9	3.9	1.8	7.2	8.0	-6.0	-3.4	-12.0	-12.3	-12.5	-11.5	-12.5	-14.5	Y
7.3	4.4	4.3	3.8	4.6	3.7	1.8	7.3	8.0	-6.0	-3.6	-11.9	-12.1	-12.6	-11.8	-12.7	-14.5	Y
7.4	4.2	4.3	3.6	4.0	3.3	1.5	7.4	8.0	-6.0	-3.7	-12.1	-12.1	-12.8	-12.3	-13.0	-14.8	Y
7.5	3.9	4.0	3.1	3.3	2.7	1.0	7.5	8.0	-6.0	-3.9	-12.5	-12.3	-13.2	-13.0	-13.6	-15.4	Y
7.6	3.3	3.6	2.5	2.3	1.9	0.1	7.6	8.0	-6.0	-4.0	-13.0	-12.7	-13.8	-14.0	-14.4	-16.2	Y
7.7	2.5	3.0	1.7	1.0	0.9	-1.0	7.7	8.0	-6.0	-4.2	-13.8	-13.4	-14.6	-15.4	-15.4	-17.4	Y
7.8	1.5	2.1	0.7	-0.8	-0.4	-2.6	7.8	8.0	-6.0	-4.3	-14.9	-14.2	-15.6	-17.1	-16.7	-18.9	Y
7.9	0.2	0.9	-0.5	-3.1	-2.0	-4.6	7.9	8.0	-6.0	-4.4	-16.2	-15.4	-16.9	-19.4	-18.4	-20.9	Y
8	-1.5	-0.6	-2.0	-6.3	-4.0	-7.2	8	8.0	-6.0	-4.6	-17.8	-17.0	-18.3	-22.6	-20.3	-23.5	Y
8.1	-3.4	-2.7	-3.6	-10.7	-6.2	-9.9	8.1	8.0	-6.0	-4.7	-19.7	-19.0	-19.9	-27.0	-22.5	-26.2	Y
8.2	-5.4	-5.5	-4.9	-13.4	-8.0	-10.5	8.2	8.0	-6.0	-4.8	-21.8	-21.8	-21.3	-29.7	-24.4	-26.8	Y
8.3	-7.0	-9.5	-5.6	-9.4	-8.4	-8.2	8.3	8.0	-6.0	-5.0	-23.4	-25.9	-22.0	-25.7	-24.8	-24.5	Y
8.4	-7.1	-15.0	-5.3	-5.5	-7.2	-5.4	8.4	8.0	-6.0	-5.1	-23.4	-31.3	-21.6	-21.8	-23.5	-21.8	Y
8.5	-5.7	-13.5	-4.3	-2.8	-5.4	-3.2	8.5	8.0	-6.0	-5.2	-22.1	-29.8	-20.6	-19.1	-21.8	-19.5	Y
8.6	-4.0	-8.4	-3.1	-0.9	-3.9	-1.5	8.6	8.0	-6.0	-5.4	-20.3	-24.7	-19.4	-17.2	-20.2	-17.8	Y
8.7	-2.5	-5.0	-2.0	0.6	-2.6	-0.1	8.7	8.0	-6.0	-5.5	-18.8	-21.3	-18.3	-15.8	-19.0	-16.5	Y
8.8	-1.3	-2.7	-1.1	1.7	-1.7	0.9	8.8	8.0	-6.0	-5.6	-17.6	-19.0	-17.4	-14.7	-18.0	-15.5	Y
8.9	-0.3	-1.0	-0.4	2.4	-1.1	1.6	8.9	8.0	-6.0	-5.7	-16.7	-17.4	-16.7	-13.9	-17.4	-14.7	Y
9	0.3	0.2	0.1	3.0	-0.7	2.2	9	8.0	-6.0	-5.9	-16.0	-16.1	-16.2	-13.3	-17.0	-14.1	Y
9.1	0.7	1.1	0.4	3.3	-0.6	2.6	9.1	8.0	-6.0	-6.0	-15.6	-15.3	-15.9	-13.0	-16.9	-13.8	Y
9.2	0.9	1.7	0.5	3.5	-0.6	2.7	9.2	8.0	-6.0	-6.1	-15.4	-14.6	-15.8	-12.8	-17.0	-13.6	Y
9.3	0.9	2.1	0.4	3.5	-0.9	2.8	9.3	7.8	-6.2	-6.2	-15.4	-14.2	-15.9	-12.8	-17.3	-13.5	Y
9.4	0.7	2.3	0.2	3.4	-1.4	2.7	9.4	7.7	-6.3	-6.3	-15.6	-14.1	-16.2	-13.0	-17.8	-13.7	Y
9.5	0.3	2.3	-0.2	3.1	-2.1	2.4	9.5	7.6	-6.4	-6.4	-16.0	-14.1	-16.5	-13.3	-18.5	-13.9	Y
9.6	-0.3	2.1	-0.7	2.6	-3.0	2.0	9.6	7.4	-6.6	-6.6	-16.6	-14.3	-17.1	-13.8	-19.3	-14.3	Y
9.7	-1.1	1.7	-1.3	1.9	-4.1	1.5	9.7	7.3	-6.7	-6.7	-17.4	-14.7	-17.7	-14.4	-20.4	-14.9	Y
9.8	-2.0	1.1	-2.0	1.1	-5.2	0.8	9.8	7.2	-6.8	-6.8	-18.4	-15.3	-18.3	-15.3	-21.5	-15.6	Y
9.9	-3.1	0.2	-2.6	0.0	-6.2	-0.1	9.9	7.1	-6.9	-6.9	-19.5	-16.1	-18.9	-16.3	-22.5	-16.4	Y

10	-4.2	-0.9	-3.0	-1.3	-6.6	-1.2	10	7.0	-7.0	-7.0	-20.5	-17.2	-19.4	-17.6	-23.0	-17.5	Y
15.0	-3.4	-11.1	-1.7	-7.7	-1.5	-1.1	15	2.6	-11.4	-11.4	-19.8	-27.4	-18.1	-24.1	-17.8	-17.5	Y
20.0	-8.8	-10.7	-10.8	-9.0	-16.8	-8.9	20	-0.5	-14.5	-14.5	-25.1	-27.0	-27.1	-25.3	-33.1	-25.3	Y
25.0	-11.5	-16.5	-12.7	-11.4	-8.2	-11.0	25	-2.9	-16.9	-16.9	-27.8	-32.8	-29.0	-27.8	-24.5	-27.3	Y
30.0	-20.4	-14.6	-21.4	-22.0	-16.5	-12.1	30	-4.9	-18.9	-18.9	-36.7	-30.9	-37.7	-38.3	-32.9	-28.5	Y
35.0	-14.6	-11.1	-16.6	-15.1	-18.1	-10.6	35	-6.6	-20.6	-20.6	-30.9	-27.4	-33.0	-31.4	-34.4	-27.0	Y
40.0	-13.6	-17.1	-16.8	-18.7	-26.0	-7.2	40	-8.1	-22.1	-22.1	-29.9	-33.5	-33.2	-35.0	-42.3	-23.6	Y
45.0	-25.4	-20.9	-29.7	-11.6	-23.7	-14.8	45	-9.3	-23.3	-23.3	-41.7	-37.2	-46.1	-27.9	-40.0	-31.2	Y
50.0	-17.4	-14.1	-15.0	-15.7	-18.4	-16.7	50	-10.0	-24.0	-24.0	-33.8	-30.5	-31.3	-32.1	-34.7	-33.0	Y
55.0	-17.2	-13.0	-20.3	-20.8	-29.4	-15.8	55	-10.0	-24.0	-24.0	-33.5	-29.4	-36.6	-37.2	-45.8	-32.1	Y
60.0	-16.5	-17.5	-22.3	-20.2	-20.8	-9.7	60	-10.0	-24.0	-24.0	-32.9	-33.8	-38.6	-36.5	-37.1	-26.1	Y
65.0	-23.0	-18.2	-30.3	-18.1	-22.4	-30.4	65	-10.0	-24.0	-24.0	-39.3	-34.5	-46.7	-34.4	-38.7	-46.7	Y
70.0	-16.7	-25.4	-25.9	-27.0	-24.1	-13.1	70	-10.0	-24.0	-24.0	-33.0	-41.7	-42.2	-43.4	-40.4	-29.4	Y
75.0	-24.0	-20.3	-27.4	-22.9	-32.2	-21.8	75	-10.0	-24.0	-24.0	-40.3	-36.6	-43.7	-39.2	-48.6	-38.1	Y
80.0	-30.3	-29.8	-33.9	-24.2	-60.7	-26.5	80	-10.0	-24.0	-24.0	-46.6	-46.2	-50.2	-40.5	-77.1	-42.8	Y
85.0	-34.5	-25.4	-40.4	-29.6	-42.0	-27.9	85	-10.0	-24.0	-24.0	-50.8	-41.7	-56.7	-45.9	-58.3	-44.3	Y
90.0	-39.0	-26.6	-48.3	-25.0	-39.8	-60.3	90	0.0	-14.0	-14.0	-55.4	-43.0	-64.7	-41.3	-56.1	-76.7	Y
95.0	-43.8	-29.0	-46.1	-29.6	-43.7	-33.8	95	0.0	-14.0	-14.0	-60.2	-45.4	-62.4	-45.9	-60.0	-50.2	Y
100.0	-41.1	-34.5	-44.7	-25.4	-38.9	-34.0	100	0.0	-14.0	-14.0	-57.4	-50.8	-61.0	-41.7	-55.3	-50.3	Y
105.0	-51.3	-27.2	-48.2	-30.4	-42.7	-27.3	105	0.0	-14.0	-14.0	-67.6	-43.6	-64.5	-46.7	-59.0	-43.6	Y
110.0	-55.9	-34.9	-40.7	-29.2	-36.5	-31.0	110	0.0	-14.0	-14.0	-72.2	-51.3	-57.0	-45.5	-52.8	-47.4	Y
115.0	-53.4	-32.9	-41.2	-35.6	-36.0	-25.5	115	0.0	-14.0	-14.0	-69.7	-49.2	-57.5	-51.9	-52.3	-41.8	Y
120.0	-50.6	-35.9	-45.4	-34.0	-37.9	-25.3	120	0.0	-14.0	-14.0	-66.9	-52.2	-61.7	-50.4	-54.2	-41.6	Y
125.0	-48.1	-31.0	-44.8	-43.4	-35.1	-31.2	125	0.0	-14.0	-14.0	-64.4	-47.4	-61.1	-59.7	-51.5	-47.6	Y
130.0	-42.1	-30.8	-39.6	-41.7	-44.9	-31.3	130	0.0	-14.0	-14.0	-58.4	-47.1	-55.9	-58.1	-61.3	-47.6	Y
135.0	-48.0	-32.3	-50.1	-31.3	-37.3	-37.4	135	0.0	-14.0	-14.0	-64.3	-48.6	-66.4	-47.7	-53.6	-53.8	Y
140.0	-46.3	-46.8	-53.3	-37.9	-41.3	-34.3	140	0.0	-14.0	-14.0	-62.6	-63.1	-69.7	-54.2	-57.7	-50.6	Y
145.0	-55.0	-30.8	-49.8	-32.2	-52.2	-34.0	145	0.0	-14.0	-14.0	-71.3	-47.1	-66.1	-48.5	-68.5	-50.3	Y
150.0	-35.6	-24.1	-34.8	-27.3	-39.4	-25.9	150	0.0	-14.0	-14.0	-51.9	-40.5	-51.2	-43.6	-55.7	-42.2	Y
155.0	-56.2	-33.9	-46.2	-33.1	-43.6	-34.6	155	0.0	-14.0	-14.0	-72.6	-50.2	-62.5	-49.4	-60.0	-51.0	Y
160.0	-47.7	-33.9	-48.3	-31.8	-53.6	-35.6	160	0.0	-14.0	-14.0	-64.0	-50.2	-64.6	-48.1	-69.9	-51.9	Y
165.0	-45.5	-36.7	-57.9	-39.7	-49.2	-43.0	165	0.0	-14.0	-14.0	-61.8	-53.1	-74.2	-56.1	-65.5	-59.4	Y
170.0	-54.4	-42.3	-50.5	-58.9	-56.8	-65.7	170	0.0	-14.0	-14.0	-70.7	-58.7	-66.9	-75.2	-73.2	-82.0	Y
175.0	-53.7	-44.5	-49.4	-51.5	-55.8	-46.7	175	0.0	-14.0	-14.0	-70.0	-60.8	-65.7	-67.8	-72.1	-63.0	Y
180.0	-50.2	-42.7	-50.8	-47.2	-42.7	-53.4	180	0.0	-14.0	-14.0	-66.6	-59.0	-67.1	-63.5	-59.1	-69.7	Y

APPENDIX D: Antenna Gain and EIRP Tables

Co Pol Azimuth	Antenna Gain (dBi)									Off-Axis EIRP (dBW/4 kHz)							
Off-Axis Angle	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Off-Axis Angle	FCC §25.209	FCC §25.209(a)(2) + §25.212 EIRP GSO Mask, Skew = 25 deg	FCC §25.209(a)(4)+ §25.212 EIRP non-GSO Mask, Skew = 25 deg	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Meets Mask
-180	-43.8	-51.1	-50.7	-48.6	-47.0	-53.4	-180	0.0	-14.0	-14.0	-60.2	-67.4	-67.0	-64.9	-63.3	-69.7	Y
-175	-43.7	-46.0	-51.9	-45.1	-50.1	-57.0	-175	0.0	-14.0	-14.0	-60.0	-62.3	-68.3	-61.5	-66.4	-73.4	Y
-170	-51.0	-49.8	-50.0	-43.3	-47.1	-45.1	-170	0.0	-14.0	-14.0	-67.3	-66.1	-66.3	-59.7	-63.4	-61.5	Y
-165	-42.3	-34.3	-44.0	-35.5	-55.3	-41.1	-165	0.0	-14.0	-14.0	-58.6	-50.6	-60.4	-51.8	-71.7	-57.4	Y
-160	-45.9	-37.3	-55.3	-33.2	-46.7	-52.3	-160	0.0	-14.0	-14.0	-62.2	-53.7	-71.6	-49.6	-63.1	-68.7	Y
-155	-43.3	-37.9	-43.7	-32.3	-49.8	-32.5	-155	0.0	-14.0	-14.0	-59.7	-54.3	-60.0	-48.6	-66.1	-48.8	Y
-150	-45.6	-25.3	-36.0	-25.3	-36.4	-24.6	-150	0.0	-14.0	-14.0	-61.9	-41.7	-52.3	-41.6	-52.7	-40.9	Y
-145	-35.6	-31.6	-47.4	-41.0	-35.2	-29.9	-145	0.0	-14.0	-14.0	-52.0	-47.9	-63.7	-57.4	-51.5	-46.2	Y
-140	-51.3	-31.7	-38.2	-36.6	-37.6	-33.5	-140	0.0	-14.0	-14.0	-67.6	-48.0	-54.6	-53.0	-54.0	-49.8	Y
-135	-35.5	-37.2	-47.7	-30.0	-51.0	-28.7	-135	0.0	-14.0	-14.0	-51.8	-53.6	-64.1	-46.3	-67.3	-45.1	Y
-130	-34.9	-35.6	-41.7	-31.5	-36.6	-29.4	-130	0.0	-14.0	-14.0	-51.2	-51.9	-58.0	-47.9	-52.9	-45.7	Y
-125	-41.7	-33.6	-52.2	-29.5	-33.9	-50.9	-125	0.0	-14.0	-14.0	-58.1	-49.9	-68.5	-45.8	-50.2	-67.2	Y
-120	-36.3	-28.7	-37.6	-26.1	-34.9	-28.4	-120	0.0	-14.0	-14.0	-52.6	-45.0	-54.0	-42.4	-51.3	-44.8	Y
-115	-37.2	-34.0	-32.1	-28.4	-28.8	-26.5	-115	0.0	-14.0	-14.0	-53.6	-50.3	-48.4	-44.8	-45.1	-42.9	Y
-110	-27.8	-24.5	-32.4	-27.4	-26.9	-24.9	-110	0.0	-14.0	-14.0	-44.2	-40.8	-48.8	-43.7	-43.2	-41.2	Y
-105	-25.1	-27.3	-29.0	-26.0	-21.8	-21.3	-105	0.0	-14.0	-14.0	-41.4	-43.7	-45.3	-42.4	-38.1	-37.6	Y
-100	-21.6	-28.1	-24.8	-22.5	-18.3	-24.0	-100	0.0	-14.0	-14.0	-38.0	-44.4	-41.1	-38.8	-34.7	-40.4	Y
-95	-19.0	-21.2	-26.0	-23.1	-18.6	-25.4	-95	0.0	-14.0	-14.0	-35.4	-37.6	-42.3	-39.4	-34.9	-41.8	Y
-90	-21.8	-19.8	-26.1	-19.4	-17.7	-27.0	-90	0.0	-14.0	-14.0	-38.1	-36.1	-42.5	-35.7	-34.1	-43.4	Y
-85	-21.2	-21.9	-24.4	-20.2	-16.2	-22.4	-85	-10.0	-24.0	-24.0	-37.5	-38.2	-40.7	-36.6	-32.5	-38.8	Y
-80	-31.5	-23.9	-24.9	-22.5	-13.0	-13.5	-80	-10.0	-24.0	-24.0	-47.8	-40.3	-41.2	-38.9	-29.4	-29.8	Y
-75	-22.9	-16.4	-32.0	-27.8	-18.9	-18.1	-75	-10.0	-24.0	-24.0	-39.2	-32.7	-48.3	-44.1	-35.2	-34.5	Y
-70	-18.6	-16.6	-19.0	-14.8	-15.2	-11.8	-70	-10.0	-24.0	-24.0	-34.9	-32.9	-35.3	-31.2	-31.5	-28.1	Y
-65	-22.9	-16.7	-18.5	-15.3	-11.2	-14.2	-65	-10.0	-24.0	-24.0	-39.2	-33.0	-34.8	-31.6	-27.6	-30.5	Y
-60	-27.4	-13.3	-24.4	-14.8	-20.6	-14.5	-60	-10.0	-24.0	-24.0	-43.7	-29.6	-40.7	-31.1	-37.0	-30.8	Y
-55	-17.8	-16.6	-29.6	-12.9	-25.0	-14.6	-55	-10.0	-24.0	-24.0	-34.1	-32.9	-46.0	-29.2	-41.3	-31.0	Y

-50	-20.7	-18.9	-17.7	-14.1	-18.6	-9.7	-50	-10.0	-24.0	-24.0	-37.0	-35.2	-34.0	-30.4	-34.9	-26.1	Y
-48	-15.5	-26.4	-14.9	-13.7	-15.4	-24.1	-48	-10.0	-24.0	-24.0	-31.8	-42.7	-31.2	-30.0	-31.7	-40.4	Y
-45	-28.6	-18.7	-25.1	-20.0	-33.2	-19.6	-45	-9.3	-23.3	-23.3	-45.0	-35.1	-41.4	-36.4	-49.5	-36.0	Y
-40	-17.8	-22.2	-18.8	-22.0	-20.5	-9.4	-40	-8.1	-22.1	-22.1	-34.2	-38.5	-35.1	-38.3	-36.8	-25.7	Y
-35	-14.6	-23.0	-12.9	-14.6	-9.1	-13.7	-35	-6.6	-20.6	-20.6	-30.9	-39.3	-29.3	-30.9	-25.5	-30.0	Y
-30	-27.0	-14.6	-22.4	-30.4	-19.9	-13.8	-30	-4.9	-18.9	-18.9	-43.3	-30.9	-38.8	-46.8	-36.2	-30.2	Y
-25	-11.1	-29.6	-12.9	-23.8	-17.0	-13.7	-25	-2.9	-16.9	-16.9	-27.5	-46.0	-29.2	-40.1	-33.4	-30.1	Y
-20	-14.2	-25.1	-16.5	-17.1	-30.1	-7.6	-20	-0.5	-14.5	-14.5	-30.5	-41.4	-32.9	-33.4	-46.4	-24.0	Y
-15	-6.4	-8.5	-9.7	-13.9	-8.4	-1.2	-15	2.6	-11.4	-11.4	-22.8	-24.8	-26.1	-30.2	-24.7	-17.5	Y
-10	-0.5	-1.8	-2.9	-1.9	-2.9	-2.3	-10	7.0	-7.0	-7.0	-16.9	-18.2	-19.2	-18.2	-19.2	-18.7	Y
-9.9	-0.4	-2.4	-2.6	-1.9	-2.5	-1.5	-9.9	7.1	-6.9	-6.9	-16.8	-18.7	-19.0	-18.2	-18.9	-17.8	Y
-9.8	-0.5	-3.1	-2.5	-2.0	-2.3	-0.8	-9.8	7.2	-6.8	-6.8	-16.8	-19.4	-18.9	-18.4	-18.6	-17.1	Y
-9.7	-0.6	-4.1	-2.5	-2.4	-2.2	-0.2	-9.7	7.3	-6.7	-6.7	-17.0	-20.4	-18.9	-18.7	-18.6	-16.6	Y
-9.6	-1.0	-5.4	-2.7	-2.9	-2.3	0.2	-9.6	7.4	-6.6	-6.6	-17.3	-21.7	-19.0	-19.2	-18.6	-16.2	Y
-9.5	-1.6	-7.2	-3.0	-3.6	-2.5	0.4	-9.5	7.6	-6.4	-6.4	-17.9	-23.5	-19.3	-19.9	-18.9	-15.9	Y
-9.4	-2.3	-9.7	-3.4	-4.5	-2.9	0.5	-9.4	7.7	-6.3	-6.3	-18.6	-26.0	-19.8	-20.8	-19.3	-15.9	Y
-9.3	-3.2	-13.4	-4.0	-5.6	-3.5	0.4	-9.3	7.8	-6.2	-6.2	-19.6	-29.7	-20.4	-22.0	-19.8	-15.9	Y
-9.2	-4.4	-19.1	-4.8	-7.0	-4.3	0.1	-9.2	8.0	-6.0	-6.1	-20.7	-35.4	-21.1	-23.3	-20.6	-16.2	Y
-9.1	-5.6	-19.0	-5.7	-8.3	-5.3	-0.3	-9.1	8.0	-6.0	-6.0	-21.9	-35.4	-22.0	-24.6	-21.6	-16.7	Y
-9	-6.6	-13.0	-6.5	-9.2	-6.4	-1.0	-9	8.0	-6.0	-5.9	-23.0	-29.4	-22.9	-25.6	-22.7	-17.3	Y
-8.9	-7.0	-9.0	-7.2	-9.2	-7.5	-1.9	-8.9	8.0	-6.0	-5.7	-23.4	-25.4	-23.6	-25.5	-23.9	-18.2	Y
-8.8	-6.4	-6.3	-7.4	-8.0	-8.3	-3.1	-8.8	8.0	-6.0	-5.6	-22.8	-22.6	-23.8	-24.3	-24.7	-19.5	Y
-8.7	-5.1	-4.2	-7.0	-6.3	-8.3	-4.7	-8.7	8.0	-6.0	-5.5	-21.4	-20.5	-23.3	-22.7	-24.6	-21.0	Y
-8.6	-3.5	-2.6	-6.0	-4.7	-7.3	-6.5	-8.6	8.0	-6.0	-5.4	-19.8	-19.0	-22.3	-21.0	-23.7	-22.9	Y
-8.5	-2.0	-1.4	-4.7	-3.2	-5.9	-8.2	-8.5	8.0	-6.0	-5.2	-18.3	-17.7	-21.0	-19.5	-22.2	-24.5	Y
-8.4	-0.7	-0.4	-3.4	-1.9	-4.3	-8.5	-8.4	8.0	-6.0	-5.1	-17.0	-16.7	-19.8	-18.2	-20.6	-24.8	Y
-8.3	0.5	0.4	-2.3	-0.9	-2.9	-6.9	-8.3	8.0	-6.0	-5.0	-15.9	-16.0	-18.6	-17.2	-19.2	-23.2	Y
-8.2	1.4	0.9	-1.2	0.0	-1.7	-4.6	-8.2	8.0	-6.0	-4.8	-14.9	-15.4	-17.6	-16.3	-18.0	-20.9	Y
-8.1	2.1	1.3	-0.4	0.6	-0.7	-2.5	-8.1	8.0	-6.0	-4.7	-14.2	-15.0	-16.7	-15.7	-17.0	-18.8	Y
-8	2.7	1.5	0.3	1.1	0.2	-0.7	-8	8.0	-6.0	-4.6	-13.6	-14.8	-16.0	-15.2	-16.2	-17.0	Y
-7.9	3.1	1.6	0.8	1.5	0.8	0.8	-7.9	8.0	-6.0	-4.4	-13.2	-14.7	-15.5	-14.9	-15.5	-15.5	Y
-7.8	3.4	1.5	1.2	1.6	1.3	2.0	-7.8	8.0	-6.0	-4.3	-13.0	-14.8	-15.2	-14.7	-15.1	-14.3	Y
-7.7	3.4	1.2	1.4	1.7	1.6	3.0	-7.7	8.0	-6.0	-4.2	-12.9	-15.1	-15.0	-14.7	-14.8	-13.4	Y
-7.6	3.3	0.7	1.4	1.5	1.7	3.7	-7.6	8.0	-6.0	-4.0	-13.0	-15.6	-15.0	-14.8	-14.6	-12.6	Y
-7.5	3.1	0.0	1.2	1.2	1.6	4.3	-7.5	8.0	-6.0	-3.9	-13.3	-16.3	-15.1	-15.2	-14.7	-12.1	Y

-7.4	2.6	-0.9	0.9	0.6	1.4	4.7	-7.4	8.0	-6.0	-3.7	-13.8	-17.2	-15.5	-15.7	-14.9	-11.7	Y
-7.3	1.8	-2.2	0.3	-0.1	0.9	4.9	-7.3	8.0	-6.0	-3.6	-14.5	-18.5	-16.0	-16.5	-15.4	-11.5	Y
-7.2	0.8	-3.9	-0.5	-1.2	0.2	4.9	-7.2	8.0	-6.0	-3.4	-15.5	-20.2	-16.9	-17.5	-16.1	-11.4	Y
-7.1	-0.6	-6.0	-1.7	-2.5	-0.8	4.8	-7.1	8.0	-6.0	-3.3	-17.0	-22.3	-18.0	-18.9	-17.2	-11.5	Y
-7	-2.7	-8.3	-3.3	-4.3	-2.3	4.5	-7	8.0	-6.0	-3.1	-19.0	-24.6	-19.6	-20.6	-18.6	-11.8	Y
-6.9	-5.6	-9.2	-5.4	-6.4	-4.4	4.0	-6.9	8.0	-6.0	-3.0	-22.0	-25.5	-21.7	-22.8	-20.7	-12.3	Y
-6.8	-10.3	-7.4	-7.9	-8.4	-7.5	3.3	-6.8	8.2	-5.8	-2.8	-26.7	-23.7	-24.2	-24.7	-23.8	-13.0	Y
-6.7	-15.1	-4.7	-9.6	-8.5	-12.3	2.4	-6.7	8.3	-5.7	-2.7	-31.4	-21.0	-25.9	-24.8	-28.7	-13.9	Y
-6.6	-9.4	-2.2	-8.1	-6.4	-15.8	1.3	-6.6	8.5	-5.5	-2.5	-25.8	-18.6	-24.4	-22.8	-32.2	-15.0	Y
-6.5	-4.4	-0.2	-5.1	-3.9	-9.9	0.1	-6.5	8.7	-5.3	-2.3	-20.8	-16.6	-21.4	-20.2	-26.3	-16.2	Y
-6.4	-1.1	1.4	-2.4	-1.7	-5.3	-1.0	-6.4	8.8	-5.2	-2.2	-17.5	-14.9	-18.7	-18.0	-21.6	-17.3	Y
-6.3	1.3	2.7	-0.1	0.2	-2.1	-1.5	-6.3	9.0	-5.0	-2.0	-15.1	-13.6	-16.5	-16.2	-18.5	-17.8	Y
-6.2	3.1	3.8	1.6	1.6	0.2	-0.9	-6.2	9.2	-4.8	-1.8	-13.2	-12.5	-14.7	-14.7	-16.2	-17.3	Y
-6.1	4.5	4.6	3.1	2.8	1.9	0.3	-6.1	9.4	-4.6	-1.6	-11.8	-11.7	-13.3	-13.5	-14.4	-16.0	Y
-6	5.7	5.3	4.2	3.8	3.3	1.9	-6	9.5	-4.5	-1.5	-10.6	-11.0	-12.1	-12.6	-13.0	-14.5	Y
-5.9	6.6	5.8	5.1	4.5	4.4	3.4	-5.9	9.7	-4.3	-1.3	-9.7	-10.6	-11.2	-11.8	-11.9	-13.0	Y
-5.8	7.3	6.1	5.9	5.1	5.2	4.6	-5.8	9.9	-4.1	-1.1	-9.0	-10.2	-10.5	-11.3	-11.1	-11.7	Y
-5.7	7.8	6.2	6.4	5.4	5.9	5.7	-5.7	10.1	-3.9	-0.9	-8.5	-10.1	-10.0	-10.9	-10.5	-10.6	Y
-5.6	8.1	6.2	6.7	5.6	6.3	6.6	-5.6	10.3	-3.7	-0.7	-8.2	-10.1	-9.6	-10.7	-10.0	-9.7	Y
-5.5	8.3	6.0	6.9	5.7	6.5	7.2	-5.5	10.5	-3.5	-0.5	-8.0	-10.3	-9.4	-10.7	-9.8	-9.1	Y
-5.4	8.3	5.6	6.9	5.5	6.6	7.7	-5.4	10.7	-3.3	-0.3	-8.0	-10.7	-9.4	-10.8	-9.7	-8.6	Y
-5.3	8.1	5.0	6.7	5.2	6.5	8.0	-5.3	10.9	-3.1	-0.1	-8.2	-11.3	-9.6	-11.2	-9.9	-8.4	Y
-5.2	7.8	4.1	6.3	4.6	6.1	8.1	-5.2	11.1	-2.9	0.1	-8.6	-12.2	-10.0	-11.7	-10.2	-8.3	Y
-5.1	7.2	2.8	5.7	3.8	5.5	7.9	-5.1	11.3	-2.7	0.3	-9.1	-13.5	-10.6	-12.6	-10.9	-8.4	Y
-5	6.4	1.0	4.8	2.6	4.5	7.6	-5	11.5	-2.5	0.5	-10.0	-15.4	-11.5	-13.7	-11.8	-8.8	Y
-4.9	5.2	-1.7	3.5	1.0	3.2	6.9	-4.9	11.7	-2.3	0.7	-11.1	-18.0	-12.8	-15.3	-13.1	-9.4	Y
-4.8	3.7	-6.2	1.8	-1.2	1.3	6.0	-4.8	12.0	-2.0	1.0	-12.6	-22.5	-14.5	-17.5	-15.1	-10.3	Y
-4.7	1.8	-16.2	-0.5	-4.1	-1.6	4.7	-4.7	12.2	-1.8	1.2	-14.6	-32.5	-16.8	-20.4	-17.9	-11.7	Y
-4.6	-0.5	-10.5	-3.2	-6.8	-6.0	2.8	-4.6	12.4	-1.6	1.4	-16.8	-26.8	-19.5	-23.2	-22.4	-13.6	Y
-4.5	-2.0	-3.1	-4.2	-5.7	-9.6	0.1	-4.5	12.7	-1.3	1.7	-18.3	-19.5	-20.5	-22.0	-26.0	-16.2	Y
-4.4	-0.9	1.0	-1.7	-2.1	-4.4	-2.9	-4.4	12.9	-1.1	1.9	-17.3	-15.4	-18.1	-18.4	-20.7	-19.2	Y
-4.3	1.8	3.8	1.5	1.0	0.4	-3.1	-4.3	13.2	-0.8	2.2	-14.6	-12.6	-14.8	-15.3	-16.0	-19.4	Y
-4.2	4.4	5.9	4.2	3.5	3.7	0.5	-4.2	13.4	-0.6	2.4	-12.0	-10.5	-12.1	-12.9	-12.7	-15.9	Y
-4.1	6.6	7.5	6.4	5.4	6.1	3.9	-4.1	13.7	-0.3	2.7	-9.8	-8.8	-9.9	-11.0	-10.2	-12.4	Y
-4	8.3	8.8	8.2	6.9	8.0	6.6	-4	13.9	-0.1	2.9	-8.0	-7.5	-8.2	-9.4	-8.3	-9.7	Y

-3.9	9.8	9.9	9.6	8.1	9.6	8.8	-3.9	14.2	0.2	3.2	-6.6	-6.5	-6.7	-8.2	-6.8	-7.5	Y
-3.8	11.0	10.7	10.7	9.1	10.8	10.5	-3.8	14.5	0.5	3.5	-5.4	-5.6	-5.6	-7.3	-5.5	-5.8	Y
-3.7	11.9	11.4	11.7	9.8	11.8	11.9	-3.7	14.8	0.8	3.8	-4.4	-5.0	-4.7	-6.5	-4.5	-4.4	Y
-3.6	12.7	11.8	12.4	10.4	12.6	13.0	-3.6	15.1	1.1	4.1	-3.7	-4.5	-3.9	-6.0	-3.7	-3.3	Y
-3.5	13.2	12.1	13.0	10.7	13.2	14.0	-3.5	15.4	1.4	4.4	-3.1	-4.2	-3.3	-5.6	-3.1	-2.4	Y
-3.4	13.6	12.3	13.4	10.9	13.7	14.7	-3.4	15.7	1.7	4.7	-2.7	-4.1	-2.9	-5.4	-2.7	-1.6	Y
-3.3	13.9	12.2	13.6	10.9	13.9	15.2	-3.3	16.0	2.0	5.0	-2.5	-4.1	-2.7	-5.4	-2.4	-1.1	Y
-3.2	13.9	12.0	13.7	10.7	14.1	15.6	-3.2	16.4	2.4	5.4	-2.4	-4.3	-2.6	-5.7	-2.3	-0.7	Y
-3.1	13.8	11.5	13.6	10.2	14.0	15.9	-3.1	16.7	2.7	5.7	-2.5	-4.8	-2.7	-6.2	-2.3	-0.5	Y
-3	13.5	10.8	13.3	9.4	13.8	15.9	-3	17.1	3.1	6.1	-2.8	-5.5	-3.1	-7.0	-2.6	-0.4	Y
-2.9	13.0	9.7	12.7	8.1	13.3	15.8	-2.9	17.4	3.4		-3.4	-6.6	-3.6	-8.2	-3.0	-0.6	Y
-2.8	12.1	8.2	11.9	6.2	12.6	15.5	-2.8	17.8	3.8		-4.2	-8.1	-4.4	-10.1	-3.8	-0.9	Y
-2.7	10.9	6.0	10.7	3.2	11.5	14.9	-2.7	18.2	4.2		-5.4	-10.4	-5.7	-13.1	-4.9	-1.4	Y
-2.6	9.2	2.8	8.9	-2.7	9.9	14.0	-2.6	18.6	4.6		-7.1	-13.6	-7.4	-19.0	-6.5	-2.3	Y
-2.5	6.8	-0.4	6.3	-18.4	7.5	12.8	-2.5	19.1	5.1		-9.6	-16.8	-10.1	-34.7	-8.9	-3.5	Y
-2.4	3.3	1.8	2.3	0.2	3.4	11.0	-2.4	19.5	5.5		-13.0	-14.5	-14.0	-16.2	-12.9	-5.4	Y
-2.3	0.8	6.4	-0.9	6.2	-5.5	8.2	-2.3	20.0	6.0		-15.6	-9.9	-17.2	-10.1	-21.9	-8.1	Y
-2.2	4.3	10.0	3.6	10.0	-2.8	3.6	-2.2	20.4	6.4		-12.1	-6.3	-12.8	-6.3	-19.2	-12.8	Y
-2.1	8.6	12.8	8.3	12.8	5.7	-4.4	-2.1	20.9	6.9		-7.7	-3.5	-8.0	-3.5	-10.7	-20.7	Y
-2	12.0	15.0	11.8	15.1	10.2	2.9	-2	21.5	7.5		-4.4	-1.3	-4.5	-1.3	-6.1	-13.4	Y
-1.9	14.6	16.9	14.5	16.9	13.4	9.0	-1.9	22.0	8.0		-1.7	0.6	-1.9	0.6	-2.9	-7.3	Y
-1.8	16.7	18.5	16.6	18.5	15.8	12.9	-1.8	22.6	8.6		0.4	2.2	0.3	2.2	-0.5	-3.4	Y
-1.7	18.5	19.9	18.4	19.9	17.8	15.7	-1.7	23.2	9.2		2.1	3.6	2.1	3.6	1.4	-0.6	Y
-1.6	20.0	21.2	19.9	21.2	19.4	17.9	-1.6	23.9	9.9		3.7	4.8	3.6	4.8	3.1	1.6	Y
-1.5	21.3	22.3	21.3	22.2	20.8	19.7	-1.5	24.6	10.6		5.0	5.9	4.9	5.9	4.5	3.4	Y
-1.4	22.4	23.2	22.4	23.2	22.1	21.2	-1.4				6.1	6.9	6.1	6.9	5.7	4.9	Y
-1.3	23.5	24.1	23.4	24.1	23.1	22.5	-1.3				7.1	7.7	7.1	7.7	6.8	6.2	Y
-1.2	24.3	24.9	24.3	24.8	24.1	23.6	-1.2				8.0	8.5	8.0	8.5	7.7	7.3	Y
-1.1	25.1	25.5	25.1	25.5	24.9	24.6	-1.1				8.8	9.2	8.8	9.2	8.6	8.2	Y
-1	25.8	26.2	25.8	26.2	25.6	25.4	-1				9.5	9.8	9.5	9.8	9.3	9.1	Y
-0.9	26.5	26.7	26.4	26.7	26.3	26.2	-0.9				10.1	10.4	10.1	10.4	10.0	9.8	Y
-0.8	27.0	27.2	27.0	27.2	26.9	26.8	-0.8				10.7	10.8	10.6	10.8	10.5	10.4	Y
-0.7	27.5	27.6	27.5	27.6	27.4	27.3	-0.7				11.1	11.3	11.1	11.3	11.0	11.0	Y
-0.6	27.9	28.0	27.9	28.0	27.8	27.8	-0.6				11.5	11.6	11.5	11.6	11.4	11.4	Y
-0.5	28.2	28.3	28.2	28.3	28.1	28.2	-0.5				11.9	11.9	11.9	11.9	11.8	11.8	Y

-0.4	28.5	28.5	28.5	28.5	28.4	28.5	-0.4				12.1	12.2	12.1	12.2	12.1	12.1	Y
-0.3	28.7	28.7	28.7	28.7	28.7	28.7	-0.3				12.4	12.4	12.4	12.4	12.3	12.4	Y
-0.2	28.8	28.9	28.8	28.9	28.8	28.9	-0.2				12.5	12.5	12.5	12.5	12.5	12.5	Y
-0.1	29.0	29.0	29.0	29.0	28.9	29.0	-0.1				12.6	12.6	12.6	12.6	12.6	12.6	Y
0	29.0	29.0	29.0	29.0	29.0	29.0	0				12.7	12.7	12.7	12.7	12.7	12.7	Y
0.1	29.0	29.0	29.0	29.0	29.0	29.0	0.1				12.7	12.7	12.7	12.7	12.7	12.6	Y
0.2	28.9	28.9	28.9	28.9	28.9	28.9	0.2				12.6	12.6	12.6	12.6	12.6	12.5	Y
0.3	28.8	28.8	28.8	28.8	28.8	28.7	0.3				12.5	12.5	12.5	12.5	12.5	12.4	Y
0.4	28.6	28.7	28.6	28.7	28.7	28.5	0.4				12.3	12.4	12.3	12.3	12.3	12.1	Y
0.5	28.4	28.5	28.4	28.5	28.4	28.2	0.5				12.1	12.1	12.1	12.1	12.1	11.8	Y
0.6	28.1	28.2	28.1	28.2	28.1	27.8	0.6				11.8	11.9	11.8	11.9	11.8	11.4	Y
0.7	27.8	27.9	27.7	27.9	27.8	27.3	0.7				11.4	11.6	11.4	11.5	11.4	11.0	Y
0.8	27.3	27.5	27.3	27.5	27.3	26.8	0.8				11.0	11.2	11.0	11.2	11.0	10.4	Y
0.9	26.9	27.1	26.8	27.0	26.8	26.1	0.9				10.5	10.8	10.5	10.7	10.5	9.8	Y
1	26.3	26.6	26.2	26.5	26.3	25.4	1				10.0	10.3	9.9	10.2	9.9	9.0	Y
1.1	25.6	26.0	25.6	26.0	25.6	24.5	1.1				9.3	9.7	9.2	9.6	9.3	8.2	Y
1.2	24.9	25.4	24.8	25.3	24.8	23.5	1.2				8.6	9.0	8.5	9.0	8.5	7.2	Y
1.3	24.1	24.7	24.0	24.6	24.0	22.4	1.3				7.7	8.3	7.6	8.2	7.6	6.1	Y
1.4	23.1	23.8	23.0	23.7	23.0	21.1	1.4				6.8	7.5	6.7	7.4	6.7	4.7	Y
1.5	22.1	22.9	21.9	22.8	21.9	19.5	1.5	24.6	10.6		5.7	6.6	5.6	6.4	5.5	3.2	Y
1.6	20.8	21.9	20.7	21.7	20.6	17.7	1.6	23.9	9.9		4.5	5.5	4.3	5.4	4.3	1.3	Y
1.7	19.4	20.7	19.2	20.5	19.1	15.4	1.7	23.2	9.2		3.1	4.4	2.9	4.2	2.8	-0.9	Y
1.8	17.8	19.4	17.5	19.1	17.3	12.5	1.8	22.6	8.6		1.4	3.0	1.2	2.8	1.0	-3.9	Y
1.9	15.8	17.8	15.5	17.6	15.2	8.4	1.9	22.0	8.0		-0.5	1.5	-0.9	1.2	-1.2	-7.9	Y
2	13.4	16.0	12.9	15.7	12.4	2.3	2	21.5	7.5		-2.9	-0.3	-3.4	-0.7	-3.9	-14.1	Y
2.1	10.4	13.9	9.7	13.4	8.7	-0.4	2.1	20.9	6.9		-5.9	-2.5	-6.7	-2.9	-7.6	-16.7	Y
2.2	6.6	11.3	5.2	10.5	2.9	5.6	2.2	20.4	6.4		-9.8	-5.0	-11.2	-5.8	-13.4	-10.8	Y
2.3	2.8	8.2	0.0	6.5	-6.0	9.4	2.3	20.0	6.0		-13.6	-8.1	-16.4	-9.8	-22.4	-7.0	Y
2.4	3.5	5.0	1.9	-0.1	1.8	11.8	2.4	19.5	5.5		-12.8	-11.3	-14.4	-16.5	-14.6	-4.5	Y
2.5	6.8	4.0	6.2	-12.1	6.9	13.4	2.5	19.1	5.1		-9.5	-12.3	-10.1	-28.4	-9.5	-2.9	Y
2.6	9.4	5.9	9.1	0.4	9.8	14.6	2.6	18.6	4.6		-6.9	-10.4	-7.2	-16.0	-6.5	-1.8	Y
2.7	11.3	8.3	11.0	5.3	11.7	15.3	2.7	18.2	4.2		-5.0	-8.0	-5.3	-11.0	-4.6	-1.0	Y
2.8	12.6	10.2	12.4	8.1	13.0	15.8	2.8	17.8	3.8		-3.7	-6.1	-4.0	-8.2	-3.3	-0.5	Y
2.9	13.6	11.6	13.3	9.9	13.9	16.1	2.9	17.4	3.4		-2.8	-4.7	-3.0	-6.4	-2.4	-0.2	Y
3	14.2	12.6	13.9	11.1	14.5	16.2	3	17.1	3.1	6.1	-2.1	-3.7	-2.4	-5.2	-1.8	-0.2	Y

3.1	14.6	13.3	14.3	11.9	14.9	16.1	3.1	16.7	2.7	5.7	-1.7	-3.0	-2.1	-4.4	-1.5	-0.3	Y
3.2	14.8	13.8	14.4	12.4	15.0	15.8	3.2	16.4	2.4	5.4	-1.6	-2.5	-1.9	-3.9	-1.3	-0.5	Y
3.3	14.8	14.1	14.4	12.7	15.0	15.4	3.3	16.0	2.0	5.0	-1.6	-2.2	-1.9	-3.7	-1.3	-1.0	Y
3.4	14.6	14.2	14.2	12.7	14.8	14.7	3.4	15.7	1.7	4.7	-1.7	-2.1	-2.1	-3.6	-1.5	-1.6	Y
3.5	14.3	14.1	13.8	12.6	14.4	13.9	3.5	15.4	1.4	4.4	-2.1	-2.2	-2.5	-3.8	-1.9	-2.4	Y
3.6	13.8	13.9	13.3	12.2	13.9	12.9	3.6	15.1	1.1	4.1	-2.6	-2.4	-3.0	-4.1	-2.4	-3.4	Y
3.7	13.1	13.5	12.6	11.7	13.2	11.6	3.7	14.8	0.8	3.8	-3.3	-2.8	-3.8	-4.6	-3.1	-4.7	Y
3.8	12.2	13.0	11.6	11.0	12.3	10.1	3.8	14.5	0.5	3.5	-4.2	-3.4	-4.7	-5.3	-4.1	-6.2	Y
3.9	11.1	12.3	10.5	10.1	11.1	8.2	3.9	14.2	0.2	3.2	-5.3	-4.1	-5.9	-6.2	-5.2	-8.2	Y
4	9.7	11.4	9.0	9.0	9.7	5.8	4	13.9	-0.1	2.9	-6.7	-5.0	-7.3	-7.4	-6.6	-10.5	Y
4.1	7.9	10.2	7.2	7.5	7.9	3.0	4.1	13.7	-0.3	2.7	-8.4	-6.1	-9.1	-8.8	-8.4	-13.3	Y
4.2	5.7	8.8	5.0	5.7	5.6	0.5	4.2	13.4	-0.6	2.4	-10.6	-7.5	-11.3	-10.6	-10.7	-15.9	Y
4.3	2.9	7.1	2.3	3.3	2.5	0.3	4.3	13.2	-0.8	2.2	-13.5	-9.3	-14.0	-13.0	-13.8	-16.0	Y
4.4	-0.7	4.8	-0.6	0.2	-1.9	2.4	4.4	12.9	-1.1	1.9	-17.0	-11.5	-16.9	-16.2	-18.2	-13.9	Y
4.5	-3.4	1.7	-1.9	-4.0	-7.4	4.7	4.5	12.7	-1.3	1.7	-19.7	-14.6	-18.2	-20.4	-23.8	-11.7	Y
4.6	-1.7	-3.0	-0.2	-7.0	-5.0	6.5	4.6	12.4	-1.6	1.4	-18.0	-19.4	-16.5	-23.3	-21.3	-9.8	Y
4.7	1.5	-13.6	2.3	-3.9	-0.3	7.9	4.7	12.2	-1.8	1.2	-14.8	-30.0	-14.1	-20.3	-16.6	-8.5	Y
4.8	4.0	-11.5	4.3	-0.3	2.8	8.9	4.8	12.0	-2.0	1.0	-12.3	-27.8	-12.0	-16.6	-13.5	-7.4	Y
4.9	5.9	-3.0	5.9	2.3	4.9	9.6	4.9	11.7	-2.3	0.7	-10.4	-19.3	-10.5	-14.0	-11.4	-6.7	Y
5	7.3	0.9	7.0	4.2	6.4	10.1	5	11.5	-2.5	0.5	-9.1	-15.4	-9.3	-12.2	-10.0	-6.2	Y
5.1	8.2	3.4	7.9	5.5	7.4	10.4	5.1	11.3	-2.7	0.3	-8.1	-12.9	-8.5	-10.8	-8.9	-5.9	Y
5.2	9.0	5.1	8.5	6.5	8.1	10.5	5.2	11.1	-2.9	0.1	-7.4	-11.3	-7.9	-9.9	-8.2	-5.8	Y
5.3	9.4	6.3	8.8	7.2	8.6	10.4	5.3	10.9	-3.1	-0.1	-6.9	-10.1	-7.5	-9.2	-7.7	-5.9	Y
5.4	9.7	7.1	9.0	7.6	8.9	10.2	5.4	10.7	-3.3	-0.3	-6.6	-9.2	-7.3	-8.7	-7.5	-6.1	Y
5.5	9.8	7.7	9.0	7.9	8.9	9.8	5.5	10.5	-3.5	-0.5	-6.5	-8.6	-7.4	-8.5	-7.4	-6.5	Y
5.6	9.7	8.1	8.8	7.9	8.8	9.2	5.6	10.3	-3.7	-0.7	-6.6	-8.3	-7.5	-8.4	-7.6	-7.1	Y
5.7	9.5	8.2	8.4	7.8	8.5	8.5	5.7	10.1	-3.9	-0.9	-6.8	-8.1	-7.9	-8.5	-7.9	-7.8	Y
5.8	9.1	8.2	7.9	7.5	8.0	7.6	5.8	9.9	-4.1	-1.1	-7.2	-8.1	-8.4	-8.8	-8.4	-8.7	Y
5.9	8.5	8.1	7.2	7.0	7.3	6.5	5.9	9.7	-4.3	-1.3	-7.8	-8.3	-9.1	-9.3	-9.0	-9.8	Y
6	7.8	7.7	6.3	6.4	6.4	5.2	6	9.5	-4.5	-1.5	-8.6	-8.6	-10.0	-10.0	-9.9	-11.1	Y
6.1	6.8	7.2	5.1	5.5	5.3	3.7	6.1	9.4	-4.6	-1.6	-9.6	-9.1	-11.2	-10.8	-11.0	-12.7	Y
6.2	5.6	6.5	3.7	4.4	3.9	1.9	6.2	9.2	-4.8	-1.8	-10.8	-9.8	-12.6	-11.9	-12.5	-14.4	Y
6.3	4.0	5.6	2.0	3.0	2.1	0.0	6.3	9.0	-5.0	-2.0	-12.3	-10.8	-14.4	-13.3	-14.2	-16.3	Y
6.4	2.1	4.4	-0.2	1.2	-0.1	-1.7	6.4	8.8	-5.2	-2.2	-14.3	-11.9	-16.5	-15.1	-16.4	-18.1	Y
6.5	-0.5	2.9	-2.7	-1.1	-2.8	-2.7	6.5	8.7	-5.3	-2.3	-16.8	-13.4	-19.0	-17.4	-19.2	-19.0	Y

6.6	-3.9	1.1	-5.0	-4.2	-5.9	-2.5	6.6	8.5	-5.5	-2.5	-20.2	-15.3	-21.4	-20.5	-22.2	-18.8	Y
6.7	-8.4	-1.5	-5.6	-8.0	-7.4	-1.5	6.7	8.3	-5.7	-2.7	-24.7	-17.8	-21.9	-24.3	-23.7	-17.9	Y
6.8	-10.3	-5.0	-4.0	-9.9	-5.6	-0.4	6.8	8.2	-5.8	-2.8	-26.6	-21.4	-20.3	-26.2	-22.0	-16.8	Y
6.9	-6.5	-10.9	-1.9	-7.0	-3.0	0.5	6.9	8.0	-6.0	-3.0	-22.8	-27.2	-18.2	-23.4	-19.4	-15.8	Y
7	-3.0	-17.5	-0.1	-3.7	-0.9	1.2	7	7.9	-6.1	-3.1	-19.4	-33.9	-16.4	-20.1	-17.3	-15.1	Y
7.1	-0.6	-9.8	1.3	-1.3	0.7	1.7	7.1	8.0	-6.0	-3.3	-16.9	-26.1	-15.0	-17.6	-15.7	-14.7	Y
7.2	1.1	-4.9	2.4	0.6	1.8	1.8	7.2	8.0	-6.0	-3.4	-15.2	-21.2	-14.0	-15.8	-14.5	-14.5	Y
7.3	2.3	-2.0	3.1	1.9	2.7	1.8	7.3	8.0	-6.0	-3.6	-14.0	-18.3	-13.2	-14.4	-13.6	-14.5	Y
7.4	3.2	0.1	3.7	2.9	3.3	1.5	7.4	8.0	-6.0	-3.7	-13.1	-16.3	-12.7	-13.5	-13.1	-14.8	Y
7.5	3.8	1.5	4.0	3.6	3.6	1.0	7.5	8.0	-6.0	-3.9	-12.6	-14.8	-12.3	-12.7	-12.7	-15.4	Y
7.6	4.1	2.6	4.1	4.1	3.7	0.1	7.6	8.0	-6.0	-4.0	-12.2	-13.8	-12.2	-12.2	-12.6	-16.2	Y
7.7	4.3	3.3	4.1	4.4	3.7	-1.0	7.7	8.0	-6.0	-4.2	-12.1	-13.0	-12.2	-12.0	-12.7	-17.4	Y
7.8	4.2	3.8	3.9	4.5	3.4	-2.6	7.8	8.0	-6.0	-4.3	-12.1	-12.5	-12.5	-11.8	-12.9	-18.9	Y
7.9	4.0	4.2	3.5	4.5	3.0	-4.6	7.9	8.0	-6.0	-4.4	-12.3	-12.2	-12.8	-11.9	-13.3	-20.9	Y
8	3.6	4.3	3.0	4.2	2.4	-7.2	8	8.0	-6.0	-4.6	-12.7	-12.0	-13.3	-12.1	-13.9	-23.5	Y
8.1	3.0	4.3	2.3	3.9	1.6	-9.9	8.1	8.0	-6.0	-4.7	-13.3	-12.1	-14.0	-12.5	-14.7	-26.2	Y
8.2	2.2	4.1	1.5	3.3	0.7	-10.5	8.2	8.0	-6.0	-4.8	-14.1	-12.3	-14.8	-13.0	-15.7	-26.8	Y
8.3	1.3	3.7	0.6	2.6	-0.5	-8.2	8.3	8.0	-6.0	-5.0	-15.1	-12.6	-15.7	-13.7	-16.8	-24.5	Y
8.4	0.1	3.2	-0.4	1.7	-1.8	-5.4	8.4	8.0	-6.0	-5.1	-16.2	-13.2	-16.7	-14.7	-18.2	-21.8	Y
8.5	-1.2	2.5	-1.4	0.5	-3.2	-3.2	8.5	8.0	-6.0	-5.2	-17.6	-13.9	-17.8	-15.8	-19.5	-19.5	Y
8.6	-2.7	1.5	-2.3	-0.8	-4.4	-1.5	8.6	8.0	-6.0	-5.4	-19.0	-14.8	-18.6	-17.1	-20.8	-17.8	Y
8.7	-4.0	0.3	-2.7	-2.4	-5.0	-0.1	8.7	8.0	-6.0	-5.5	-20.3	-16.0	-19.1	-18.7	-21.4	-16.5	Y
8.8	-4.8	-1.2	-2.8	-4.1	-4.8	0.9	8.8	8.0	-6.0	-5.6	-21.1	-17.6	-19.1	-20.4	-21.2	-15.5	Y
8.9	-4.7	-3.2	-2.4	-5.6	-4.0	1.6	8.9	8.0	-6.0	-5.7	-21.0	-19.5	-18.7	-21.9	-20.3	-14.7	Y
9	-3.8	-5.9	-1.7	-6.1	-2.9	2.2	9	8.0	-6.0	-5.9	-20.2	-22.2	-18.1	-22.5	-19.2	-14.1	Y
9.1	-2.7	-9.8	-1.1	-5.4	-1.9	2.6	9.1	8.0	-6.0	-6.0	-19.0	-26.1	-17.4	-21.8	-18.2	-13.8	Y
9.2	-1.6	-15.9	-0.4	-4.0	-1.0	2.7	9.2	8.0	-6.0	-6.1	-17.9	-32.2	-16.7	-20.4	-17.3	-13.6	Y
9.3	-0.6	-17.7	0.1	-2.5	-0.3	2.8	9.3	7.8	-6.2	-6.2	-17.0	-34.1	-16.2	-18.9	-16.6	-13.5	Y
9.4	0.1	-11.4	0.5	-1.2	0.2	2.7	9.4	7.7	-6.3	-6.3	-16.2	-27.7	-15.8	-17.5	-16.1	-13.7	Y
9.5	0.7	-7.3	0.8	-0.1	0.6	2.4	9.5	7.6	-6.4	-6.4	-15.6	-23.7	-15.5	-16.4	-15.8	-13.9	Y
9.6	1.1	-4.7	0.9	0.8	0.7	2.0	9.6	7.4	-6.6	-6.6	-15.3	-21.1	-15.4	-15.5	-15.6	-14.3	Y
9.7	1.3	-2.9	0.9	1.5	0.7	1.5	9.7	7.3	-6.7	-6.7	-15.1	-19.2	-15.5	-14.9	-15.6	-14.9	Y
9.8	1.3	-1.5	0.7	2.0	0.5	0.8	9.8	7.2	-6.8	-6.8	-15.1	-17.9	-15.6	-14.4	-15.8	-15.6	Y
9.9	1.1	-0.5	0.4	2.3	0.1	-0.1	9.9	7.1	-6.9	-6.9	-15.2	-16.9	-15.9	-14.0	-16.2	-16.4	Y
10	0.8	0.2	-0.1	2.5	-0.4	-1.2	10	7.0	-7.0	-7.0	-15.6	-16.2	-16.4	-13.8	-16.8	-17.5	Y

15.0	-7.4	-10.7	-6.1	-15.5	-2.9	-1.1	15	2.6	-11.4	-11.4	-23.7	-27.1	-22.5	-31.8	-19.3	-17.5	Y
20.0	-33.8	-15.8	-14.2	-18.4	-11.4	-8.9	20	-0.5	-14.5	-14.5	-50.1	-32.2	-30.6	-34.8	-27.8	-25.3	Y
25.0	-22.3	-25.2	-16.5	-18.7	-17.3	-11.0	25	-2.9	-16.9	-16.9	-38.6	-41.5	-32.9	-35.0	-33.6	-27.3	Y
30.0	-16.6	-14.6	-16.2	-14.9	-16.9	-12.1	30	-4.9	-18.9	-18.9	-32.9	-30.9	-32.5	-31.3	-33.2	-28.5	Y
35.0	-20.8	-28.3	-26.7	-18.9	-22.3	-10.6	35	-6.6	-20.6	-20.6	-37.1	-44.7	-43.0	-35.2	-38.6	-27.0	Y
40.0	-34.4	-18.6	-37.7	-19.6	-18.0	-7.2	40	-8.1	-22.1	-22.1	-50.7	-34.9	-54.1	-35.9	-34.4	-23.6	Y
45.0	-23.8	-24.2	-28.1	-29.4	-30.0	-14.8	45	-9.3	-23.3	-23.3	-40.1	-40.5	-44.5	-45.7	-46.3	-31.2	Y
50.0	-26.6	-18.3	-25.6	-11.2	-21.6	-16.7	50	-10.0	-24.0	-24.0	-42.9	-34.6	-41.9	-27.5	-37.9	-33.0	Y
55.0	-20.4	-30.9	-23.1	-14.9	-18.5	-15.8	55	-10.0	-24.0	-24.0	-36.7	-47.2	-39.4	-31.2	-34.8	-32.1	Y
60.0	-26.9	-17.6	-22.2	-18.4	-35.3	-9.7	60	-10.0	-24.0	-24.0	-43.3	-33.9	-38.5	-34.7	-51.6	-26.1	Y
65.0	-31.5	-18.8	-28.7	-21.6	-18.2	-30.4	65	-10.0	-24.0	-24.0	-47.8	-35.1	-45.1	-38.0	-34.5	-46.7	Y
70.0	-22.6	-20.1	-19.2	-15.7	-15.3	-13.1	70	-10.0	-24.0	-24.0	-38.9	-36.5	-35.5	-32.0	-31.6	-29.4	Y
75.0	-55.2	-12.4	-25.1	-23.3	-23.8	-21.8	75	-10.0	-24.0	-24.0	-71.6	-28.7	-41.4	-39.7	-40.1	-38.1	Y
80.0	-25.8	-16.7	-32.1	-21.6	-14.4	-26.5	80	-10.0	-24.0	-24.0	-42.1	-33.0	-48.4	-37.9	-30.8	-42.8	Y
85.0	-33.9	-21.8	-25.9	-19.2	-17.7	-27.9	85	-10.0	-24.0	-24.0	-50.2	-38.1	-42.3	-35.5	-34.0	-44.3	Y
90.0	-28.7	-20.6	-31.3	-22.3	-20.8	-60.3	90	0.0	-14.0	-14.0	-45.1	-36.9	-47.7	-38.6	-37.1	-76.7	Y
95.0	-24.5	-18.8	-34.6	-34.7	-20.1	-33.8	95	0.0	-14.0	-14.0	-40.8	-35.1	-50.9	-51.0	-36.5	-50.2	Y
100.0	-20.1	-24.8	-26.9	-30.0	-22.8	-34.0	100	0.0	-14.0	-14.0	-36.5	-41.1	-43.2	-46.4	-39.1	-50.3	Y
105.0	-25.5	-23.0	-38.4	-21.5	-23.7	-27.3	105	0.0	-14.0	-14.0	-41.9	-39.3	-54.7	-37.9	-40.0	-43.6	Y
110.0	-33.0	-38.1	-38.7	-29.2	-29.3	-31.0	110	0.0	-14.0	-14.0	-49.3	-54.4	-55.0	-45.6	-45.6	-47.4	Y
115.0	-34.8	-29.8	-44.1	-28.5	-32.5	-25.5	115	0.0	-14.0	-14.0	-51.1	-46.1	-60.4	-44.8	-48.9	-41.8	Y
120.0	-43.9	-26.9	-40.5	-28.6	-39.9	-25.3	120	0.0	-14.0	-14.0	-60.2	-43.2	-56.8	-44.9	-56.3	-41.6	Y
125.0	-39.2	-30.1	-38.4	-25.8	-38.5	-31.2	125	0.0	-14.0	-14.0	-55.5	-46.4	-54.8	-42.1	-54.8	-47.6	Y
130.0	-38.4	-37.0	-51.3	-34.1	-38.4	-31.3	130	0.0	-14.0	-14.0	-54.7	-53.4	-67.6	-50.4	-54.8	-47.6	Y
135.0	-41.6	-35.3	-40.9	-28.3	-36.4	-37.4	135	0.0	-14.0	-14.0	-57.9	-51.6	-57.2	-44.7	-52.7	-53.8	Y
140.0	-36.9	-39.9	-41.5	-41.8	-45.6	-34.3	140	0.0	-14.0	-14.0	-53.2	-56.2	-57.9	-58.2	-61.9	-50.6	Y
145.0	-43.8	-33.6	-42.5	-36.8	-35.4	-34.0	145	0.0	-14.0	-14.0	-60.2	-49.9	-58.8	-53.2	-51.7	-50.3	Y
150.0	-35.2	-24.1	-33.6	-26.1	-36.8	-25.9	150	0.0	-14.0	-14.0	-51.5	-40.5	-49.9	-42.5	-53.1	-42.2	Y
155.0	-35.7	-34.5	-41.6	-35.5	-47.2	-34.6	155	0.0	-14.0	-14.0	-52.0	-50.8	-57.9	-51.8	-63.5	-51.0	Y
160.0	-41.0	-32.5	-50.8	-50.4	-41.6	-35.6	160	0.0	-14.0	-14.0	-57.3	-48.9	-67.1	-66.7	-58.0	-51.9	Y
165.0	-46.8	-33.6	-42.4	-43.9	-47.6	-43.0	165	0.0	-14.0	-14.0	-63.1	-50.0	-58.8	-60.2	-64.0	-59.4	Y
170.0	-45.7	-46.6	-52.1	-47.2	-60.4	-65.7	170	0.0	-14.0	-14.0	-62.1	-62.9	-68.4	-63.5	-76.7	-82.0	Y
175.0	-46.1	-42.1	-44.0	-58.1	-45.8	-46.7	175	0.0	-14.0	-14.0	-62.4	-58.4	-60.4	-74.4	-62.1	-63.0	Y
180.0	-43.8	-51.1	-50.7	-48.6	-47.0	-53.4	180	0.0	-14.0	-14.0	-60.2	-67.4	-67.0	-64.9	-63.3	-69.7	Y

APPENDIX D: Antenna Gain and EIRP Tables

Co Pol Azimuth	Antenna Gain (dBi)									Off-Axis EIRP (dBW/4 kHz)							
Off-Axis Angle	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Off-Axis Angle	FCC §25.209	FCC §25.209(a)(2) + §25.212 EIRP GSO Mask, Skew = 35 deg	FCC §25.209(a)(4)+ §25.212 EIRP non-GSO Mask, Skew = 35 deg	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Meets Mask
-180	-47.0	-45.0	-48.7	-46.7	-66.5	-50.3	-180	0.0	-14.0	-14.0	-63.3	-61.4	-65.0	-63.1	-82.8	-66.6	Y
-175	-43.9	-50.4	-46.3	-52.0	-46.3	-52.0	-175	0.0	-14.0	-14.0	-60.2	-66.8	-62.6	-68.3	-62.7	-68.4	Y
-170	-57.6	-58.4	-51.0	-48.3	-48.0	-50.9	-170	0.0	-14.0	-14.0	-73.9	-74.7	-67.3	-64.6	-64.4	-67.3	Y
-165	-35.9	-43.0	-46.3	-48.4	-46.1	-49.0	-165	0.0	-14.0	-14.0	-52.3	-59.4	-62.6	-64.7	-62.5	-65.4	Y
-160	-34.2	-36.3	-38.2	-49.9	-50.8	-44.1	-160	0.0	-14.0	-14.0	-50.5	-52.7	-54.5	-66.3	-67.1	-60.5	Y
-155	-38.3	-50.3	-35.4	-59.8	-45.1	-45.6	-155	0.0	-14.0	-14.0	-54.6	-66.7	-51.8	-76.1	-61.5	-61.9	Y
-150	-39.1	-37.4	-40.9	-36.5	-33.3	-35.2	-150	0.0	-14.0	-14.0	-55.5	-53.8	-57.2	-52.8	-49.7	-51.5	Y
-145	-33.7	-39.7	-61.3	-41.3	-35.5	-36.1	-145	0.0	-14.0	-14.0	-50.1	-56.1	-77.6	-57.7	-51.9	-52.5	Y
-140	-33.9	-31.3	-31.7	-33.6	-36.2	-41.8	-140	0.0	-14.0	-14.0	-50.3	-47.6	-48.1	-49.9	-52.5	-58.2	Y
-135	-27.5	-28.2	-32.2	-35.8	-35.8	-50.2	-135	0.0	-14.0	-14.0	-43.8	-44.5	-48.6	-52.2	-52.1	-66.6	Y
-130	-32.9	-33.3	-32.1	-36.1	-33.8	-31.3	-130	0.0	-14.0	-14.0	-49.3	-49.7	-48.4	-52.5	-50.1	-47.6	Y
-125	-36.8	-27.3	-36.5	-31.6	-35.8	-36.7	-125	0.0	-14.0	-14.0	-53.2	-43.7	-52.9	-47.9	-52.1	-53.0	Y
-120	-26.8	-35.7	-30.4	-35.4	-30.9	-25.3	-120	0.0	-14.0	-14.0	-43.1	-52.0	-46.7	-51.7	-47.2	-41.7	Y
-115	-23.8	-26.5	-25.5	-21.3	-34.9	-35.2	-115	0.0	-14.0	-14.0	-40.1	-42.8	-41.8	-37.7	-51.3	-51.5	Y
-110	-24.4	-23.9	-24.7	-30.1	-37.2	-29.0	-110	0.0	-14.0	-14.0	-40.7	-40.2	-41.1	-46.5	-53.6	-45.3	Y
-105	-17.9	-27.3	-46.1	-20.8	-23.6	-27.5	-105	0.0	-14.0	-14.0	-34.2	-43.7	-62.4	-37.1	-39.9	-43.9	Y
-100	-20.0	-23.2	-19.3	-19.9	-25.6	-20.6	-100	0.0	-14.0	-14.0	-36.3	-39.5	-35.6	-36.2	-42.0	-36.9	Y
-95	-16.3	-22.0	-21.5	-15.4	-20.6	-23.3	-95	0.0	-14.0	-14.0	-32.7	-38.3	-37.8	-31.7	-36.9	-39.6	Y
-90	-19.9	-18.3	-20.5	-16.4	-21.4	-37.1	-90	0.0	-14.0	-14.0	-36.2	-34.6	-36.8	-32.7	-37.7	-53.4	Y
-85	-18.1	-16.9	-22.7	-12.7	-23.5	-26.7	-85	-10.0	-24.0	-24.0	-34.4	-33.2	-39.0	-29.0	-39.8	-43.0	Y
-80	-17.9	-20.3	-20.3	-20.5	-21.8	-20.5	-80	-10.0	-24.0	-24.0	-34.3	-36.6	-36.6	-36.9	-38.2	-36.8	Y
-75	-20.2	-15.9	-19.7	-15.2	-21.2	-16.2	-75	-10.0	-24.0	-24.0	-36.5	-32.3	-36.0	-31.6	-37.6	-32.5	Y
-70	-22.4	-25.0	-30.0	-21.4	-19.5	-14.4	-70	-10.0	-24.0	-24.0	-38.7	-41.4	-46.3	-37.8	-35.9	-30.7	Y
-65	-24.9	-25.7	-23.7	-28.9	-21.6	-14.4	-65	-10.0	-24.0	-24.0	-41.3	-42.0	-40.0	-45.3	-38.0	-30.7	Y
-60	-38.7	-28.5	-25.6	-22.9	-25.6	-18.0	-60	-10.0	-24.0	-24.0	-55.0	-44.8	-42.0	-39.3	-41.9	-34.3	Y
-55	-19.6	-24.6	-19.0	-19.2	-23.2	-19.2	-55	-10.0	-24.0	-24.0	-36.0	-40.9	-35.3	-35.5	-39.5	-35.6	Y
-50	-13.0	-26.0	-15.9	-23.2	-16.5	-20.6	-50	-10.0	-24.0	-24.0	-29.4	-42.3	-32.2	-39.5	-32.8	-36.9	Y

-48	-17.1	-21.6	-22.0	-23.9	-20.5	-24.3	-48	-10.0	-24.0	-24.0	-33.5	-38.0	-38.3	-40.3	-36.9	-40.7	Y
-45	-19.2	-24.7	-22.3	-25.5	-15.8	-23.9	-45	-9.3	-23.3	-23.3	-35.5	-41.0	-38.6	-41.9	-32.2	-40.2	Y
-40	-27.5	-28.4	-19.1	-25.9	-22.7	-18.7	-40	-8.1	-22.1	-22.1	-43.9	-44.8	-35.4	-42.3	-39.1	-35.0	Y
-35	-21.6	-15.9	-29.8	-20.6	-23.3	-14.3	-35	-6.6	-20.6	-20.6	-37.9	-32.2	-46.2	-36.9	-39.6	-30.6	Y
-30	-27.3	-15.2	-21.8	-20.9	-20.4	-23.7	-30	-4.9	-18.9	-18.9	-43.6	-31.6	-38.2	-37.2	-36.8	-40.0	Y
-25	-17.6	-14.8	-15.2	-28.2	-13.4	-25.7	-25	-2.9	-16.9	-16.9	-34.0	-31.2	-31.5	-44.6	-29.7	-42.0	Y
-20	-14.2	-15.9	-21.9	-20.5	-11.6	-20.1	-20	-0.5	-14.5	-14.5	-30.5	-32.3	-38.2	-36.8	-27.9	-36.4	Y
-15	-8.3	-28.9	-9.2	-18.1	-8.1	-15.8	-15	2.6	-11.4	-11.4	-24.7	-45.2	-25.6	-34.5	-24.5	-32.1	Y
-10	-13.1	-12.4	-13.2	-14.6	-9.3	-14.7	-10	7.0	-7.0	-7.0	-29.5	-28.8	-29.6	-31.0	-25.6	-31.0	Y
-9.9	-13.5	-11.0	-13.1	-13.7	-9.5	-12.9	-9.9	7.1	-6.9	-6.9	-29.8	-27.3	-29.4	-30.0	-25.8	-29.2	Y
-9.8	-14.0	-9.5	-13.0	-12.6	-9.7	-11.3	-9.8	7.2	-6.8	-6.8	-30.3	-25.9	-29.3	-28.9	-26.0	-27.6	Y
-9.7	-14.6	-8.1	-12.8	-11.5	-9.9	-9.9	-9.7	7.3	-6.7	-6.7	-30.9	-24.5	-29.1	-27.8	-26.2	-26.2	Y
-9.6	-15.4	-6.9	-12.7	-10.4	-10.1	-8.7	-9.6	7.4	-6.6	-6.6	-31.7	-23.2	-29.0	-26.7	-26.5	-25.0	Y
-9.5	-16.2	-5.8	-12.6	-9.3	-10.4	-7.6	-9.5	7.6	-6.4	-6.4	-32.6	-22.1	-29.0	-25.7	-26.8	-23.9	Y
-9.4	-17.2	-4.8	-12.6	-8.4	-10.8	-6.7	-9.4	7.7	-6.3	-6.3	-33.5	-21.1	-28.9	-24.7	-27.1	-23.0	Y
-9.3	-18.0	-4.0	-12.6	-7.5	-11.2	-5.9	-9.3	7.8	-6.2	-6.2	-34.4	-20.3	-28.9	-23.8	-27.6	-22.2	Y
-9.2	-18.6	-3.3	-12.5	-6.7	-11.8	-5.2	-9.2	8.0	-6.0	-6.1	-34.9	-19.6	-28.9	-23.1	-28.1	-21.5	Y
-9.1	-18.5	-2.7	-12.5	-6.1	-12.4	-4.6	-9.1	8.0	-6.0	-6.0	-34.8	-19.0	-28.8	-22.4	-28.7	-20.9	Y
-9	-17.8	-2.2	-12.4	-5.5	-13.1	-4.1	-9	8.0	-6.0	-5.9	-34.2	-18.6	-28.8	-21.9	-29.4	-20.4	Y
-8.9	-16.8	-1.9	-12.3	-5.1	-13.8	-3.7	-8.9	8.0	-6.0	-5.7	-33.1	-18.2	-28.6	-21.4	-30.2	-20.1	Y
-8.8	-15.6	-1.7	-12.1	-4.8	-14.6	-3.5	-8.8	8.0	-6.0	-5.6	-32.0	-18.0	-28.4	-21.1	-31.0	-19.8	Y
-8.7	-14.6	-1.6	-11.8	-4.6	-15.4	-3.3	-8.7	8.0	-6.0	-5.5	-30.9	-17.9	-28.1	-20.9	-31.8	-19.7	Y
-8.6	-13.7	-1.6	-11.5	-4.5	-16.1	-3.3	-8.6	8.0	-6.0	-5.4	-30.0	-18.0	-27.8	-20.8	-32.5	-19.6	Y
-8.5	-13.0	-1.8	-11.1	-4.6	-16.6	-3.4	-8.5	8.0	-6.0	-5.2	-29.3	-18.2	-27.5	-20.9	-33.0	-19.7	Y
-8.4	-12.5	-2.2	-10.8	-4.7	-16.9	-3.6	-8.4	8.0	-6.0	-5.1	-28.8	-18.5	-27.1	-21.1	-33.2	-20.0	Y
-8.3	-12.2	-2.7	-10.4	-5.1	-16.8	-4.0	-8.3	8.0	-6.0	-5.0	-28.6	-19.0	-26.8	-21.4	-33.1	-20.3	Y
-8.2	-12.2	-3.4	-10.1	-5.6	-16.5	-4.6	-8.2	8.0	-6.0	-4.8	-28.5	-19.8	-26.4	-21.9	-32.8	-20.9	Y
-8.1	-12.3	-4.4	-9.8	-6.3	-16.0	-5.4	-8.1	8.0	-6.0	-4.7	-28.7	-20.8	-26.1	-22.7	-32.3	-21.8	Y
-8	-12.7	-5.8	-9.5	-7.3	-15.4	-6.5	-8	8.0	-6.0	-4.6	-29.1	-22.1	-25.8	-23.6	-31.7	-22.9	Y
-7.9	-13.3	-7.7	-9.1	-8.5	-14.7	-8.1	-7.9	8.0	-6.0	-4.4	-29.6	-24.1	-25.5	-24.8	-31.0	-24.4	Y
-7.8	-14.0	-10.6	-8.8	-9.8	-13.9	-10.3	-7.8	8.0	-6.0	-4.3	-30.3	-26.9	-25.1	-26.2	-30.2	-26.6	Y
-7.7	-14.4	-15.3	-8.4	-11.1	-12.9	-13.6	-7.7	8.0	-6.0	-4.2	-30.8	-31.7	-24.7	-27.5	-29.3	-29.9	Y
-7.6	-14.3	-27.5	-7.8	-11.7	-11.9	-19.8	-7.6	8.0	-6.0	-4.0	-30.6	-43.9	-24.2	-28.0	-28.3	-36.1	Y
-7.5	-13.2	-18.7	-7.2	-10.8	-10.8	-29.7	-7.5	8.0	-6.0	-3.9	-29.6	-35.1	-23.5	-27.2	-27.1	-46.0	Y
-7.4	-11.6	-11.5	-6.5	-9.0	-9.6	-16.8	-7.4	8.0	-6.0	-3.7	-27.9	-27.8	-22.8	-25.3	-26.0	-33.1	Y

-7.3	-9.7	-7.5	-5.6	-7.0	-8.4	-11.3	-7.3	8.0	-6.0	-3.6	-26.0	-23.8	-22.0	-23.3	-24.7	-27.6	Y
-7.2	-7.9	-4.7	-4.8	-5.1	-7.2	-7.9	-7.2	8.0	-6.0	-3.4	-24.2	-21.1	-21.1	-21.4	-23.5	-24.2	Y
-7.1	-6.2	-2.6	-3.9	-3.5	-6.0	-5.4	-7.1	8.0	-6.0	-3.3	-22.5	-19.0	-20.2	-19.8	-22.3	-21.7	Y
-7	-4.7	-1.0	-3.0	-2.1	-4.9	-3.5	-7	8.0	-6.0	-3.1	-21.1	-17.3	-19.3	-18.4	-21.2	-19.8	Y
-6.9	-3.4	0.4	-2.2	-0.9	-3.9	-1.9	-6.9	8.0	-6.0	-3.0	-19.8	-16.0	-18.5	-17.2	-20.2	-18.3	Y
-6.8	-2.3	1.5	-1.4	0.2	-2.9	-0.7	-6.8	8.2	-5.8	-2.8	-18.7	-14.9	-17.7	-16.2	-19.3	-17.0	Y
-6.7	-1.4	2.4	-0.7	1.0	-2.1	0.3	-6.7	8.3	-5.7	-2.7	-17.7	-14.0	-17.0	-15.3	-18.4	-16.0	Y
-6.6	-0.6	3.1	0.0	1.7	-1.3	1.2	-6.6	8.5	-5.5	-2.5	-16.9	-13.2	-16.4	-14.6	-17.7	-15.2	Y
-6.5	0.1	3.7	0.5	2.3	-0.7	1.8	-6.5	8.7	-5.3	-2.3	-16.2	-12.7	-15.8	-14.1	-17.0	-14.5	Y
-6.4	0.6	4.1	1.0	2.7	-0.2	2.3	-6.4	8.8	-5.2	-2.2	-15.7	-12.2	-15.4	-13.7	-16.5	-14.0	Y
-6.3	1.0	4.4	1.3	3.0	0.3	2.6	-6.3	9.0	-5.0	-2.0	-15.3	-12.0	-15.0	-13.4	-16.1	-13.7	Y
-6.2	1.2	4.5	1.6	3.1	0.6	2.8	-6.2	9.2	-4.8	-1.8	-15.1	-11.8	-14.8	-13.2	-15.8	-13.5	Y
-6.1	1.3	4.5	1.7	3.1	0.7	2.9	-6.1	9.4	-4.6	-1.6	-15.0	-11.8	-14.7	-13.2	-15.6	-13.5	Y
-6	1.2	4.4	1.7	3.0	0.7	2.7	-6	9.5	-4.5	-1.5	-15.1	-12.0	-14.7	-13.4	-15.6	-13.6	Y
-5.9	1.0	4.1	1.5	2.6	0.6	2.4	-5.9	9.7	-4.3	-1.3	-15.4	-12.3	-14.8	-13.7	-15.7	-13.9	Y
-5.8	0.5	3.5	1.2	2.1	0.3	1.9	-5.8	9.9	-4.1	-1.1	-15.9	-12.8	-15.2	-14.2	-16.1	-14.4	Y
-5.7	-0.3	2.8	0.7	1.4	-0.2	1.1	-5.7	10.1	-3.9	-0.9	-16.6	-13.5	-15.7	-14.9	-16.6	-15.2	Y
-5.6	-1.4	1.8	-0.1	0.4	-1.0	0.0	-5.6	10.3	-3.7	-0.7	-17.7	-14.5	-16.4	-15.9	-17.4	-16.4	Y
-5.5	-2.9	0.4	-1.1	-0.9	-2.1	-1.6	-5.5	10.5	-3.5	-0.5	-19.3	-15.9	-17.4	-17.2	-18.5	-17.9	Y
-5.4	-5.3	-1.4	-2.5	-2.6	-3.6	-3.9	-5.4	10.7	-3.3	-0.3	-21.6	-17.8	-18.8	-18.9	-20.0	-20.2	Y
-5.3	-9.2	-4.0	-4.3	-4.4	-5.6	-7.1	-5.3	10.9	-3.1	-0.1	-25.5	-20.3	-20.6	-20.8	-21.9	-23.5	Y
-5.2	-18.1	-7.0	-6.6	-5.7	-7.6	-10.9	-5.2	11.1	-2.9	0.1	-34.4	-23.3	-22.9	-22.1	-24.0	-27.3	Y
-5.1	-18.3	-8.0	-8.6	-5.0	-8.3	-9.4	-5.1	11.3	-2.7	0.3	-34.7	-24.3	-24.9	-21.4	-24.6	-25.7	Y
-5	-8.2	-5.0	-8.0	-2.7	-6.2	-4.7	-5	11.5	-2.5	0.5	-24.6	-21.3	-24.3	-19.0	-22.6	-21.0	Y
-4.9	-3.4	-1.4	-5.1	-0.1	-3.2	-1.0	-4.9	11.7	-2.3	0.7	-19.8	-17.8	-21.5	-16.5	-19.5	-17.4	Y
-4.8	-0.2	1.4	-2.2	2.1	-0.5	1.7	-4.8	12.0	-2.0	1.0	-16.6	-14.9	-18.5	-14.2	-16.8	-14.6	Y
-4.7	2.1	3.6	0.3	4.0	1.8	3.9	-4.7	12.2	-1.8	1.2	-14.2	-12.7	-16.0	-12.3	-14.6	-12.4	Y
-4.6	4.0	5.4	2.3	5.6	3.7	5.7	-4.6	12.4	-1.6	1.4	-12.3	-10.9	-14.0	-10.7	-12.7	-10.7	Y
-4.5	5.6	6.9	4.0	7.0	5.3	7.2	-4.5	12.7	-1.3	1.7	-10.7	-9.4	-12.3	-9.3	-11.1	-9.2	Y
-4.4	6.9	8.2	5.4	8.2	6.6	8.4	-4.4	12.9	-1.1	1.9	-9.4	-8.2	-10.9	-8.2	-9.7	-7.9	Y
-4.3	8.0	9.2	6.6	9.1	7.8	9.4	-4.3	13.2	-0.8	2.2	-8.4	-7.1	-9.7	-7.2	-8.6	-6.9	Y
-4.2	8.9	10.1	7.6	9.9	8.8	10.3	-4.2	13.4	-0.6	2.4	-7.5	-6.3	-8.8	-6.4	-7.6	-6.0	Y
-4.1	9.6	10.8	8.4	10.6	9.6	11.1	-4.1	13.7	-0.3	2.7	-6.7	-5.6	-8.0	-5.7	-6.8	-5.3	Y
-4	10.2	11.3	9.0	11.2	10.3	11.6	-4	13.9	-0.1	2.9	-6.1	-5.0	-7.3	-5.2	-6.1	-4.7	Y
-3.9	10.7	11.8	9.5	11.6	10.8	12.1	-3.9	14.2	0.2	3.2	-5.7	-4.6	-6.8	-4.8	-5.5	-4.2	Y

-3.8	11.0	12.0	9.9	11.9	11.2	12.5	-3.8	14.5	0.5	3.5	-5.4	-4.3	-6.5	-4.5	-5.1	-3.9	Y
-3.7	11.2	12.2	10.1	12.0	11.5	12.7	-3.7	14.8	0.8	3.8	-5.2	-4.1	-6.3	-4.3	-4.9	-3.7	Y
-3.6	11.2	12.2	10.1	12.0	11.6	12.8	-3.6	15.1	1.1	4.1	-5.1	-4.1	-6.2	-4.3	-4.7	-3.6	Y
-3.5	11.1	12.1	10.0	11.9	11.6	12.7	-3.5	15.4	1.4	4.4	-5.3	-4.3	-6.4	-4.5	-4.7	-3.6	Y
-3.4	10.8	11.8	9.6	11.6	11.4	12.5	-3.4	15.7	1.7	4.7	-5.6	-4.6	-6.7	-4.8	-4.9	-3.8	Y
-3.3	10.3	11.3	9.1	11.1	11.1	12.1	-3.3	16.0	2.0	5.0	-6.1	-5.1	-7.3	-5.3	-5.2	-4.2	Y
-3.2	9.5	10.5	8.2	10.3	10.5	11.5	-3.2	16.4	2.4	5.4	-6.8	-5.8	-8.1	-6.0	-5.8	-4.8	Y
-3.1	8.4	9.5	7.0	9.2	9.7	10.7	-3.1	16.7	2.7	5.7	-7.9	-6.9	-9.4	-7.1	-6.7	-5.7	Y
-3	6.9	8.0	5.1	7.7	8.4	9.4	-3	17.1	3.1	6.1	-9.4	-8.3	-11.3	-8.6	-7.9	-6.9	Y
-2.9	4.9	5.9	2.2	5.5	6.6	7.7	-2.9	17.4	3.4		-11.5	-10.4	-14.2	-10.8	-9.7	-8.7	Y
-2.8	2.2	3.0	-3.0	2.1	3.8	5.0	-2.8	17.8	3.8		-14.2	-13.3	-19.3	-14.2	-12.6	-11.3	Y
-2.7	0.2	-0.3	-8.6	-3.4	-1.3	0.5	-2.7	18.2	4.2		-16.2	-16.6	-24.9	-19.7	-17.7	-15.8	Y
-2.6	2.1	0.5	-0.3	-3.1	-18.3	-10.6	-2.6	18.6	4.6		-14.2	-15.8	-16.7	-19.4	-34.6	-26.9	Y
-2.5	5.9	4.8	5.2	3.3	-1.8	-2.8	-2.5	19.1	5.1		-10.5	-11.5	-11.2	-13.0	-18.2	-19.2	Y
-2.4	9.1	8.5	8.8	7.7	5.0	4.6	-2.4	19.5	5.5		-7.2	-7.8	-7.5	-8.6	-11.4	-11.7	Y
-2.3	11.8	11.4	11.6	10.9	9.0	8.9	-2.3	20.0	6.0		-4.6	-5.0	-4.7	-5.5	-7.3	-7.4	Y
-2.2	14.0	13.7	13.8	13.3	11.9	11.9	-2.2	20.4	6.4		-2.4	-2.6	-2.5	-3.0	-4.4	-4.4	Y
-2.1	15.8	15.7	15.7	15.3	14.3	14.3	-2.1	20.9	6.9		-0.5	-0.7	-0.6	-1.0	-2.1	-2.1	Y
-2	17.4	17.3	17.3	17.1	16.2	16.2	-2	21.5	7.5		1.1	1.0	1.0	0.7	-0.2	-0.1	Y
-1.9	18.8	18.7	18.7	18.5	17.8	17.8	-1.9	22.0	8.0		2.5	2.4	2.4	2.2	1.5	1.5	Y
-1.8	20.1	20.0	20.0	19.8	19.2	19.3	-1.8	22.6	8.6		3.7	3.7	3.7	3.5	2.9	2.9	Y
-1.7	21.2	21.1	21.1	21.0	20.5	20.5	-1.7	23.2	9.2		4.8	4.8	4.8	4.7	4.1	4.2	Y
-1.6	22.2	22.2	22.1	22.0	21.6	21.6	-1.6	23.9	9.9		5.8	5.8	5.8	5.7	5.2	5.3	Y
-1.5	23.1	23.1	23.0	22.9	22.6	22.6	-1.5	24.6	10.6		6.7	6.7	6.7	6.6	6.2	6.3	Y
-1.4	23.9	23.9	23.8	23.8	23.5	23.5	-1.4				7.5	7.5	7.5	7.4	7.1	7.2	Y
-1.3	24.6	24.6	24.6	24.5	24.3	24.3	-1.3				8.3	8.3	8.2	8.2	7.9	7.9	Y
-1.2	25.3	25.3	25.2	25.2	25.0	25.0	-1.2				8.9	8.9	8.9	8.9	8.6	8.7	Y
-1.1	25.9	25.9	25.8	25.8	25.6	25.6	-1.1				9.5	9.5	9.5	9.5	9.3	9.3	Y
-1	26.4	26.4	26.4	26.4	26.2	26.2	-1				10.1	10.1	10.0	10.0	9.9	9.9	Y
-0.9	26.9	26.9	26.9	26.8	26.7	26.7	-0.9				10.6	10.5	10.5	10.5	10.4	10.4	Y
-0.8	27.3	27.3	27.3	27.3	27.2	27.2	-0.8				11.0	11.0	11.0	10.9	10.8	10.8	Y
-0.7	27.7	27.7	27.7	27.7	27.6	27.6	-0.7				11.4	11.3	11.3	11.3	11.2	11.2	Y
-0.6	28.0	28.0	28.0	28.0	27.9	27.9	-0.6				11.7	11.7	11.7	11.6	11.6	11.6	Y
-0.5	28.3	28.3	28.3	28.3	28.2	28.2	-0.5				12.0	11.9	11.9	11.9	11.9	11.9	Y
-0.4	28.5	28.5	28.5	28.5	28.5	28.5	-0.4				12.2	12.2	12.2	12.2	12.1	12.1	Y

-0.3	28.7	28.7	28.7	28.7	28.7	28.7	-0.3				12.4	12.4	12.4	12.4	12.3	12.3	Y
-0.2	28.8	28.8	28.8	28.8	28.8	28.8	-0.2				12.5	12.5	12.5	12.5	12.5	12.5	Y
-0.1	28.9	28.9	28.9	28.9	28.9	28.9	-0.1				12.6	12.6	12.6	12.6	12.6	12.6	Y
0	29.0	29.0	29.0	29.0	29.0	29.0	0				12.7	12.7	12.7	12.7	12.7	12.6	Y
0.1	29.0	29.0	29.0	29.0	29.0	29.0	0.1				12.7	12.7	12.7	12.7	12.7	12.7	Y
0.2	29.0	29.0	29.0	29.0	29.0	29.0	0.2				12.6	12.6	12.6	12.6	12.6	12.6	Y
0.3	28.9	28.9	28.9	28.9	28.9	28.9	0.3				12.6	12.6	12.6	12.6	12.6	12.6	Y
0.4	28.8	28.8	28.8	28.8	28.8	28.8	0.4				12.4	12.4	12.4	12.4	12.4	12.4	Y
0.5	28.6	28.6	28.6	28.6	28.6	28.6	0.5				12.3	12.3	12.3	12.3	12.3	12.3	Y
0.6	28.4	28.4	28.4	28.4	28.4	28.4	0.6				12.0	12.1	12.0	12.1	12.0	12.1	Y
0.7	28.1	28.2	28.1	28.1	28.1	28.1	0.7				11.8	11.8	11.8	11.8	11.8	11.8	Y
0.8	27.8	27.8	27.8	27.8	27.8	27.8	0.8				11.5	11.5	11.5	11.5	11.4	11.5	Y
0.9	27.4	27.5	27.4	27.5	27.4	27.4	0.9				11.1	11.2	11.1	11.1	11.0	11.1	Y
1	27.0	27.1	27.0	27.1	26.9	27.0	1				10.7	10.8	10.7	10.7	10.6	10.7	Y
1.1	26.6	26.6	26.5	26.6	26.4	26.5	1.1				10.2	10.3	10.2	10.3	10.1	10.2	Y
1.2	26.0	26.1	26.0	26.1	25.9	26.0	1.2				9.7	9.8	9.7	9.7	9.5	9.6	Y
1.3	25.4	25.5	25.4	25.5	25.2	25.4	1.3				9.1	9.2	9.1	9.1	8.9	9.0	Y
1.4	24.7	24.9	24.7	24.8	24.5	24.7	1.4				8.4	8.5	8.4	8.5	8.2	8.3	Y
1.5	24.0	24.1	24.0	24.0	23.7	23.9	1.5	24.6	10.6		7.7	7.8	7.6	7.7	7.4	7.5	Y
1.6	23.2	23.3	23.1	23.2	22.8	23.0	1.6	23.9	9.9		6.8	7.0	6.8	6.9	6.4	6.6	Y
1.7	22.2	22.4	22.2	22.3	21.8	22.0	1.7	23.2	9.2		5.9	6.0	5.8	5.9	5.4	5.6	Y
1.8	21.2	21.3	21.1	21.2	20.6	20.8	1.8	22.6	8.6		4.8	5.0	4.8	4.9	4.3	4.5	Y
1.9	20.0	20.2	19.9	20.0	19.3	19.6	1.9	22.0	8.0		3.6	3.8	3.6	3.7	2.9	3.2	Y
2	18.6	18.8	18.5	18.7	17.7	18.1	2	21.5	7.5		2.3	2.5	2.2	2.3	1.4	1.7	Y
2.1	17.1	17.3	17.0	17.1	15.9	16.3	2.1	20.9	6.9		0.7	1.0	0.6	0.8	-0.4	0.0	Y
2.2	15.2	15.6	15.1	15.3	13.7	14.2	2.2	20.4	6.4		-1.1	-0.8	-1.2	-1.1	-2.6	-2.2	Y
2.3	13.0	13.5	12.9	13.0	10.9	11.5	2.3	20.0	6.0		-3.3	-2.9	-3.5	-3.3	-5.4	-4.9	Y
2.4	10.3	10.9	10.1	10.2	7.1	7.8	2.4	19.5	5.5		-6.0	-5.4	-6.3	-6.1	-9.2	-8.5	Y
2.5	6.9	7.9	6.3	6.5	0.8	2.2	2.5	19.1	5.1		-9.5	-8.5	-10.1	-9.9	-15.5	-14.1	Y
2.6	2.6	4.5	0.6	1.0	-12.7	-7.0	2.6	18.6	4.6		-13.8	-11.9	-15.8	-15.3	-29.0	-23.3	Y
2.7	0.4	3.0	-4.8	-3.1	0.4	0.2	2.7	18.2	4.2		-15.9	-13.3	-21.1	-19.5	-16.0	-16.2	Y
2.8	3.4	4.9	1.1	2.0	5.7	5.4	2.8	17.8	3.8		-12.9	-11.4	-15.3	-14.4	-10.6	-11.0	Y
2.9	6.6	7.5	5.4	6.0	8.7	8.4	2.9	17.4	3.4		-9.7	-8.8	-10.9	-10.3	-7.7	-7.9	Y
3	8.9	9.6	8.1	8.6	10.6	10.4	3	17.1	3.1	6.1	-7.4	-6.8	-8.3	-7.7	-5.7	-5.9	Y
3.1	10.6	11.1	9.9	10.4	12.0	11.8	3.1	16.7	2.7	5.7	-5.8	-5.2	-6.5	-6.0	-4.3	-4.5	Y

3.2	11.7	12.2	11.1	11.6	13.0	12.8	3.2	16.4	2.4	5.4	-4.6	-4.1	-5.2	-4.7	-3.3	-3.5	Y
3.3	12.6	13.1	12.0	12.5	13.7	13.6	3.3	16.0	2.0	5.0	-3.8	-3.2	-4.3	-3.8	-2.6	-2.8	Y
3.4	13.2	13.7	12.6	13.1	14.2	14.1	3.4	15.7	1.7	4.7	-3.2	-2.6	-3.7	-3.2	-2.2	-2.2	Y
3.5	13.6	14.1	13.0	13.6	14.4	14.4	3.5	15.4	1.4	4.4	-2.8	-2.2	-3.3	-2.8	-1.9	-1.9	Y
3.6	13.8	14.3	13.3	13.8	14.6	14.6	3.6	15.1	1.1	4.1	-2.6	-2.0	-3.1	-2.6	-1.8	-1.7	Y
3.7	13.8	14.4	13.3	13.9	14.6	14.6	3.7	14.8	0.8	3.8	-2.5	-1.9	-3.0	-2.5	-1.8	-1.7	Y
3.8	13.8	14.3	13.2	13.8	14.4	14.5	3.8	14.5	0.5	3.5	-2.6	-2.0	-3.1	-2.5	-1.9	-1.8	Y
3.9	13.6	14.2	13.0	13.6	14.2	14.3	3.9	14.2	0.2	3.2	-2.8	-2.2	-3.3	-2.8	-2.2	-2.0	Y
4	13.2	13.8	12.7	13.2	13.8	13.9	4	13.9	-0.1	2.9	-3.1	-2.5	-3.7	-3.1	-2.6	-2.4	Y
4.1	12.7	13.4	12.2	12.8	13.3	13.5	4.1	13.7	-0.3	2.7	-3.6	-2.9	-4.2	-3.6	-3.1	-2.9	Y
4.2	12.1	12.8	11.6	12.2	12.6	12.9	4.2	13.4	-0.6	2.4	-4.2	-3.5	-4.8	-4.2	-3.7	-3.5	Y
4.3	11.4	12.1	10.8	11.4	11.9	12.1	4.3	13.2	-0.8	2.2	-5.0	-4.3	-5.5	-4.9	-4.5	-4.2	Y
4.4	10.5	11.2	9.9	10.5	10.9	11.2	4.4	12.9	-1.1	1.9	-5.9	-5.1	-6.5	-5.9	-5.4	-5.1	Y
4.5	9.4	10.1	8.8	9.3	9.8	10.1	4.5	12.7	-1.3	1.7	-7.0	-6.2	-7.6	-7.0	-6.5	-6.2	Y
4.6	8.1	8.8	7.5	8.0	8.5	8.8	4.6	12.4	-1.6	1.4	-8.3	-7.5	-8.9	-8.3	-7.8	-7.5	Y
4.7	6.5	7.2	6.0	6.4	7.0	7.3	4.7	12.2	-1.8	1.2	-9.8	-9.1	-10.4	-9.9	-9.3	-9.0	Y
4.8	4.6	5.3	4.2	4.5	5.2	5.4	4.8	12.0	-2.0	1.0	-11.7	-11.1	-12.2	-11.9	-11.2	-10.9	Y
4.9	2.3	2.8	2.1	2.1	2.9	3.0	4.9	11.7	-2.3	0.7	-14.1	-13.5	-14.3	-14.2	-13.4	-13.3	Y
5	-0.6	-0.4	-0.3	-0.6	0.0	0.0	5	11.5	-2.5	0.5	-16.9	-16.7	-16.6	-17.0	-16.3	-16.4	Y
5.1	-3.8	-4.2	-2.4	-3.1	-3.6	-3.9	5.1	11.3	-2.7	0.3	-20.1	-20.5	-18.7	-19.4	-19.9	-20.3	Y
5.2	-5.4	-5.9	-3.2	-3.4	-7.4	-7.0	5.2	11.1	-2.9	0.1	-21.7	-22.2	-19.6	-19.7	-23.8	-23.4	Y
5.3	-3.7	-3.1	-2.3	-1.5	-7.4	-4.4	5.3	10.9	-3.1	-0.1	-20.0	-19.4	-18.6	-17.8	-23.8	-20.7	Y
5.4	-1.1	0.0	-0.7	0.7	-4.3	-1.0	5.4	10.7	-3.3	-0.3	-17.5	-16.3	-17.0	-15.6	-20.6	-17.3	Y
5.5	1.0	2.4	0.9	2.5	-1.6	1.6	5.5	10.5	-3.5	-0.5	-15.3	-14.0	-15.5	-13.8	-17.9	-14.8	Y
5.6	2.6	4.1	2.1	3.9	0.3	3.4	5.6	10.3	-3.7	-0.7	-13.7	-12.2	-14.2	-12.4	-16.0	-12.9	Y
5.7	3.8	5.4	3.1	5.0	1.7	4.8	5.7	10.1	-3.9	-0.9	-12.5	-10.9	-13.2	-11.3	-14.6	-11.6	Y
5.8	4.7	6.4	3.8	5.8	2.7	5.8	5.8	9.9	-4.1	-1.1	-11.7	-10.0	-12.5	-10.5	-13.7	-10.6	Y
5.9	5.3	7.1	4.3	6.4	3.3	6.5	5.9	9.7	-4.3	-1.3	-11.0	-9.3	-12.0	-10.0	-13.0	-9.9	Y
6	5.7	7.6	4.6	6.7	3.7	7.0	6	9.5	-4.5	-1.5	-10.6	-8.8	-11.7	-9.6	-12.6	-9.4	Y
6.1	6.0	7.9	4.7	6.9	4.0	7.3	6.1	9.4	-4.6	-1.6	-10.3	-8.4	-11.6	-9.4	-12.4	-9.1	Y
6.2	6.1	8.1	4.7	7.0	4.0	7.4	6.2	9.2	-4.8	-1.8	-10.3	-8.3	-11.7	-9.3	-12.4	-8.9	Y
6.3	6.0	8.1	4.5	6.9	3.8	7.4	6.3	9.0	-5.0	-2.0	-10.3	-8.2	-11.8	-9.4	-12.5	-8.9	Y
6.4	5.8	8.0	4.2	6.7	3.5	7.3	6.4	8.8	-5.2	-2.2	-10.5	-8.4	-12.2	-9.6	-12.8	-9.1	Y
6.5	5.5	7.7	3.7	6.3	3.1	7.0	6.5	8.7	-5.3	-2.3	-10.8	-8.6	-12.7	-10.0	-13.2	-9.3	Y
6.6	5.1	7.4	3.0	5.8	2.5	6.6	6.6	8.5	-5.5	-2.5	-11.3	-9.0	-13.3	-10.5	-13.8	-9.8	Y

6.7	4.5	6.9	2.2	5.1	1.8	6.0	6.7	8.3	-5.7	-2.7	-11.9	-9.5	-14.1	-11.2	-14.6	-10.3	Y
6.8	3.7	6.2	1.3	4.3	0.9	5.3	6.8	8.2	-5.8	-2.8	-12.6	-10.1	-15.1	-12.0	-15.5	-11.0	Y
6.9	2.8	5.4	0.1	3.3	-0.2	4.4	6.9	8.0	-6.0	-3.0	-13.5	-10.9	-16.2	-13.0	-16.5	-11.9	Y
7	1.8	4.4	-1.3	2.1	-1.4	3.4	7	7.9	-6.1	-3.1	-14.6	-11.9	-17.7	-14.3	-17.7	-13.0	Y
7.1	0.5	3.2	-3.0	0.6	-2.7	2.1	7.1	8.0	-6.0	-3.3	-15.8	-13.1	-19.3	-15.8	-19.1	-14.3	Y
7.2	-1.0	1.8	-5.0	-1.2	-4.1	0.5	7.2	8.0	-6.0	-3.4	-17.4	-14.6	-21.4	-17.6	-20.4	-15.8	Y
7.3	-2.8	-0.1	-7.4	-3.5	-5.4	-1.3	7.3	8.0	-6.0	-3.6	-19.2	-16.4	-23.8	-19.8	-21.7	-17.7	Y
7.4	-5.1	-2.4	-9.9	-6.2	-6.4	-3.6	7.4	8.0	-6.0	-3.7	-21.4	-18.7	-26.3	-22.5	-22.7	-20.0	Y
7.5	-7.7	-5.5	-11.6	-9.1	-6.7	-6.4	7.5	8.0	-6.0	-3.9	-24.1	-21.8	-27.9	-25.4	-23.1	-22.7	Y
7.6	-10.8	-10.1	-11.2	-10.2	-6.5	-9.1	7.6	8.0	-6.0	-4.0	-27.2	-26.4	-27.5	-26.5	-22.8	-25.4	Y
7.7	-13.2	-16.8	-9.4	-8.5	-5.9	-10.0	7.7	8.0	-6.0	-4.2	-29.5	-33.1	-25.8	-24.8	-22.2	-26.4	Y
7.8	-12.7	-14.2	-7.7	-6.0	-5.2	-8.3	7.8	8.0	-6.0	-4.3	-29.0	-30.5	-24.0	-22.4	-21.5	-24.7	Y
7.9	-10.5	-8.8	-6.2	-4.0	-4.5	-6.0	7.9	8.0	-6.0	-4.4	-26.8	-25.1	-22.5	-20.3	-20.8	-22.4	Y
8	-8.4	-5.4	-5.1	-2.4	-3.9	-4.1	8	8.0	-6.0	-4.6	-24.7	-21.7	-21.4	-18.7	-20.3	-20.4	Y
8.1	-6.8	-3.2	-4.3	-1.2	-3.6	-2.6	8.1	8.0	-6.0	-4.7	-23.1	-19.5	-20.6	-17.5	-19.9	-18.9	Y
8.2	-5.6	-1.6	-3.8	-0.3	-3.3	-1.5	8.2	8.0	-6.0	-4.8	-21.9	-17.9	-20.1	-16.6	-19.6	-17.8	Y
8.3	-4.8	-0.4	-3.4	0.4	-3.2	-0.6	8.3	8.0	-6.0	-5.0	-21.1	-16.8	-19.8	-15.9	-19.6	-17.0	Y
8.4	-4.2	0.4	-3.3	0.9	-3.3	0.0	8.4	8.0	-6.0	-5.1	-20.6	-15.9	-19.6	-15.4	-19.6	-16.4	Y
8.5	-3.9	1.0	-3.3	1.2	-3.5	0.4	8.5	8.0	-6.0	-5.2	-20.3	-15.3	-19.6	-15.1	-19.8	-15.9	Y
8.6	-3.8	1.4	-3.5	1.4	-3.8	0.6	8.6	8.0	-6.0	-5.4	-20.2	-14.9	-19.8	-15.0	-20.2	-15.7	Y
8.7	-3.9	1.6	-3.8	1.4	-4.3	0.7	8.7	8.0	-6.0	-5.5	-20.2	-14.7	-20.2	-15.0	-20.7	-15.6	Y
8.8	-4.1	1.7	-4.3	1.3	-5.0	0.7	8.8	8.0	-6.0	-5.6	-20.5	-14.7	-20.7	-15.1	-21.3	-15.7	Y
8.9	-4.5	1.6	-5.0	1.1	-5.8	0.5	8.9	8.0	-6.0	-5.7	-20.9	-14.7	-21.3	-15.3	-22.1	-15.9	Y
9	-5.1	1.4	-5.8	0.7	-6.8	0.2	9	8.0	-6.0	-5.9	-21.4	-14.9	-22.1	-15.6	-23.1	-16.2	Y
9.1	-5.8	1.1	-6.8	0.3	-8.0	-0.3	9.1	8.0	-6.0	-6.0	-22.2	-15.3	-23.1	-16.0	-24.3	-16.6	Y
9.2	-6.8	0.6	-8.0	-0.2	-9.4	-0.8	9.2	8.0	-6.0	-6.1	-23.1	-15.7	-24.3	-16.5	-25.7	-17.1	Y
9.3	-7.9	0.0	-9.4	-0.8	-11.1	-1.4	9.3	7.8	-6.2	-6.2	-24.2	-16.3	-25.8	-17.1	-27.5	-17.8	Y
9.4	-9.2	-0.7	-11.1	-1.4	-13.2	-2.2	9.4	7.7	-6.3	-6.3	-25.6	-17.0	-27.5	-17.8	-29.5	-18.5	Y
9.5	-10.8	-1.5	-13.1	-2.1	-15.8	-3.0	9.5	7.6	-6.4	-6.4	-27.2	-17.8	-29.4	-18.5	-32.1	-19.3	Y
9.6	-12.7	-2.4	-15.4	-2.8	-19.2	-3.8	9.6	7.4	-6.6	-6.6	-29.1	-18.7	-31.7	-19.1	-35.5	-20.1	Y
9.7	-15.0	-3.4	-17.8	-3.4	-24.0	-4.6	9.7	7.3	-6.7	-6.7	-31.3	-19.7	-34.1	-19.7	-40.3	-20.9	Y
9.8	-17.5	-4.4	-19.8	-3.9	-30.5	-5.3	9.8	7.2	-6.8	-6.8	-33.8	-20.7	-36.1	-20.2	-46.8	-21.6	Y
9.9	-20.1	-5.3	-20.3	-4.1	-29.1	-5.8	9.9	7.1	-6.9	-6.9	-36.4	-21.7	-36.6	-20.5	-45.4	-22.1	Y
10	-21.6	-6.0	-19.5	-4.2	-24.4	-6.0	10	7.0	-7.0	-7.0	-37.9	-22.4	-35.8	-20.6	-40.8	-22.3	Y
15.0	-16.7	-17.8	-27.3	-13.3	-10.9	-18.9	15	2.6	-11.4	-11.4	-33.0	-34.2	-43.6	-29.6	-27.3	-35.3	Y

20.0	-9.6	-15.2	-14.4	-16.1	-15.8	-18.4	20	-0.5	-14.5	-14.5	-26.0	-31.5	-30.7	-32.4	-32.2	-34.8	Y
25.0	-20.2	-12.5	-18.8	-12.7	-11.0	-17.5	25	-2.9	-16.9	-16.9	-36.5	-28.8	-35.1	-29.1	-27.4	-33.8	Y
30.0	-14.5	-13.4	-16.1	-11.6	-13.8	-13.9	30	-4.9	-18.9	-18.9	-30.8	-29.7	-32.5	-28.0	-30.2	-30.3	Y
35.0	-23.4	-13.7	-24.2	-15.3	-36.7	-14.0	35	-6.6	-20.6	-20.6	-39.8	-30.0	-40.5	-31.6	-53.1	-30.3	Y
40.0	-22.0	-31.9	-32.3	-20.8	-20.5	-22.2	40	-8.1	-22.1	-22.1	-38.3	-48.2	-48.6	-37.2	-36.8	-38.5	Y
45.0	-24.3	-17.3	-23.0	-27.3	-15.7	-17.9	45	-9.3	-23.3	-23.3	-40.7	-33.6	-39.3	-43.7	-32.0	-34.2	Y
50.0	-15.1	-22.3	-18.5	-28.5	-15.5	-24.7	50	-10.0	-24.0	-24.0	-31.4	-38.6	-34.9	-44.8	-31.9	-41.0	Y
55.0	-21.3	-37.2	-22.6	-32.1	-19.1	-27.5	55	-10.0	-24.0	-24.0	-37.7	-53.6	-39.0	-48.4	-35.4	-43.8	Y
60.0	-28.0	-33.0	-29.0	-31.8	-31.6	-16.7	60	-10.0	-24.0	-24.0	-44.3	-49.3	-45.3	-48.1	-48.0	-33.1	Y
65.0	-33.3	-23.3	-24.6	-19.5	-29.8	-13.9	65	-10.0	-24.0	-24.0	-49.6	-39.6	-41.0	-35.8	-46.2	-30.3	Y
70.0	-25.3	-16.1	-21.8	-15.5	-20.9	-15.0	70	-10.0	-24.0	-24.0	-41.7	-32.4	-38.1	-31.8	-37.2	-31.4	Y
75.0	-25.0	-13.5	-21.7	-14.4	-17.9	-14.6	75	-10.0	-24.0	-24.0	-41.3	-29.8	-38.0	-30.8	-34.2	-30.9	Y
80.0	-21.3	-15.9	-22.2	-30.1	-20.5	-19.4	80	-10.0	-24.0	-24.0	-37.7	-32.2	-38.6	-46.5	-36.8	-35.7	Y
85.0	-23.0	-22.2	-20.3	-17.4	-35.5	-21.6	85	-10.0	-24.0	-24.0	-39.4	-38.5	-36.7	-33.7	-51.8	-37.9	Y
90.0	-20.2	-21.2	-19.5	-23.7	-28.4	-24.5	90	0.0	-14.0	-14.0	-36.6	-37.6	-35.9	-40.1	-44.8	-40.8	Y
95.0	-19.9	-21.2	-17.0	-19.4	-20.4	-20.8	95	0.0	-14.0	-14.0	-36.2	-37.5	-33.3	-35.7	-36.7	-37.1	Y
100.0	-18.4	-26.3	-22.3	-21.8	-26.9	-26.7	100	0.0	-14.0	-14.0	-34.8	-42.6	-38.6	-38.2	-43.2	-43.0	Y
105.0	-22.8	-24.7	-27.7	-33.7	-22.3	-27.9	105	0.0	-14.0	-14.0	-39.2	-41.1	-44.1	-50.1	-38.6	-44.2	Y
110.0	-27.9	-30.6	-25.0	-26.5	-31.6	-29.9	110	0.0	-14.0	-14.0	-44.2	-46.9	-41.3	-42.9	-48.0	-46.3	Y
115.0	-26.4	-28.3	-23.0	-27.3	-28.4	-43.3	115	0.0	-14.0	-14.0	-42.7	-44.7	-39.3	-43.6	-44.8	-59.6	Y
120.0	-27.4	-36.1	-27.1	-27.4	-34.9	-28.8	120	0.0	-14.0	-14.0	-43.7	-52.4	-43.4	-43.7	-51.2	-45.1	Y
125.0	-27.7	-38.2	-30.8	-50.4	-38.2	-40.5	125	0.0	-14.0	-14.0	-44.0	-54.5	-47.2	-66.7	-54.6	-56.8	Y
130.0	-29.9	-30.5	-36.5	-37.4	-42.2	-42.2	130	0.0	-14.0	-14.0	-46.3	-46.8	-52.8	-53.7	-58.5	-58.5	Y
135.0	-28.2	-31.1	-37.6	-39.3	-30.3	-39.8	135	0.0	-14.0	-14.0	-44.5	-47.4	-53.9	-55.6	-46.6	-56.1	Y
140.0	-40.9	-44.4	-30.7	-38.9	-33.1	-40.6	140	0.0	-14.0	-14.0	-57.3	-60.7	-47.1	-55.2	-49.4	-57.0	Y
145.0	-40.0	-44.9	-43.0	-38.8	-39.9	-42.4	145	0.0	-14.0	-14.0	-56.3	-61.2	-59.3	-55.2	-56.2	-58.7	Y
150.0	-49.0	-33.4	-42.5	-32.7	-34.7	-36.0	150	0.0	-14.0	-14.0	-65.3	-49.7	-58.8	-49.1	-51.0	-52.4	Y
155.0	-41.1	-50.2	-34.9	-44.7	-41.2	-47.8	155	0.0	-14.0	-14.0	-57.4	-66.5	-51.3	-61.1	-57.5	-64.2	Y
160.0	-35.4	-43.8	-42.8	-49.1	-36.5	-43.6	160	0.0	-14.0	-14.0	-51.7	-60.1	-59.1	-65.4	-52.8	-59.9	Y
165.0	-43.8	-46.9	-39.4	-51.7	-50.0	-48.1	165	0.0	-14.0	-14.0	-60.1	-63.2	-55.7	-68.0	-66.3	-64.4	Y
170.0	-48.0	-51.4	-56.5	-52.3	-50.9	-48.6	170	0.0	-14.0	-14.0	-64.4	-67.7	-72.9	-68.6	-67.2	-64.9	Y
175.0	-46.9	-48.2	-48.3	-59.3	-54.2	-43.8	175	0.0	-14.0	-14.0	-63.3	-64.5	-64.6	-75.6	-70.6	-60.2	Y
180.0	-47.0	-45.0	-48.7	-46.7	-66.5	-50.3	180	0.0	-14.0	-14.0	-63.3	-61.4	-65.0	-63.1	-82.8	-66.6	Y

APPENDIX D: Antenna Gain and EIRP Tables

Co Pol Azimuth	Antenna Gain (dBi)									Off-Axis EIRP (dBW/4 kHz)							
Off-Axis Angle	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Off-Axis Angle	FCC §25.209	FCC §25.209(a)(2) + §25.212 EIRP GSO Mask, Skew = 45 deg	FCC §25.209(a)(4) + §25.212 EIRP non-GSO Mask, Skew = 45 deg	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Meets Mask
-180	-28.5	-28.4	-26.0	-29.5	-29.0	-29.0	-180	0.0	-14.0	-14.0	-44.9	-44.8	-42.4	-45.8	-45.3	-45.3	Y
-175	-49.1	-36.5	-47.4	-43.5	-27.5	-27.5	-175	0.0	-14.0	-14.0	-65.4	-52.8	-63.7	-59.9	-43.9	-43.9	Y
-170	-27.8	-26.2	-28.2	-29.9	-36.8	-36.8	-170	0.0	-14.0	-14.0	-44.2	-42.5	-44.6	-46.2	-53.1	-53.1	Y
-165	-33.4	-27.9	-34.3	-28.8	-43.1	-43.1	-165	0.0	-14.0	-14.0	-49.7	-44.3	-50.6	-45.1	-59.4	-59.4	Y
-160	-26.4	-28.1	-26.2	-38.5	-27.9	-27.9	-160	0.0	-14.0	-14.0	-42.8	-44.4	-42.6	-54.8	-44.2	-44.2	Y
-155	-29.3	-22.5	-37.4	-23.4	-25.1	-25.1	-155	0.0	-14.0	-14.0	-45.7	-38.8	-53.7	-39.7	-41.4	-41.4	Y
-150	-23.0	-29.1	-29.8	-29.3	-42.6	-42.6	-150	0.0	-14.0	-14.0	-39.4	-45.4	-46.2	-45.6	-58.9	-58.9	Y
-145	-29.9	-20.7	-31.3	-33.0	-22.1	-22.1	-145	0.0	-14.0	-14.0	-46.2	-37.0	-47.6	-49.3	-38.4	-38.4	Y
-140	-27.1	-25.4	-28.2	-20.1	-25.4	-25.4	-140	0.0	-14.0	-14.0	-43.4	-41.8	-44.5	-36.4	-41.8	-41.8	Y
-135	-35.6	-37.5	-18.6	-22.3	-23.9	-23.9	-135	0.0	-14.0	-14.0	-51.9	-53.8	-34.9	-38.7	-40.2	-40.2	Y
-130	-22.0	-26.1	-24.3	-25.6	-24.2	-24.2	-130	0.0	-14.0	-14.0	-38.3	-42.4	-40.6	-41.9	-40.6	-40.6	Y
-125	-22.3	-22.2	-33.0	-19.2	-22.8	-22.8	-125	0.0	-14.0	-14.0	-38.6	-38.5	-49.4	-35.5	-39.1	-39.1	Y
-120	-26.8	-28.3	-20.0	-16.3	-17.7	-17.7	-120	0.0	-14.0	-14.0	-43.1	-44.6	-36.3	-32.6	-34.0	-34.0	Y
-115	-32.2	-22.0	-30.9	-12.9	-17.7	-17.7	-115	0.0	-14.0	-14.0	-48.5	-38.4	-47.2	-29.2	-34.1	-34.1	Y
-110	-23.9	-32.6	-20.4	-15.5	-25.1	-25.1	-110	0.0	-14.0	-14.0	-40.3	-49.0	-36.7	-31.8	-41.4	-41.4	Y
-105	-19.8	-42.8	-23.1	-16.2	-17.6	-17.6	-105	0.0	-14.0	-14.0	-36.2	-59.1	-39.4	-32.5	-34.0	-34.0	Y
-100	-15.3	-29.0	-15.3	-14.5	-20.6	-20.6	-100	0.0	-14.0	-14.0	-31.6	-45.3	-31.7	-30.8	-37.0	-37.0	Y
-95	-17.8	-25.3	-20.6	-14.5	-15.1	-15.1	-95	0.0	-14.0	-14.0	-34.2	-41.7	-37.0	-30.9	-31.4	-31.4	Y
-90	-15.9	-24.0	-29.8	-18.0	-20.0	-20.0	-90	0.0	-14.0	-14.0	-32.3	-40.3	-46.1	-34.3	-36.3	-36.3	Y
-85	-15.6	-21.7	-24.8	-17.7	-14.4	-14.4	-85	-10.0	-24.0	-24.0	-31.9	-38.0	-41.1	-34.1	-30.8	-30.8	Y
-80	-21.6	-27.3	-21.3	-20.5	-27.0	-27.0	-80	-10.0	-24.0	-24.0	-38.0	-43.6	-37.7	-36.9	-43.3	-43.3	Y
-75	-16.3	-16.6	-20.8	-14.0	-26.3	-26.3	-75	-10.0	-24.0	-24.0	-32.7	-32.9	-37.2	-30.4	-42.7	-42.7	Y
-70	-21.5	-32.1	-20.9	-20.6	-13.2	-13.2	-70	-10.0	-24.0	-24.0	-37.8	-48.5	-37.2	-37.0	-29.5	-29.5	Y
-65	-18.2	-16.1	-20.6	-9.2	-25.1	-25.1	-65	-10.0	-24.0	-24.0	-34.5	-32.4	-36.9	-25.5	-41.4	-41.4	Y
-60	-22.0	-14.8	-19.3	-10.6	-22.9	-22.9	-60	-10.0	-24.0	-24.0	-38.3	-31.1	-35.7	-26.9	-39.2	-39.2	Y

-55	-32.7	-10.3	-26.1	-10.2	-26.4	-26.4	-55	-10.0	-24.0	-24.0	-49.1	-26.6	-42.4	-26.5	-42.8	-42.8	Y
-50	-14.1	-27.2	-19.5	-36.0	-18.5	-18.5	-50	-10.0	-24.0	-24.0	-30.4	-43.5	-35.8	-52.4	-34.9	-34.9	Y
-48	-32.6	-21.1	-17.1	-19.7	-23.2	-23.2	-48	-10.0	-24.0	-24.0	-49.0	-37.4	-33.5	-36.1	-39.5	-39.5	Y
-45	-17.1	-15.6	-22.9	-11.9	-25.4	-25.4	-45	-9.3	-23.3	-23.3	-33.4	-31.9	-39.2	-28.3	-41.7	-41.7	Y
-40	-22.3	-17.8	-27.2	-14.6	-21.7	-21.7	-40	-8.1	-22.1	-22.1	-38.6	-34.1	-43.5	-30.9	-38.0	-38.0	Y
-35	-28.2	-19.3	-16.6	-22.1	-11.4	-11.4	-35	-6.6	-20.6	-20.6	-44.5	-35.6	-33.0	-38.5	-27.7	-27.7	Y
-30	-17.2	-17.1	-12.9	-25.0	-29.1	-29.1	-30	-4.9	-18.9	-18.9	-33.6	-33.5	-29.2	-41.3	-45.4	-45.4	Y
-25	-23.8	-23.6	-13.9	-24.9	-18.1	-18.1	-25	-2.9	-16.9	-16.9	-40.2	-40.0	-30.2	-41.3	-34.5	-34.5	Y
-20	-8.7	-16.3	-6.2	-14.6	-6.9	-6.9	-20	-0.5	-14.5	-14.5	-25.1	-32.6	-22.6	-30.9	-23.3	-23.3	Y
-15	-11.0	-7.3	-8.5	-9.8	-3.6	-3.6	-15	2.6	-11.4	-11.4	-27.3	-23.6	-24.8	-26.2	-19.9	-19.9	Y
-10	-10.2	-14.6	-13.5	-15.4	-8.8	-8.8	-10	7.0	-7.0	-7.0	-26.5	-31.0	-29.8	-31.7	-25.2	-25.2	Y
-9.9	-9.0	-16.7	-11.7	-17.3	-9.3	-9.3	-9.9	7.1	-6.9	-6.9	-25.4	-33.0	-28.1	-33.7	-25.6	-25.6	Y
-9.8	-8.1	-19.3	-10.3	-19.2	-9.8	-9.8	-9.8	7.2	-6.8	-6.8	-24.4	-35.6	-26.6	-35.6	-26.2	-26.2	Y
-9.7	-7.2	-22.4	-9.0	-19.7	-10.5	-10.5	-9.7	7.3	-6.7	-6.7	-23.6	-38.7	-25.3	-36.0	-26.8	-26.8	Y
-9.6	-6.6	-25.5	-8.0	-18.7	-11.2	-11.2	-9.6	7.4	-6.6	-6.6	-23.0	-41.9	-24.3	-35.1	-27.5	-27.5	Y
-9.5	-6.1	-24.7	-7.1	-17.0	-11.8	-11.8	-9.5	7.6	-6.4	-6.4	-22.5	-41.1	-23.4	-33.3	-28.1	-28.1	Y
-9.4	-5.7	-21.9	-6.4	-15.3	-12.1	-12.1	-9.4	7.7	-6.3	-6.3	-22.1	-38.2	-22.7	-31.7	-28.5	-28.5	Y
-9.3	-5.5	-19.4	-5.8	-13.9	-12.2	-12.2	-9.3	7.8	-6.2	-6.2	-21.8	-35.7	-22.1	-30.2	-28.5	-28.5	Y
-9.2	-5.3	-17.5	-5.3	-12.7	-11.9	-11.9	-9.2	8.0	-6.0	-6.1	-21.7	-33.9	-21.6	-29.1	-28.3	-28.3	Y
-9.1	-5.3	-16.4	-5.0	-12.0	-11.5	-11.5	-9.1	8.0	-6.0	-6.0	-21.7	-32.7	-21.4	-28.3	-27.8	-27.8	Y
-9	-5.5	-15.7	-4.8	-11.5	-10.8	-10.8	-9	8.0	-6.0	-5.9	-21.9	-32.0	-21.2	-27.8	-27.2	-27.2	Y
-8.9	-5.9	-15.4	-4.8	-11.3	-10.3	-10.3	-8.9	8.0	-6.0	-5.7	-22.2	-31.7	-21.2	-27.6	-26.6	-26.6	Y
-8.8	-6.4	-15.5	-5.0	-11.4	-9.8	-9.8	-8.8	8.0	-6.0	-5.6	-22.7	-31.9	-21.3	-27.7	-26.2	-26.2	Y
-8.7	-7.2	-16.1	-5.3	-11.8	-9.5	-9.5	-8.7	8.0	-6.0	-5.5	-23.5	-32.4	-21.7	-28.1	-25.8	-25.8	Y
-8.6	-8.2	-17.4	-5.9	-12.6	-9.4	-9.4	-8.6	8.0	-6.0	-5.4	-24.5	-33.7	-22.2	-28.9	-25.7	-25.7	Y
-8.5	-9.5	-19.3	-6.7	-13.9	-9.5	-9.5	-8.5	8.0	-6.0	-5.2	-25.9	-35.7	-23.0	-30.2	-25.9	-25.9	Y
-8.4	-11.1	-22.3	-7.7	-16.0	-9.8	-9.8	-8.4	8.0	-6.0	-5.1	-27.4	-38.6	-24.0	-32.3	-26.2	-26.2	Y
-8.3	-12.5	-24.0	-9.0	-19.3	-10.5	-10.5	-8.3	8.0	-6.0	-5.0	-28.8	-40.3	-25.3	-35.6	-26.8	-26.8	Y
-8.2	-12.8	-20.8	-10.4	-25.9	-11.5	-11.5	-8.2	8.0	-6.0	-4.8	-29.1	-37.1	-26.7	-42.2	-27.9	-27.9	Y
-8.1	-11.3	-16.4	-11.3	-27.6	-13.1	-13.1	-8.1	8.0	-6.0	-4.7	-27.6	-32.7	-27.7	-44.0	-29.4	-29.4	Y
-8	-8.9	-13.0	-10.9	-18.9	-15.3	-15.3	-8	8.0	-6.0	-4.6	-25.3	-29.3	-27.3	-35.2	-31.7	-31.7	Y
-7.9	-6.6	-10.3	-9.3	-13.9	-18.8	-18.8	-7.9	8.0	-6.0	-4.4	-23.0	-26.6	-25.6	-30.3	-35.1	-35.1	Y
-7.8	-4.6	-8.0	-7.1	-10.6	-22.6	-22.6	-7.8	8.0	-6.0	-4.3	-20.9	-24.3	-23.4	-26.9	-38.9	-38.9	Y
-7.7	-2.8	-6.2	-4.9	-8.1	-19.8	-19.8	-7.7	8.0	-6.0	-4.2	-19.2	-22.5	-21.3	-24.4	-36.2	-36.2	Y
-7.6	-1.4	-4.7	-3.1	-6.1	-15.0	-15.0	-7.6	8.0	-6.0	-4.0	-17.7	-21.0	-19.5	-22.4	-31.3	-31.3	Y

-7.5	-0.1	-3.4	-1.5	-4.4	-11.4	-11.4	-7.5	8.0	-6.0	-3.9	-16.4	-19.7	-17.8	-20.8	-27.7	-27.7	Y
-7.4	0.9	-2.3	-0.2	-3.1	-8.8	-8.8	-7.4	8.0	-6.0	-3.7	-15.4	-18.6	-16.5	-19.4	-25.1	-25.1	Y
-7.3	1.8	-1.4	1.0	-2.0	-6.7	-6.7	-7.3	8.0	-6.0	-3.6	-14.5	-17.8	-15.4	-18.3	-23.1	-23.1	Y
-7.2	2.6	-0.7	2.0	-1.0	-5.0	-5.0	-7.2	8.0	-6.0	-3.4	-13.7	-17.0	-14.3	-17.4	-21.3	-21.3	Y
-7.1	3.3	-0.1	2.9	-0.3	-3.7	-3.7	-7.1	8.0	-6.0	-3.3	-13.1	-16.4	-13.5	-16.6	-20.0	-20.0	Y
-7	3.8	0.3	3.6	0.4	-2.5	-2.5	-7	8.0	-6.0	-3.1	-12.5	-16.0	-12.7	-15.9	-18.8	-18.8	Y
-6.9	4.2	0.7	4.2	0.9	-1.6	-1.6	-6.9	8.0	-6.0	-3.0	-12.1	-15.7	-12.1	-15.5	-18.0	-18.0	Y
-6.8	4.5	0.8	4.7	1.2	-1.0	-1.0	-6.8	8.2	-5.8	-2.8	-11.9	-15.5	-11.7	-15.1	-17.3	-17.3	Y
-6.7	4.6	0.8	5.0	1.4	-0.5	-0.5	-6.7	8.3	-5.7	-2.7	-11.7	-15.5	-11.3	-15.0	-16.8	-16.8	Y
-6.6	4.6	0.7	5.2	1.4	-0.1	-0.1	-6.6	8.5	-5.5	-2.5	-11.7	-15.7	-11.1	-14.9	-16.5	-16.5	Y
-6.5	4.5	0.3	5.3	1.3	0.0	0.0	-6.5	8.7	-5.3	-2.3	-11.8	-16.0	-11.0	-15.1	-16.3	-16.3	Y
-6.4	4.3	-0.2	5.3	1.0	0.0	0.0	-6.4	8.8	-5.2	-2.2	-12.0	-16.6	-11.0	-15.4	-16.4	-16.4	Y
-6.3	3.9	-1.1	5.1	0.4	-0.3	-0.3	-6.3	9.0	-5.0	-2.0	-12.4	-17.4	-11.2	-15.9	-16.6	-16.6	Y
-6.2	3.3	-2.3	4.8	-0.4	-0.9	-0.9	-6.2	9.2	-4.8	-1.8	-13.1	-18.7	-11.5	-16.8	-17.2	-17.2	Y
-6.1	2.4	-4.1	4.3	-1.7	-1.6	-1.6	-6.1	9.4	-4.6	-1.6	-13.9	-20.4	-12.1	-18.0	-18.0	-18.0	Y
-6	1.3	-6.7	3.6	-3.3	-2.9	-2.9	-6	9.5	-4.5	-1.5	-15.1	-23.0	-12.8	-19.7	-19.3	-19.3	Y
-5.9	-0.3	-11.2	2.6	-6.0	-4.8	-4.8	-5.9	9.7	-4.3	-1.3	-16.7	-27.5	-13.8	-22.3	-21.1	-21.1	Y
-5.8	-2.6	-20.5	1.2	-10.1	-7.6	-7.6	-5.8	9.9	-4.1	-1.1	-18.9	-36.8	-15.2	-26.4	-24.0	-24.0	Y
-5.7	-6.0	-14.3	-0.6	-19.0	-13.1	-13.1	-5.7	10.1	-3.9	-0.9	-22.3	-30.6	-16.9	-35.3	-29.4	-29.4	Y
-5.6	-11.7	-7.0	-3.1	-13.4	-20.2	-20.2	-5.6	10.3	-3.7	-0.7	-28.1	-23.3	-19.5	-29.7	-36.5	-36.5	Y
-5.5	-12.9	-2.8	-6.7	-6.4	-10.6	-10.6	-5.5	10.5	-3.5	-0.5	-29.3	-19.1	-23.0	-22.7	-26.9	-26.9	Y
-5.4	-6.1	0.0	-8.5	-2.3	-5.1	-5.1	-5.4	10.7	-3.3	-0.3	-22.4	-16.3	-24.9	-18.6	-21.4	-21.4	Y
-5.3	-1.7	2.4	-5.4	0.7	-1.3	-1.3	-5.3	10.9	-3.1	-0.1	-18.0	-13.9	-21.7	-15.7	-17.7	-17.7	Y
-5.2	1.5	4.1	-1.4	2.8	1.2	1.2	-5.2	11.1	-2.9	0.1	-14.9	-12.2	-17.7	-13.6	-15.1	-15.1	Y
-5.1	3.7	5.6	1.6	4.6	3.3	3.3	-5.1	11.3	-2.7	0.3	-12.6	-10.7	-14.8	-11.7	-13.1	-13.1	Y
-5	5.6	7.0	4.0	6.1	5.1	5.1	-5	11.5	-2.5	0.5	-10.7	-9.4	-12.3	-10.2	-11.2	-11.2	Y
-4.9	7.2	8.1	6.0	7.5	6.6	6.6	-4.9	11.7	-2.3	0.7	-9.1	-8.2	-10.3	-8.8	-9.7	-9.7	Y
-4.8	8.5	9.1	7.6	8.6	7.9	7.9	-4.8	12.0	-2.0	1.0	-7.8	-7.3	-8.7	-7.8	-8.5	-8.5	Y
-4.7	9.6	9.8	8.9	9.5	8.9	8.9	-4.7	12.2	-1.8	1.2	-6.7	-6.5	-7.4	-6.9	-7.4	-7.4	Y
-4.6	10.5	10.5	10.0	10.3	9.8	9.8	-4.6	12.4	-1.6	1.4	-5.8	-5.9	-6.3	-6.1	-6.5	-6.5	Y
-4.5	11.3	11.1	11.0	10.9	10.6	10.6	-4.5	12.7	-1.3	1.7	-5.1	-5.3	-5.4	-5.4	-5.8	-5.8	Y
-4.4	11.9	11.5	11.7	11.5	11.2	11.2	-4.4	12.9	-1.1	1.9	-4.4	-4.8	-4.6	-4.9	-5.1	-5.1	Y
-4.3	12.4	11.8	12.4	11.9	11.8	11.8	-4.3	13.2	-0.8	2.2	-3.9	-4.5	-4.0	-4.4	-4.6	-4.6	Y
-4.2	12.8	12.1	12.9	12.2	12.2	12.2	-4.2	13.4	-0.6	2.4	-3.5	-4.3	-3.4	-4.1	-4.1	-4.1	Y
-4.1	13.1	12.2	13.3	12.4	12.5	12.5	-4.1	13.7	-0.3	2.7	-3.2	-4.2	-3.0	-3.9	-3.9	-3.9	Y

-4	13.3	12.2	13.6	12.5	12.7	12.7	-4	13.9	-0.1	2.9	-3.1	-4.2	-2.7	-3.8	-3.7	-3.7	Y
-3.9	13.3	12.0	13.8	12.5	12.7	12.7	-3.9	14.2	0.2	3.2	-3.0	-4.3	-2.6	-3.9	-3.6	-3.6	Y
-3.8	13.3	11.7	13.8	12.3	12.7	12.7	-3.8	14.5	0.5	3.5	-3.1	-4.6	-2.5	-4.0	-3.7	-3.7	Y
-3.7	13.1	11.3	13.7	12.0	12.4	12.4	-3.7	14.8	0.8	3.8	-3.3	-5.1	-2.6	-4.4	-3.9	-3.9	Y
-3.6	12.7	10.6	13.5	11.5	12.0	12.0	-3.6	15.1	1.1	4.1	-3.6	-5.8	-2.8	-4.9	-4.3	-4.3	Y
-3.5	12.2	9.6	13.1	10.7	11.4	11.4	-3.5	15.4	1.4	4.4	-4.2	-6.7	-3.2	-5.6	-4.9	-4.9	Y
-3.4	11.5	8.3	12.6	9.7	10.6	10.6	-3.4	15.7	1.7	4.7	-4.9	-8.0	-3.8	-6.6	-5.7	-5.7	Y
-3.3	10.4	6.5	11.8	8.3	9.4	9.4	-3.3	16.0	2.0	5.0	-5.9	-9.8	-4.5	-8.0	-6.9	-6.9	Y
-3.2	9.0	3.8	10.8	6.3	7.8	7.8	-3.2	16.4	2.4	5.4	-7.3	-12.6	-5.6	-10.1	-8.5	-8.5	Y
-3.1	7.1	-1.2	9.3	3.0	5.3	5.3	-3.1	16.7	2.7	5.7	-9.2	-17.6	-7.0	-13.3	-11.0	-11.0	Y
-3	4.1	-15.4	7.3	-3.3	1.3	1.3	-3	17.1	3.1	6.1	-12.2	-31.7	-9.1	-19.6	-15.1	-15.1	Y
-2.9	-1.0	-2.7	4.5	-15.6	-8.2	-8.2	-2.9	17.4	3.4		-17.3	-19.0	-11.9	-31.9	-24.5	-24.5	Y
-2.8	-14.1	4.0	0.3	0.0	-5.4	-5.4	-2.8	17.8	3.8		-30.4	-12.3	-16.0	-16.4	-21.8	-21.8	Y
-2.7	-0.6	8.2	-0.6	5.9	3.2	3.2	-2.7	18.2	4.2		-16.9	-8.2	-16.9	-10.5	-13.1	-13.1	Y
-2.6	5.6	11.2	4.0	9.5	8.0	8.0	-2.6	18.6	4.6		-10.8	-5.1	-12.3	-6.8	-8.3	-8.3	Y
-2.5	9.5	13.4	8.2	12.2	11.0	11.0	-2.5	19.1	5.1		-6.8	-3.0	-8.1	-4.2	-5.3	-5.3	Y
-2.4	12.3	15.3	11.3	14.3	13.4	13.4	-2.4	19.5	5.5		-4.0	-1.0	-5.0	-2.0	-2.9	-2.9	Y
-2.3	14.5	16.9	13.7	16.1	15.5	15.5	-2.3	20.0	6.0		-1.8	0.5	-2.6	-0.2	-0.9	-0.9	Y
-2.2	16.4	18.3	15.8	17.6	17.1	17.1	-2.2	20.4	6.4		0.1	1.9	-0.6	1.3	0.7	0.7	Y
-2.1	18.0	19.5	17.4	19.0	18.6	18.6	-2.1	20.9	6.9		1.7	3.2	1.1	2.6	2.2	2.2	Y
-2	19.4	20.7	18.9	20.3	19.9	19.9	-2	21.5	7.5		3.0	4.3	2.6	3.9	3.5	3.5	Y
-1.9	20.6	21.7	20.2	21.3	21.0	21.0	-1.9	22.0	8.0		4.3	5.3	3.9	4.9	4.6	4.6	Y
-1.8	21.7	22.5	21.4	22.2	22.0	22.0	-1.8	22.6	8.6		5.3	6.2	5.0	5.9	5.6	5.6	Y
-1.7	22.6	23.4	22.3	23.1	22.9	22.9	-1.7	23.2	9.2		6.2	7.0	6.0	6.7	6.5	6.5	Y
-1.6	23.4	24.1	23.2	23.8	23.7	23.7	-1.6	23.9	9.9		7.1	7.7	6.9	7.5	7.3	7.3	Y
-1.5	24.2	24.7	24.0	24.6	24.4	24.4	-1.5	24.6	10.6		7.8	8.4	7.7	8.2	8.1	8.1	Y
-1.4	24.8	25.3	24.7	25.1	25.1	25.1	-1.4				8.4	9.0	8.4	8.8	8.7	8.7	Y
-1.3	25.4	25.9	25.4	25.7	25.7	25.7	-1.3				9.1	9.6	9.1	9.4	9.4	9.4	Y
-1.2	26.0	26.4	26.0	26.3	26.2	26.2	-1.2				9.6	10.1	9.6	9.9	9.9	9.9	Y
-1.1	26.5	26.8	26.5	26.7	26.7	26.7	-1.1				10.1	10.5	10.2	10.4	10.4	10.4	Y
-1	26.9	27.2	27.0	27.1	27.2	27.2	-1				10.6	10.9	10.6	10.8	10.8	10.8	Y
-0.9	27.3	27.6	27.3	27.5	27.5	27.5	-0.9				10.9	11.2	11.0	11.2	11.2	11.2	Y
-0.8	27.6	27.9	27.7	27.9	27.9	27.9	-0.8				11.3	11.6	11.4	11.5	11.5	11.5	Y
-0.7	27.9	28.2	28.0	28.1	28.2	28.2	-0.7				11.6	11.8	11.7	11.8	11.8	11.8	Y
-0.6	28.2	28.4	28.3	28.4	28.4	28.4	-0.6				11.9	12.1	11.9	12.0	12.1	12.1	Y

-0.5	28.4	28.6	28.5	28.6	28.6	28.6	-0.5				12.1	12.3	12.2	12.2	12.3	12.3	Y
-0.4	28.6	28.8	28.7	28.7	28.8	28.8	-0.4				12.3	12.4	12.3	12.4	12.4	12.4	Y
-0.3	28.8	28.9	28.8	28.9	28.9	28.9	-0.3				12.4	12.6	12.5	12.6	12.6	12.6	Y
-0.2	28.9	29.0	28.9	29.0	29.0	29.0	-0.2				12.6	12.6	12.6	12.6	12.6	12.6	Y
-0.1	29.0	29.0	29.0	29.0	29.0	29.0	-0.1				12.6	12.7	12.6	12.7	12.7	12.7	Y
0	29.0	29.0	29.0	29.0	29.0	29.0	0				12.7	12.7	12.7	12.7	12.7	12.7	Y
0.1	29.0	29.0	29.0	29.0	28.9	28.9	0.1				12.7	12.6	12.6	12.6	12.6	12.6	Y
0.2	28.9	28.9	28.9	28.9	28.9	28.9	0.2				12.6	12.5	12.6	12.5	12.5	12.5	Y
0.3	28.8	28.8	28.8	28.7	28.7	28.7	0.3				12.5	12.4	12.5	12.4	12.4	12.4	Y
0.4	28.7	28.6	28.7	28.6	28.5	28.5	0.4				12.3	12.3	12.4	12.2	12.2	12.2	Y
0.5	28.5	28.4	28.5	28.3	28.3	28.3	0.5				12.1	12.1	12.2	12.0	12.0	12.0	Y
0.6	28.2	28.2	28.3	28.1	28.1	28.1	0.6				11.9	11.8	12.0	11.8	11.7	11.7	Y
0.7	28.0	27.9	28.0	27.8	27.8	27.8	0.7				11.6	11.5	11.7	11.5	11.4	11.4	Y
0.8	27.6	27.5	27.7	27.4	27.4	27.4	0.8				11.3	11.2	11.4	11.1	11.1	11.1	Y
0.9	27.3	27.2	27.3	27.1	27.0	27.0	0.9				10.9	10.8	11.0	10.7	10.7	10.7	Y
1	26.9	26.8	26.9	26.7	26.6	26.6	1				10.5	10.5	10.5	10.3	10.2	10.2	Y
1.1	26.4	26.3	26.4	26.2	26.0	26.0	1.1				10.1	10.0	10.0	9.8	9.7	9.7	Y
1.2	25.9	25.9	25.8	25.6	25.5	25.5	1.2				9.6	9.5	9.5	9.3	9.2	9.2	Y
1.3	25.4	25.3	25.2	25.0	24.9	24.9	1.3				9.0	9.0	8.9	8.7	8.5	8.5	Y
1.4	24.8	24.7	24.5	24.4	24.1	24.1	1.4				8.5	8.3	8.2	8.0	7.8	7.8	Y
1.5	24.1	24.0	23.7	23.6	23.4	23.4	1.5	24.6	10.6		7.8	7.7	7.4	7.3	7.1	7.1	Y
1.6	23.4	23.3	22.9	22.9	22.6	22.6	1.6	23.9	9.9		7.1	6.9	6.6	6.5	6.2	6.2	Y
1.7	22.6	22.5	22.0	22.0	21.6	21.6	1.7	23.2	9.2		6.2	6.2	5.6	5.7	5.3	5.3	Y
1.8	21.7	21.6	21.0	21.0	20.6	20.6	1.8	22.6	8.6		5.4	5.2	4.6	4.7	4.2	4.2	Y
1.9	20.7	20.6	19.8	19.9	19.4	19.4	1.9	22.0	8.0		4.3	4.2	3.5	3.6	3.0	3.0	Y
2	19.5	19.5	18.5	18.7	18.1	18.1	2	21.5	7.5		3.2	3.2	2.2	2.4	1.7	1.7	Y
2.1	18.2	18.2	17.0	17.3	16.5	16.5	2.1	20.9	6.9		1.8	1.9	0.6	0.9	0.2	0.2	Y
2.2	16.6	16.8	15.3	15.7	14.7	14.7	2.2	20.4	6.4		0.3	0.5	-1.1	-0.6	-1.6	-1.6	Y
2.3	14.8	15.3	13.1	13.8	12.6	12.6	2.3	20.0	6.0		-1.6	-1.1	-3.2	-2.5	-3.7	-3.7	Y
2.4	12.5	13.3	10.4	11.5	9.9	9.9	2.4	19.5	5.5		-3.8	-3.0	-5.9	-4.8	-6.5	-6.5	Y
2.5	9.6	11.1	6.8	8.6	6.3	6.3	2.5	19.1	5.1		-6.8	-5.3	-9.5	-7.7	-10.1	-10.1	Y
2.6	5.5	8.1	1.1	4.6	0.9	0.9	2.6	18.6	4.6		-10.8	-8.2	-15.3	-11.7	-15.5	-15.5	Y
2.7	-1.0	4.0	-17.1	-2.3	-14.1	-14.1	2.7	18.2	4.2		-17.3	-12.3	-33.5	-18.6	-30.5	-30.5	Y
2.8	-6.8	-3.1	-1.9	-16.3	-3.6	-3.6	2.8	17.8	3.8		-23.1	-19.5	-18.2	-32.6	-19.9	-19.9	Y
2.9	1.3	-16.7	4.3	-0.9	3.1	3.1	2.9	17.4	3.4		-15.1	-33.0	-12.0	-17.2	-13.2	-13.2	Y

3	5.7	-1.0	7.7	4.2	6.4	6.4	3	17.1	3.1	6.1	-10.6	-17.3	-8.7	-12.1	-10.0	-10.0	Y
3.1	8.4	3.9	9.8	7.0	8.5	8.5	3.1	16.7	2.7	5.7	-8.0	-12.4	-6.5	-9.4	-7.9	-7.9	Y
3.2	9.9	6.5	11.2	8.7	9.9	9.9	3.2	16.4	2.4	5.4	-6.4	-9.8	-5.2	-7.6	-6.4	-6.4	Y
3.3	11.2	8.4	12.3	10.1	10.9	10.9	3.3	16.0	2.0	5.0	-5.1	-8.0	-4.1	-6.2	-5.4	-5.4	Y
3.4	12.1	9.8	13.0	11.0	11.7	11.7	3.4	15.7	1.7	4.7	-4.3	-6.6	-3.3	-5.3	-4.7	-4.7	Y
3.5	12.7	10.7	13.6	11.7	12.2	12.2	3.5	15.4	1.4	4.4	-3.6	-5.7	-2.8	-4.6	-4.2	-4.2	Y
3.6	13.1	11.3	13.9	12.2	12.5	12.5	3.6	15.1	1.1	4.1	-3.2	-5.0	-2.4	-4.2	-3.8	-3.8	Y
3.7	13.4	11.9	14.1	12.5	12.7	12.7	3.7	14.8	0.8	3.8	-2.9	-4.5	-2.2	-3.8	-3.7	-3.7	Y
3.8	13.5	12.2	14.2	12.7	12.7	12.7	3.8	14.5	0.5	3.5	-2.8	-4.2	-2.2	-3.7	-3.6	-3.6	Y
3.9	13.5	12.3	14.1	12.7	12.6	12.6	3.9	14.2	0.2	3.2	-2.8	-4.0	-2.3	-3.6	-3.7	-3.7	Y
4	13.4	12.4	13.9	12.6	12.4	12.4	4	13.9	-0.1	2.9	-2.9	-4.0	-2.5	-3.7	-3.9	-3.9	Y
4.1	13.2	12.3	13.5	12.4	12.1	12.1	4.1	13.7	-0.3	2.7	-3.1	-4.0	-2.8	-3.9	-4.2	-4.2	Y
4.2	12.9	12.1	13.1	12.1	11.7	11.7	4.2	13.4	-0.6	2.4	-3.5	-4.2	-3.2	-4.2	-4.7	-4.7	Y
4.3	12.4	11.8	12.5	11.7	11.1	11.1	4.3	13.2	-0.8	2.2	-3.9	-4.5	-3.8	-4.6	-5.2	-5.2	Y
4.4	11.9	11.4	11.8	11.2	10.4	10.4	4.4	12.9	-1.1	1.9	-4.5	-5.0	-4.5	-5.2	-5.9	-5.9	Y
4.5	11.1	10.9	11.0	10.5	9.6	9.6	4.5	12.7	-1.3	1.7	-5.2	-5.5	-5.4	-5.8	-6.7	-6.7	Y
4.6	10.3	10.2	9.9	9.8	8.6	8.6	4.6	12.4	-1.6	1.4	-6.0	-6.1	-6.4	-6.6	-7.7	-7.7	Y
4.7	9.2	9.5	8.7	8.9	7.5	7.5	4.7	12.2	-1.8	1.2	-7.1	-6.9	-7.6	-7.4	-8.9	-8.9	Y
4.8	8.0	8.6	7.2	7.9	6.2	6.2	4.8	12.0	-2.0	1.0	-8.3	-7.7	-9.1	-8.5	-10.2	-10.2	Y
4.9	6.6	7.6	5.5	6.7	4.7	4.7	4.9	11.7	-2.3	0.7	-9.7	-8.7	-10.8	-9.6	-11.7	-11.7	Y
5	4.7	6.4	3.3	5.2	2.6	2.6	5	11.5	-2.5	0.5	-11.6	-9.9	-13.0	-11.1	-13.7	-13.7	Y
5.1	2.4	5.0	0.5	3.6	0.3	0.3	5.1	11.3	-2.7	0.3	-13.9	-11.4	-15.8	-12.8	-16.1	-16.1	Y
5.2	-0.8	3.3	-3.2	1.6	-2.9	-2.9	5.2	11.1	-2.9	0.1	-17.1	-13.0	-19.5	-14.8	-19.2	-19.2	Y
5.3	-5.4	1.3	-6.6	-1.0	-7.0	-7.0	5.3	10.9	-3.1	-0.1	-21.7	-15.0	-22.9	-17.3	-23.3	-23.3	Y
5.4	-12.4	-1.1	-5.9	-4.1	-12.0	-12.0	5.4	10.7	-3.3	-0.3	-28.7	-17.4	-22.2	-20.4	-28.3	-28.3	Y
5.5	-11.0	-4.2	-2.6	-8.9	-11.1	-11.1	5.5	10.5	-3.5	-0.5	-27.4	-20.5	-18.9	-25.2	-27.4	-27.4	Y
5.6	-5.0	-9.0	0.1	-18.6	-7.0	-7.0	5.6	10.3	-3.7	-0.7	-21.4	-25.4	-16.3	-34.9	-23.3	-23.3	Y
5.7	-1.5	-18.9	2.1	-18.2	-3.9	-3.9	5.7	10.1	-3.9	-0.9	-17.8	-35.2	-14.2	-34.5	-20.2	-20.2	Y
5.8	1.0	-18.1	3.7	-9.4	-1.8	-1.8	5.8	9.9	-4.1	-1.1	-15.3	-34.4	-12.7	-25.8	-18.1	-18.1	Y
5.9	2.6	-9.8	4.8	-6.0	-0.4	-0.4	5.9	9.7	-4.3	-1.3	-13.7	-26.2	-11.6	-22.3	-16.7	-16.7	Y
6	3.9	-6.0	5.6	-3.6	0.6	0.6	6	9.5	-4.5	-1.5	-12.5	-22.4	-10.7	-19.9	-15.7	-15.7	Y
6.1	4.7	-3.8	6.2	-2.2	1.3	1.3	6.1	9.4	-4.6	-1.6	-11.6	-20.2	-10.1	-18.5	-15.1	-15.1	Y
6.2	5.4	-2.3	6.6	-1.1	1.7	1.7	6.2	9.2	-4.8	-1.8	-11.0	-18.6	-9.7	-17.5	-14.6	-14.6	Y
6.3	5.8	-1.2	6.9	-0.4	2.0	2.0	6.3	9.0	-5.0	-2.0	-10.5	-17.5	-9.4	-16.7	-14.4	-14.4	Y
6.4	6.2	-0.4	7.0	0.0	2.1	2.1	6.4	8.8	-5.2	-2.2	-10.2	-16.8	-9.3	-16.3	-14.3	-14.3	Y

6.5	6.3	0.0	7.0	0.3	2.0	2.0	6.5	8.7	-5.3	-2.3	-10.0	-16.3	-9.3	-16.1	-14.4	-14.4	Y
6.6	6.4	0.3	6.9	0.4	1.8	1.8	6.6	8.5	-5.5	-2.5	-10.0	-16.0	-9.5	-16.0	-14.6	-14.6	Y
6.7	6.3	0.4	6.7	0.3	1.4	1.4	6.7	8.3	-5.7	-2.7	-10.1	-15.9	-9.7	-16.1	-14.9	-14.9	Y
6.8	6.1	0.4	6.3	0.1	0.9	0.9	6.8	8.2	-5.8	-2.8	-10.2	-15.9	-10.0	-16.3	-15.4	-15.4	Y
6.9	5.8	0.2	5.8	-0.3	0.3	0.3	6.9	8.0	-6.0	-3.0	-10.5	-16.1	-10.5	-16.6	-16.0	-16.0	Y
7	5.4	-0.1	5.2	-0.8	-0.5	-0.5	7	7.9	-6.1	-3.1	-11.0	-16.4	-11.1	-17.1	-16.8	-16.8	Y
7.1	4.8	-0.5	4.5	-1.4	-1.4	-1.4	7.1	8.0	-6.0	-3.3	-11.5	-16.9	-11.8	-17.8	-17.7	-17.7	Y
7.2	4.1	-1.1	3.6	-2.2	-2.5	-2.5	7.2	8.0	-6.0	-3.4	-12.2	-17.4	-12.7	-18.6	-18.8	-18.8	Y
7.3	3.4	-1.8	2.6	-3.1	-3.7	-3.7	7.3	8.0	-6.0	-3.6	-13.0	-18.1	-13.7	-19.5	-20.0	-20.0	Y
7.4	2.4	-2.6	1.4	-4.2	-5.1	-5.1	7.4	8.0	-6.0	-3.7	-13.9	-18.9	-14.9	-20.5	-21.4	-21.4	Y
7.5	1.3	-3.5	0.0	-5.5	-6.7	-6.7	7.5	8.0	-6.0	-3.9	-15.0	-19.9	-16.3	-21.8	-23.1	-23.1	Y
7.6	0.1	-4.5	-1.6	-6.8	-8.5	-8.5	7.6	8.0	-6.0	-4.0	-16.2	-20.9	-18.0	-23.2	-24.9	-24.9	Y
7.7	-1.3	-5.7	-3.6	-8.4	-10.8	-10.8	7.7	8.0	-6.0	-4.2	-17.7	-22.0	-19.9	-24.7	-27.1	-27.1	Y
7.8	-3.0	-7.1	-5.8	-10.2	-13.3	-13.3	7.8	8.0	-6.0	-4.3	-19.3	-23.4	-22.1	-26.5	-29.7	-29.7	Y
7.9	-4.8	-8.5	-8.0	-12.0	-16.4	-16.4	7.9	8.0	-6.0	-4.4	-21.2	-24.8	-24.4	-28.3	-32.7	-32.7	Y
8	-6.8	-10.1	-9.6	-13.7	-20.2	-20.2	8	8.0	-6.0	-4.6	-23.1	-26.4	-25.9	-30.1	-36.5	-36.5	Y
8.1	-8.2	-11.6	-9.4	-14.8	-24.7	-24.7	8.1	8.0	-6.0	-4.7	-24.5	-28.0	-25.7	-31.1	-41.1	-41.1	Y
8.2	-8.7	-13.1	-7.9	-14.9	-29.0	-29.0	8.2	8.0	-6.0	-4.8	-25.1	-29.4	-24.2	-31.3	-45.3	-45.3	Y
8.3	-8.1	-14.3	-6.4	-14.4	-29.1	-29.1	8.3	8.0	-6.0	-5.0	-24.5	-30.6	-22.7	-30.8	-45.5	-45.5	Y
8.4	-7.0	-14.9	-4.9	-13.7	-26.8	-26.8	8.4	8.0	-6.0	-5.1	-23.4	-31.2	-21.3	-30.0	-43.1	-43.1	Y
8.5	-5.8	-15.2	-3.8	-12.8	-24.6	-24.6	8.5	8.0	-6.0	-5.2	-22.1	-31.5	-20.2	-29.2	-40.9	-40.9	Y
8.6	-4.8	-15.1	-3.0	-12.2	-22.5	-22.5	8.6	8.0	-6.0	-5.4	-21.1	-31.4	-19.4	-28.5	-38.8	-38.8	Y
8.7	-3.9	-14.8	-2.3	-11.6	-20.4	-20.4	8.7	8.0	-6.0	-5.5	-20.2	-31.1	-18.7	-28.0	-36.7	-36.7	Y
8.8	-3.2	-14.5	-1.9	-11.2	-18.1	-18.1	8.8	8.0	-6.0	-5.6	-19.6	-30.8	-18.3	-27.5	-34.4	-34.4	Y
8.9	-2.8	-14.1	-1.7	-10.9	-15.9	-15.9	8.9	8.0	-6.0	-5.7	-19.1	-30.5	-18.0	-27.2	-32.2	-32.2	Y
9	-2.5	-13.9	-1.6	-10.6	-13.9	-13.9	9	8.0	-6.0	-5.9	-18.8	-30.2	-17.9	-27.0	-30.3	-30.3	Y
9.1	-2.4	-13.6	-1.6	-10.4	-12.1	-12.1	9.1	8.0	-6.0	-6.0	-18.7	-29.9	-17.9	-26.8	-28.4	-28.4	Y
9.2	-2.3	-13.1	-1.8	-10.2	-10.6	-10.6	9.2	8.0	-6.0	-6.1	-18.7	-29.5	-18.1	-26.6	-26.9	-26.9	Y
9.3	-2.5	-12.7	-2.1	-10.0	-9.2	-9.2	9.3	7.8	-6.2	-6.2	-18.8	-29.0	-18.4	-26.3	-25.6	-25.6	Y
9.4	-2.7	-12.1	-2.5	-9.7	-8.1	-8.1	9.4	7.7	-6.3	-6.3	-19.0	-28.5	-18.8	-26.0	-24.5	-24.5	Y
9.5	-3.0	-11.5	-3.0	-9.5	-7.2	-7.2	9.5	7.6	-6.4	-6.4	-19.4	-27.8	-19.4	-25.8	-23.5	-23.5	Y
9.6	-3.5	-10.9	-3.7	-9.2	-6.4	-6.4	9.6	7.4	-6.6	-6.6	-19.9	-27.2	-20.1	-25.5	-22.7	-22.7	Y
9.7	-4.2	-10.2	-4.5	-8.9	-5.8	-5.8	9.7	7.3	-6.7	-6.7	-20.5	-26.6	-20.8	-25.2	-22.1	-22.1	Y
9.8	-4.9	-9.6	-5.4	-8.7	-5.3	-5.3	9.8	7.2	-6.8	-6.8	-21.2	-26.0	-21.8	-25.0	-21.7	-21.7	Y
9.9	-5.7	-9.1	-6.5	-8.5	-5.0	-5.0	9.9	7.1	-6.9	-6.9	-22.1	-25.4	-22.9	-24.8	-21.3	-21.3	Y

10	-6.7	-8.5	-7.8	-8.3	-4.8	-4.8	10	7.0	-7.0	-7.0	-23.1	-24.9	-24.1	-24.7	-21.2	-21.2	Y
15.0	-12.6	-8.6	-11.1	-7.7	-5.4	-5.4	15	2.6	-11.4	-11.4	-28.9	-25.0	-27.4	-24.1	-21.7	-21.7	Y
20.0	-9.2	-22.0	-7.2	-16.7	-11.8	-11.8	20	-0.5	-14.5	-14.5	-25.5	-38.3	-23.5	-33.0	-28.2	-28.2	Y
25.0	-15.4	-28.9	-16.4	-21.1	-16.1	-16.1	25	-2.9	-16.9	-16.9	-31.8	-45.3	-32.7	-37.4	-32.4	-32.4	Y
30.0	-23.4	-23.5	-18.2	-54.1	-19.9	-19.9	30	-4.9	-18.9	-18.9	-39.7	-39.8	-34.5	-70.4	-36.2	-36.2	Y
35.0	-19.8	-20.3	-17.6	-16.6	-11.0	-11.0	35	-6.6	-20.6	-20.6	-36.1	-36.6	-33.9	-32.9	-27.3	-27.3	Y
40.0	-16.2	-13.6	-17.9	-12.5	-18.0	-18.0	40	-8.1	-22.1	-22.1	-32.6	-30.0	-34.2	-28.8	-34.3	-34.3	Y
45.0	-23.1	-11.3	-22.0	-11.5	-17.3	-17.3	45	-9.3	-23.3	-23.3	-39.4	-27.6	-38.3	-27.8	-33.6	-33.6	Y
50.0	-14.3	-16.2	-20.8	-19.5	-20.3	-20.3	50	-10.0	-24.0	-24.0	-30.7	-32.6	-37.1	-35.8	-36.6	-36.6	Y
55.0	-15.1	-12.4	-20.5	-16.2	-29.4	-29.4	55	-10.0	-24.0	-24.0	-31.4	-28.8	-36.8	-32.5	-45.7	-45.7	Y
60.0	-24.8	-27.6	-20.3	-17.4	-25.6	-25.6	60	-10.0	-24.0	-24.0	-41.1	-43.9	-36.6	-33.7	-41.9	-41.9	Y
65.0	-18.8	-20.5	-28.0	-8.2	-17.3	-17.3	65	-10.0	-24.0	-24.0	-35.1	-36.9	-44.3	-24.6	-33.7	-33.7	Y
70.0	-20.6	-21.6	-19.4	-16.9	-16.6	-16.6	70	-10.0	-24.0	-24.0	-36.9	-37.9	-35.7	-33.3	-32.9	-32.9	Y
75.0	-36.6	-18.7	-21.9	-12.2	-21.6	-21.6	75	-10.0	-24.0	-24.0	-52.9	-35.0	-38.2	-28.6	-37.9	-37.9	Y
80.0	-28.2	-24.6	-19.7	-15.9	-18.5	-18.5	80	-10.0	-24.0	-24.0	-44.6	-41.0	-36.0	-32.2	-34.8	-34.8	Y
85.0	-20.7	-22.6	-19.2	-16.8	-16.5	-16.5	85	-10.0	-24.0	-24.0	-37.0	-38.9	-35.6	-33.2	-32.9	-32.9	Y
90.0	-25.2	-23.1	-19.2	-19.6	-19.7	-19.7	90	0.0	-14.0	-14.0	-41.6	-39.4	-35.5	-35.9	-36.0	-36.0	Y
95.0	-16.7	-38.9	-22.6	-21.5	-23.8	-23.8	95	0.0	-14.0	-14.0	-33.0	-55.2	-38.9	-37.8	-40.1	-40.1	Y
100.0	-24.9	-29.0	-21.5	-19.0	-19.1	-19.1	100	0.0	-14.0	-14.0	-41.3	-45.3	-37.8	-35.3	-35.5	-35.5	Y
105.0	-28.9	-24.9	-19.0	-14.4	-18.1	-18.1	105	0.0	-14.0	-14.0	-45.3	-41.2	-35.3	-30.7	-34.5	-34.5	Y
110.0	-21.4	-47.8	-19.3	-18.6	-19.9	-19.9	110	0.0	-14.0	-14.0	-37.7	-64.1	-35.6	-34.9	-36.2	-36.2	Y
115.0	-34.1	-32.4	-27.4	-14.7	-16.5	-16.5	115	0.0	-14.0	-14.0	-50.5	-48.7	-43.8	-31.1	-32.8	-32.8	Y
120.0	-32.3	-26.9	-20.7	-17.6	-22.4	-22.4	120	0.0	-14.0	-14.0	-48.6	-43.2	-37.0	-34.0	-38.8	-38.8	Y
125.0	-27.2	-23.2	-25.1	-22.1	-22.0	-22.0	125	0.0	-14.0	-14.0	-43.5	-39.5	-41.4	-38.4	-38.3	-38.3	Y
130.0	-29.4	-38.4	-24.0	-22.3	-31.3	-31.3	130	0.0	-14.0	-14.0	-45.8	-54.7	-40.3	-38.6	-47.6	-47.6	Y
135.0	-30.2	-24.3	-18.9	-22.1	-21.2	-21.2	135	0.0	-14.0	-14.0	-46.5	-40.6	-35.2	-38.4	-37.5	-37.5	Y
140.0	-31.3	-24.2	-28.8	-24.0	-31.1	-31.1	140	0.0	-14.0	-14.0	-47.6	-40.5	-45.1	-40.4	-47.4	-47.4	Y
145.0	-31.8	-24.1	-34.8	-27.6	-40.3	-40.3	145	0.0	-14.0	-14.0	-48.1	-40.4	-51.1	-44.0	-56.6	-56.6	Y
150.0	-26.2	-32.7	-32.2	-35.3	-39.3	-39.3	150	0.0	-14.0	-14.0	-42.6	-49.0	-48.5	-51.7	-55.7	-55.7	Y
155.0	-34.1	-25.3	-28.0	-28.5	-28.2	-28.2	155	0.0	-14.0	-14.0	-50.5	-41.6	-44.4	-44.9	-44.5	-44.5	Y
160.0	-29.0	-38.5	-35.7	-29.6	-51.8	-51.8	160	0.0	-14.0	-14.0	-45.3	-54.8	-52.1	-46.0	-68.1	-68.1	Y
165.0	-28.1	-30.0	-48.2	-29.2	-32.0	-32.0	165	0.0	-14.0	-14.0	-44.4	-46.3	-64.5	-45.5	-48.4	-48.4	Y
170.0	-32.9	-29.2	-37.6	-28.8	-32.9	-32.9	170	0.0	-14.0	-14.0	-49.2	-45.5	-53.9	-45.1	-49.3	-49.3	Y
175.0	-30.6	-34.9	-29.3	-36.9	-33.4	-33.4	175	0.0	-14.0	-14.0	-46.9	-51.2	-45.6	-53.2	-49.7	-49.7	Y
180.0	25.9	27.1	26.4	28.0	26.2	26.2	180	0.0	-14.0	-14.0	9.6	10.8	10.1	11.7	9.9	9.9	N

APPENDIX D: Antenna Gain and EIRP Tables

Co Pol Azimuth	Antenna Gain (dBi)									Off-Axis EIRP (dBW/4 kHz)							
Off-Axis Angle	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Off-Axis Angle	FCC §25.209	FCC §25.209(a)(2) + §25.212 EIRP GSO Mask, Skew = 55 deg	FCC §25.209(a)(4) + §25.212 EIRP non-GSO Mask, Skew = 55 deg	14 GHz E	14 GHz H	14.25 GHz E	14.25 GHz H	14.5 GHz E	14.5 GHz H	Meets Mask
-180	-30.8	-32.9	-24.3	-30.8	-30.8	-29.4	-180	0.0	-14.0	-14.0	-47.2	-49.2	-40.6	-47.2	-47.2	-45.7	Y
-175	-33.3	-30.1	-36.2	-34.8	-33.3	-30.1	-175	0.0	-14.0	-14.0	-49.6	-46.4	-52.6	-51.2	-49.6	-46.5	Y
-170	-34.6	-43.0	-28.5	-52.1	-34.6	-35.9	-170	0.0	-14.0	-14.0	-50.9	-59.3	-44.8	-68.4	-50.9	-52.3	Y
-165	-28.4	-27.7	-27.1	-29.4	-28.4	-33.5	-165	0.0	-14.0	-14.0	-44.7	-44.1	-43.4	-45.8	-44.7	-49.9	Y
-160	-30.1	-24.1	-26.0	-24.9	-30.1	-32.5	-160	0.0	-14.0	-14.0	-46.4	-40.5	-42.3	-41.2	-46.4	-48.9	Y
-155	-18.5	-23.3	-22.0	-27.8	-18.5	-31.7	-155	0.0	-14.0	-14.0	-34.8	-39.6	-38.3	-44.2	-34.8	-48.1	Y
-150	-29.6	-26.1	-25.1	-30.3	-29.6	-25.0	-150	0.0	-14.0	-14.0	-45.9	-42.4	-41.4	-46.7	-45.9	-41.3	Y
-145	-27.3	-24.1	-24.7	-21.2	-27.3	-30.9	-145	0.0	-14.0	-14.0	-43.7	-40.4	-41.0	-37.6	-43.7	-47.3	Y
-140	-45.6	-26.8	-44.3	-22.6	-45.6	-31.5	-140	0.0	-14.0	-14.0	-61.9	-43.2	-60.7	-38.9	-61.9	-47.8	Y
-135	-20.3	-22.9	-23.0	-24.6	-20.3	-31.6	-135	0.0	-14.0	-14.0	-36.6	-39.2	-39.4	-40.9	-36.6	-47.9	Y
-130	-23.2	-31.8	-26.2	-23.8	-23.2	-33.3	-130	0.0	-14.0	-14.0	-39.5	-48.2	-42.6	-40.1	-39.5	-49.6	Y
-125	-30.6	-33.2	-30.9	-21.9	-30.6	-28.4	-125	0.0	-14.0	-14.0	-46.9	-49.6	-47.2	-38.3	-46.9	-44.7	Y
-120	-18.7	-29.7	-19.1	-20.7	-18.7	-33.4	-120	0.0	-14.0	-14.0	-35.1	-46.1	-35.5	-37.1	-35.1	-49.7	Y
-115	-29.5	-33.7	-18.4	-24.5	-29.5	-22.3	-115	0.0	-14.0	-14.0	-45.8	-50.1	-34.7	-40.9	-45.8	-38.7	Y
-110	-21.0	-17.8	-16.9	-28.5	-21.0	-22.7	-110	0.0	-14.0	-14.0	-37.4	-34.2	-33.2	-44.8	-37.4	-39.0	Y
-105	-30.0	-19.8	-11.7	-17.8	-30.0	-21.4	-105	0.0	-14.0	-14.0	-46.4	-36.1	-28.0	-34.1	-46.4	-37.7	Y
-100	-17.3	-14.0	-18.7	-18.7	-17.3	-17.1	-100	0.0	-14.0	-14.0	-33.7	-30.3	-35.1	-35.1	-33.7	-33.4	Y
-95	-21.4	-28.0	-19.5	-20.1	-21.4	-17.2	-95	0.0	-14.0	-14.0	-37.7	-44.3	-35.9	-36.4	-37.7	-33.6	Y
-90	-16.9	-22.7	-18.4	-24.7	-16.9	-17.8	-90	0.0	-14.0	-14.0	-33.2	-39.0	-34.7	-41.0	-33.2	-34.1	Y
-85	-16.5	-16.0	-21.6	-22.1	-16.5	-27.1	-85	-10.0	-24.0	-24.0	-32.9	-32.3	-38.0	-38.5	-32.9	-43.4	Y
-80	-14.1	-20.0	-20.1	-22.5	-14.1	-19.8	-80	-10.0	-24.0	-24.0	-30.4	-36.3	-36.4	-38.9	-30.4	-36.2	Y
-75	-27.8	-21.0	-25.9	-26.1	-27.8	-21.9	-75	-10.0	-24.0	-24.0	-44.1	-37.4	-42.3	-42.4	-44.1	-38.2	Y
-70	-17.8	-17.3	-26.9	-17.2	-17.8	-21.0	-70	-10.0	-24.0	-24.0	-34.2	-33.6	-43.3	-33.5	-34.2	-37.4	Y
-65	-11.8	-15.7	-17.7	-21.6	-11.8	-15.7	-65	-10.0	-24.0	-24.0	-28.1	-32.0	-34.0	-38.0	-28.1	-32.0	Y
-60	-14.2	-18.8	-17.4	-13.9	-14.2	-19.1	-60	-10.0	-24.0	-24.0	-30.6	-35.1	-33.7	-30.2	-30.6	-35.5	Y
-55	-24.9	-14.0	-24.6	-9.6	-24.9	-25.9	-55	-10.0	-24.0	-24.0	-41.3	-30.3	-41.0	-26.0	-41.3	-42.3	Y
-50	-25.2	-14.3	-20.3	-8.5	-25.2	-19.7	-50	-10.0	-24.0	-24.0	-41.5	-30.6	-36.6	-24.8	-41.5	-36.0	Y

-48	-20.6	-35.2	-16.8	-12.5	-20.6	-14.7	-48	-10.0	-24.0	-24.0	-36.9	-51.6	-33.1	-28.8	-36.9	-31.0	Y
-45	-23.1	-34.6	-11.5	-22.1	-23.1	-19.3	-45	-9.3	-23.3	-23.3	-39.4	-51.0	-27.8	-38.5	-39.4	-35.7	Y
-40	-12.7	-17.0	-22.9	-18.1	-12.7	-37.7	-40	-8.1	-22.1	-22.1	-29.0	-33.3	-39.3	-34.5	-29.0	-54.1	Y
-35	-12.5	-12.7	-17.9	-15.6	-12.5	-11.0	-35	-6.6	-20.6	-20.6	-28.9	-29.0	-34.3	-32.0	-28.9	-27.3	Y
-30	-39.5	-15.7	-23.1	-18.8	-39.5	-16.2	-30	-4.9	-18.9	-18.9	-55.8	-32.0	-39.5	-35.1	-55.8	-32.5	Y
-25	-10.5	-18.9	-18.1	-15.8	-10.5	-29.0	-25	-2.9	-16.9	-16.9	-26.8	-35.3	-34.4	-32.1	-26.8	-45.4	Y
-20	-9.7	-9.4	-5.1	-9.4	-9.7	-13.2	-20	-0.5	-14.5	-14.5	-26.0	-25.7	-21.4	-25.7	-26.0	-29.6	Y
-15	-4.7	-5.6	-4.1	-6.2	-4.7	-2.5	-15	2.6	-11.4	-11.4	-21.0	-21.9	-20.4	-22.6	-21.0	-18.8	Y
-10	-14.5	-6.4	-26.4	-5.4	-14.5	-6.5	-10	7.0	-7.0	-7.0	-30.8	-22.8	-42.7	-21.8	-30.8	-22.8	Y
-9.9	-16.3	-6.1	-32.1	-5.1	-16.3	-5.6	-9.9	7.1	-6.9	-6.9	-32.6	-22.4	-48.5	-21.4	-32.6	-21.9	Y
-9.8	-18.4	-5.9	-33.5	-4.9	-18.4	-4.9	-9.8	7.2	-6.8	-6.8	-34.8	-22.2	-49.8	-21.3	-34.8	-21.2	Y
-9.7	-21.3	-5.9	-28.9	-4.8	-21.3	-4.4	-9.7	7.3	-6.7	-6.7	-37.6	-22.2	-45.2	-21.2	-37.6	-20.7	Y
-9.6	-24.4	-6.0	-25.6	-4.9	-24.4	-4.0	-9.6	7.4	-6.6	-6.6	-40.8	-22.3	-42.0	-21.2	-40.8	-20.3	Y
-9.5	-27.9	-6.2	-23.7	-5.1	-27.9	-3.7	-9.5	7.6	-6.4	-6.4	-44.2	-22.6	-40.0	-21.4	-44.2	-20.1	Y
-9.4	-28.6	-6.7	-22.2	-5.4	-28.6	-3.6	-9.4	7.7	-6.3	-6.3	-44.9	-23.0	-38.5	-21.7	-44.9	-20.0	Y
-9.3	-25.7	-7.3	-20.8	-5.8	-25.7	-3.6	-9.3	7.8	-6.2	-6.2	-42.1	-23.7	-37.2	-22.2	-42.1	-20.0	Y
-9.2	-22.3	-8.2	-19.6	-6.5	-22.3	-3.8	-9.2	8.0	-6.0	-6.1	-38.6	-24.5	-35.9	-22.8	-38.6	-20.1	Y
-9.1	-19.6	-9.2	-18.1	-7.2	-19.6	-4.0	-9.1	8.0	-6.0	-6.0	-36.0	-25.6	-34.4	-23.6	-36.0	-20.4	Y
-9	-17.3	-10.7	-16.4	-8.2	-17.3	-4.4	-9	8.0	-6.0	-5.9	-33.6	-27.0	-32.8	-24.5	-33.6	-20.8	Y
-8.9	-15.3	-12.5	-14.9	-9.4	-15.3	-5.0	-8.9	8.0	-6.0	-5.7	-31.6	-28.8	-31.2	-25.7	-31.6	-21.3	Y
-8.8	-13.7	-14.9	-13.2	-10.8	-13.7	-5.7	-8.8	8.0	-6.0	-5.6	-30.0	-31.2	-29.6	-27.2	-30.0	-22.1	Y
-8.7	-12.0	-18.5	-11.7	-12.7	-12.0	-6.6	-8.7	8.0	-6.0	-5.5	-28.3	-34.9	-28.1	-29.0	-28.3	-23.0	Y
-8.6	-10.5	-24.2	-10.2	-14.7	-10.5	-7.8	-8.6	8.0	-6.0	-5.4	-26.9	-40.5	-26.6	-31.1	-26.9	-24.2	Y
-8.5	-9.3	-26.9	-8.9	-16.7	-9.3	-9.3	-8.5	8.0	-6.0	-5.2	-25.6	-43.2	-25.2	-33.0	-25.6	-25.6	Y
-8.4	-8.1	-20.9	-7.7	-17.6	-8.1	-11.0	-8.4	8.0	-6.0	-5.1	-24.4	-37.2	-24.1	-33.9	-24.4	-27.3	Y
-8.3	-7.0	-16.7	-6.7	-16.8	-7.0	-13.3	-8.3	8.0	-6.0	-5.0	-23.4	-33.0	-23.0	-33.2	-23.4	-29.6	Y
-8.2	-6.1	-13.9	-5.7	-15.0	-6.1	-16.0	-8.2	8.0	-6.0	-4.8	-22.4	-30.2	-22.1	-31.4	-22.4	-32.4	Y
-8.1	-5.2	-11.9	-4.9	-13.3	-5.2	-19.3	-8.1	8.0	-6.0	-4.7	-21.6	-28.2	-21.3	-29.6	-21.6	-35.7	Y
-8	-4.5	-10.5	-4.3	-11.8	-4.5	-21.3	-8	8.0	-6.0	-4.6	-20.9	-26.9	-20.6	-28.1	-20.9	-37.6	Y
-7.9	-3.9	-9.5	-3.7	-10.7	-3.9	-19.6	-7.9	8.0	-6.0	-4.4	-20.3	-25.8	-20.0	-27.0	-20.3	-36.0	Y
-7.8	-3.4	-8.7	-3.2	-9.8	-3.4	-17.2	-7.8	8.0	-6.0	-4.3	-19.7	-25.1	-19.6	-26.2	-19.7	-33.5	Y
-7.7	-3.0	-8.3	-2.9	-9.3	-3.0	-15.1	-7.7	8.0	-6.0	-4.2	-19.3	-24.6	-19.2	-25.6	-19.3	-31.4	Y
-7.6	-2.7	-8.1	-2.7	-9.1	-2.7	-13.7	-7.6	8.0	-6.0	-4.0	-19.0	-24.4	-19.0	-25.4	-19.0	-30.1	Y
-7.5	-2.6	-8.2	-2.6	-9.1	-2.6	-12.9	-7.5	8.0	-6.0	-3.9	-18.9	-24.5	-18.9	-25.4	-18.9	-29.2	Y
-7.4	-2.5	-8.5	-2.7	-9.5	-2.5	-12.5	-7.4	8.0	-6.0	-3.7	-18.9	-24.9	-19.0	-25.8	-18.9	-28.8	Y

-7.3	-2.6	-9.2	-2.9	-10.2	-2.6	-12.5	-7.3	8.0	-6.0	-3.6	-19.0	-25.5	-19.2	-26.5	-19.0	-28.8	Y
-7.2	-3.0	-10.1	-3.3	-11.5	-3.0	-13.0	-7.2	8.0	-6.0	-3.4	-19.3	-26.5	-19.6	-27.9	-19.3	-29.4	Y
-7.1	-3.4	-11.4	-3.9	-13.7	-3.4	-14.1	-7.1	8.0	-6.0	-3.3	-19.8	-27.7	-20.2	-30.0	-19.8	-30.4	Y
-7	-4.2	-12.7	-4.8	-17.4	-4.2	-15.7	-7	8.0	-6.0	-3.1	-20.5	-29.0	-21.1	-33.8	-20.5	-32.0	Y
-6.9	-5.2	-13.1	-6.0	-23.9	-5.2	-17.1	-6.9	8.0	-6.0	-3.0	-21.5	-29.4	-22.3	-40.3	-21.5	-33.4	Y
-6.8	-6.6	-11.9	-7.4	-21.4	-6.6	-16.5	-6.8	8.2	-5.8	-2.8	-22.9	-28.2	-23.8	-37.7	-22.9	-32.8	Y
-6.7	-8.3	-9.7	-9.1	-14.4	-8.3	-13.7	-6.7	8.3	-5.7	-2.7	-24.6	-26.0	-25.4	-30.8	-24.6	-30.0	Y
-6.6	-10.4	-7.1	-10.6	-9.8	-10.4	-10.4	-6.6	8.5	-5.5	-2.5	-26.8	-23.4	-26.9	-26.1	-26.8	-26.7	Y
-6.5	-11.6	-4.8	-10.3	-6.6	-11.6	-7.4	-6.5	8.7	-5.3	-2.3	-27.9	-21.1	-26.6	-22.9	-27.9	-23.7	Y
-6.4	-10.3	-2.8	-8.2	-4.1	-10.3	-5.0	-6.4	8.8	-5.2	-2.2	-26.6	-19.2	-24.6	-20.4	-26.6	-21.3	Y
-6.3	-7.0	-1.0	-5.3	-2.0	-7.0	-2.8	-6.3	9.0	-5.0	-2.0	-23.3	-17.3	-21.6	-18.3	-23.3	-19.1	Y
-6.2	-4.2	0.5	-2.8	-0.2	-4.2	-0.9	-6.2	9.2	-4.8	-1.8	-20.5	-15.8	-19.1	-16.5	-20.5	-17.3	Y
-6.1	-1.7	1.9	-0.7	1.3	-1.7	0.6	-6.1	9.4	-4.6	-1.6	-18.1	-14.4	-17.0	-15.0	-18.1	-15.7	Y
-6	0.3	3.1	1.2	2.6	0.3	2.1	-6	9.5	-4.5	-1.5	-16.0	-13.2	-15.2	-13.7	-16.0	-14.2	Y
-5.9	2.0	4.2	2.7	3.9	2.0	3.4	-5.9	9.7	-4.3	-1.3	-14.4	-12.1	-13.6	-12.5	-14.4	-13.0	Y
-5.8	3.5	5.1	4.1	4.9	3.5	4.5	-5.8	9.9	-4.1	-1.1	-12.8	-11.2	-12.2	-11.5	-12.8	-11.8	Y
-5.7	4.9	6.0	5.3	5.8	4.9	5.5	-5.7	10.1	-3.9	-0.9	-11.5	-10.3	-11.0	-10.5	-11.5	-10.8	Y
-5.6	6.1	6.7	6.4	6.6	6.1	6.4	-5.6	10.3	-3.7	-0.7	-10.3	-9.6	-9.9	-9.7	-10.3	-9.9	Y
-5.5	7.1	7.4	7.4	7.4	7.1	7.3	-5.5	10.5	-3.5	-0.5	-9.2	-8.9	-8.9	-9.0	-9.2	-9.1	Y
-5.4	8.1	8.0	8.2	8.0	8.1	8.0	-5.4	10.7	-3.3	-0.3	-8.3	-8.4	-8.1	-8.4	-8.3	-8.4	Y
-5.3	8.9	8.5	9.0	8.5	8.9	8.6	-5.3	10.9	-3.1	-0.1	-7.4	-7.9	-7.3	-7.8	-7.4	-7.8	Y
-5.2	9.6	8.8	9.6	8.9	9.6	9.1	-5.2	11.1	-2.9	0.1	-6.7	-7.5	-6.7	-7.4	-6.7	-7.2	Y
-5.1	10.2	9.1	10.2	9.3	10.2	9.5	-5.1	11.3	-2.7	0.3	-6.1	-7.2	-6.2	-7.0	-6.1	-6.8	Y
-5	10.8	9.4	10.7	9.6	10.8	9.9	-5	11.5	-2.5	0.5	-5.5	-7.0	-5.7	-6.8	-5.5	-6.4	Y
-4.9	11.3	9.5	11.0	9.8	11.3	10.2	-4.9	11.7	-2.3	0.7	-5.1	-6.8	-5.3	-6.6	-5.1	-6.1	Y
-4.8	11.7	9.5	11.3	9.9	11.7	10.4	-4.8	12.0	-2.0	1.0	-4.7	-6.8	-5.0	-6.5	-4.7	-6.0	Y
-4.7	11.9	9.5	11.6	9.9	11.9	10.5	-4.7	12.2	-1.8	1.2	-4.4	-6.9	-4.8	-6.5	-4.4	-5.9	Y
-4.6	12.1	9.3	11.7	9.8	12.1	10.4	-4.6	12.4	-1.6	1.4	-4.2	-7.1	-4.6	-6.6	-4.2	-5.9	Y
-4.5	12.3	9.0	11.7	9.5	12.3	10.3	-4.5	12.7	-1.3	1.7	-4.1	-7.4	-4.6	-6.8	-4.1	-6.0	Y
-4.4	12.3	8.5	11.6	9.2	12.3	10.1	-4.4	12.9	-1.1	1.9	-4.0	-7.8	-4.7	-7.2	-4.0	-6.2	Y
-4.3	12.3	7.8	11.5	8.6	12.3	9.7	-4.3	13.2	-0.8	2.2	-4.1	-8.5	-4.9	-7.7	-4.1	-6.6	Y
-4.2	12.1	6.9	11.2	7.9	12.1	9.1	-4.2	13.4	-0.6	2.4	-4.3	-9.4	-5.2	-8.5	-4.3	-7.2	Y
-4.1	11.7	5.6	10.7	6.9	11.7	8.4	-4.1	13.7	-0.3	2.7	-4.6	-10.7	-5.6	-9.5	-4.6	-7.9	Y
-4	11.3	3.9	10.2	5.5	11.3	7.4	-4	13.9	-0.1	2.9	-5.0	-12.4	-6.2	-10.9	-5.0	-9.0	Y
-3.9	10.7	1.4	9.4	3.5	10.7	6.0	-3.9	14.2	0.2	3.2	-5.6	-15.0	-7.0	-12.8	-5.6	-10.3	Y

-3.8	9.9	-2.7	8.3	0.6	9.9	4.0	-3.8	14.5	0.5	3.5	-6.5	-19.0	-8.0	-15.7	-6.5	-12.3	Y
-3.7	8.8	-11.0	7.0	-4.9	8.8	1.0	-3.7	14.8	0.8	3.8	-7.6	-27.3	-9.4	-21.3	-7.6	-15.3	Y
-3.6	7.2	-7.0	5.0	-33.8	7.2	-4.5	-3.6	15.1	1.1	4.1	-9.1	-23.4	-11.3	-50.1	-9.1	-20.9	Y
-3.5	5.1	0.1	2.4	-4.7	5.1	-21.6	-3.5	15.4	1.4	4.4	-11.3	-16.2	-13.9	-21.1	-11.3	-37.9	Y
-3.4	1.8	4.5	-0.6	1.8	1.8	-4.2	-3.4	15.7	1.7	4.7	-14.5	-11.9	-16.9	-14.6	-14.5	-20.5	Y
-3.3	-4.6	7.5	-2.0	5.7	-4.6	2.5	-3.3	16.0	2.0	5.0	-21.0	-8.8	-18.3	-10.6	-21.0	-13.9	Y
-3.2	-17.1	10.0	1.2	8.7	-17.1	6.3	-3.2	16.4	2.4	5.4	-33.4	-6.4	-15.1	-7.7	-33.4	-10.1	Y
-3.1	-0.6	12.0	5.2	10.9	-0.6	9.2	-3.1	16.7	2.7	5.7	-17.0	-4.3	-11.1	-5.4	-17.0	-7.1	Y
-3	5.0	13.7	8.3	12.8	5.0	11.4	-3	17.1	3.1	6.1	-11.3	-2.7	-8.0	-3.5	-11.3	-4.9	Y
-2.9	8.4	15.2	10.7	14.5	8.4	13.3	-2.9	17.4	3.4		-7.9	-1.2	-5.6	-1.9	-7.9	-3.0	Y
-2.8	11.2	16.5	12.9	15.9	11.2	15.0	-2.8	17.8	3.8		-5.1	0.1	-3.4	-0.5	-5.1	-1.4	Y
-2.7	13.4	17.6	14.7	17.1	13.4	16.3	-2.7	18.2	4.2		-2.9	1.3	-1.7	0.8	-2.9	0.0	Y
-2.6	15.1	18.7	16.2	18.3	15.1	17.6	-2.6	18.6	4.6		-1.2	2.4	-0.2	1.9	-1.2	1.3	Y
-2.5	16.7	19.7	17.5	19.3	16.7	18.7	-2.5	19.1	5.1		0.4	3.3	1.2	3.0	0.4	2.4	Y
-2.4	18.0	20.6	18.8	20.3	18.0	19.8	-2.4	19.5	5.5		1.7	4.3	2.4	3.9	1.7	3.4	Y
-2.3	19.1	21.4	19.8	21.1	19.1	20.7	-2.3	20.0	6.0		2.8	5.0	3.5	4.8	2.8	4.3	Y
-2.2	20.2	22.2	20.8	21.9	20.2	21.5	-2.2	20.4	6.4		3.9	5.8	4.5	5.6	3.9	5.2	Y
-2.1	21.2	22.9	21.7	22.6	21.2	22.3	-2.1	20.9	6.9		4.8	6.5	5.4	6.3	4.8	6.0	Y
-2	22.0	23.5	22.5	23.3	22.0	23.0	-2	21.5	7.5		5.7	7.2	6.2	7.0	5.7	6.7	Y
-1.9	22.9	24.1	23.3	24.0	22.9	23.7	-1.9	22.0	8.0		6.5	7.8	7.0	7.6	6.5	7.4	Y
-1.8	23.5	24.6	23.9	24.5	23.5	24.3	-1.8	22.6	8.6		7.2	8.3	7.6	8.2	7.2	8.0	Y
-1.7	24.2	25.2	24.5	25.0	24.2	24.8	-1.7	23.2	9.2		7.8	8.8	8.2	8.7	7.8	8.5	Y
-1.6	24.8	25.6	25.1	25.5	24.8	25.4	-1.6	23.9	9.9		8.5	9.3	8.8	9.2	8.5	9.0	Y
-1.5	25.3	26.1	25.6	26.0	25.3	25.8	-1.5	24.6	10.6		9.0	9.7	9.3	9.6	9.0	9.5	Y
-1.4	25.8	26.5	26.0	26.4	25.8	26.3	-1.4				9.5	10.1	9.7	10.0	9.5	9.9	Y
-1.3	26.3	26.8	26.5	26.8	26.3	26.7	-1.3				10.0	10.5	10.1	10.4	10.0	10.4	Y
-1.2	26.7	27.2	26.8	27.1	26.7	27.1	-1.2				10.4	10.8	10.5	10.8	10.4	10.7	Y
-1.1	27.1	27.5	27.2	27.4	27.1	27.4	-1.1				10.8	11.1	10.9	11.1	10.8	11.1	Y
-1	27.5	27.7	27.5	27.7	27.5	27.7	-1				11.1	11.4	11.2	11.4	11.1	11.3	Y
-0.9	27.8	28.0	27.8	28.0	27.8	27.9	-0.9				11.5	11.7	11.4	11.6	11.5	11.6	Y
-0.8	28.1	28.2	28.0	28.2	28.1	28.2	-0.8				11.7	11.9	11.7	11.8	11.7	11.8	Y
-0.7	28.3	28.4	28.2	28.4	28.3	28.4	-0.7				12.0	12.1	11.9	12.0	12.0	12.0	Y
-0.6	28.5	28.6	28.4	28.5	28.5	28.6	-0.6				12.2	12.3	12.1	12.2	12.2	12.2	Y
-0.5	28.7	28.7	28.6	28.7	28.7	28.7	-0.5				12.3	12.4	12.2	12.3	12.3	12.4	Y
-0.4	28.8	28.8	28.7	28.8	28.8	28.8	-0.4				12.5	12.5	12.4	12.5	12.5	12.5	Y

-0.3	28.9	28.9	28.8	28.9	28.9	28.9	-0.3				12.6	12.6	12.5	12.6	12.6	12.6	Y
-0.2	29.0	29.0	28.9	29.0	29.0	29.0	-0.2				12.6	12.6	12.6	12.6	12.6	12.6	Y
-0.1	29.0	29.0	29.0	29.0	29.0	29.0	-0.1				12.7	12.7	12.6	12.7	12.7	12.7	Y
0	29.0	29.0	29.0	29.0	29.0	29.0	0				12.7	12.7	12.7	12.7	12.7	12.7	Y
0.1	29.0	29.0	29.0	29.0	29.0	28.9	0.1				12.6	12.6	12.7	12.6	12.6	12.6	Y
0.2	28.9	28.9	29.0	28.9	28.9	28.9	0.2				12.6	12.6	12.6	12.6	12.6	12.6	Y
0.3	28.8	28.8	28.9	28.8	28.8	28.8	0.3				12.5	12.5	12.6	12.5	12.5	12.5	Y
0.4	28.7	28.7	28.8	28.7	28.7	28.7	0.4				12.4	12.4	12.5	12.4	12.4	12.3	Y
0.5	28.6	28.6	28.7	28.5	28.6	28.5	0.5				12.2	12.3	12.4	12.2	12.2	12.2	Y
0.6	28.4	28.4	28.5	28.4	28.4	28.4	0.6				12.0	12.1	12.2	12.0	12.0	12.0	Y
0.7	28.2	28.2	28.4	28.2	28.2	28.1	0.7				11.9	11.9	12.0	11.8	11.9	11.8	Y
0.8	27.9	28.0	28.1	27.9	27.9	27.9	0.8				11.6	11.7	11.8	11.6	11.6	11.6	Y
0.9	27.7	27.7	27.8	27.7	27.7	27.6	0.9				11.4	11.4	11.5	11.3	11.4	11.3	Y
1	27.4	27.5	27.5	27.4	27.4	27.3	1				11.1	11.1	11.2	11.1	11.1	11.0	Y
1.1	27.1	27.2	27.2	27.1	27.1	27.0	1.1				10.7	10.8	10.9	10.8	10.7	10.7	Y
1.2	26.7	26.9	26.8	26.7	26.7	26.7	1.2				10.4	10.5	10.5	10.4	10.4	10.3	Y
1.3	26.3	26.5	26.4	26.4	26.3	26.2	1.3				10.0	10.2	10.1	10.0	10.0	9.9	Y
1.4	25.8	26.1	25.9	25.9	25.8	25.8	1.4				9.5	9.8	9.6	9.6	9.5	9.5	Y
1.5	25.3	25.7	25.4	25.5	25.3	25.3	1.5	24.6	10.6		9.0	9.3	9.1	9.1	9.0	9.0	Y
1.6	24.8	25.2	24.9	25.0	24.8	24.8	1.6	23.9	9.9		8.4	8.9	8.6	8.6	8.4	8.5	Y
1.7	24.1	24.7	24.3	24.5	24.1	24.2	1.7	23.2	9.2		7.8	8.4	8.0	8.1	7.8	7.9	Y
1.8	23.5	24.2	23.7	23.9	23.5	23.7	1.8	22.6	8.6		7.1	7.8	7.3	7.5	7.1	7.3	Y
1.9	22.7	23.6	23.0	23.3	22.7	23.0	1.9	22.0	8.0		6.4	7.2	6.6	6.9	6.4	6.6	Y
2	21.9	23.0	22.2	22.6	21.9	22.3	2	21.5	7.5		5.6	6.6	5.9	6.2	5.6	5.9	Y
2.1	21.0	22.3	21.4	21.9	21.0	21.5	2.1	20.9	6.9		4.7	5.9	5.1	5.5	4.7	5.2	Y
2.2	20.0	21.6	20.5	21.1	20.0	20.6	2.2	20.4	6.4		3.7	5.2	4.2	4.7	3.7	4.3	Y
2.3	18.9	20.7	19.5	20.2	18.9	19.7	2.3	20.0	6.0		2.6	4.4	3.2	3.9	2.6	3.4	Y
2.4	17.7	19.9	18.4	19.3	17.7	18.7	2.4	19.5	5.5		1.4	3.5	2.1	3.0	1.4	2.4	Y
2.5	16.3	19.0	17.2	18.3	16.3	17.6	2.5	19.1	5.1		0.0	2.6	0.8	2.0	0.0	1.3	Y
2.6	14.9	18.0	15.9	17.2	14.9	16.4	2.6	18.6	4.6		-1.4	1.6	-0.5	0.9	-1.4	0.1	Y
2.7	13.1	16.8	14.3	16.0	13.1	15.0	2.7	18.2	4.2		-3.2	0.5	-2.0	-0.3	-3.2	-1.3	Y
2.8	11.0	15.6	12.4	14.6	11.0	13.5	2.8	17.8	3.8		-5.3	-0.8	-3.9	-1.8	-5.3	-2.9	Y
2.9	8.5	14.2	10.2	13.0	8.5	11.6	2.9	17.4	3.4		-7.8	-2.2	-6.1	-3.3	-7.8	-4.8	Y
3	5.1	12.5	7.4	11.1	5.1	9.4	3	17.1	3.1	6.1	-11.3	-3.8	-9.0	-5.2	-11.3	-6.9	Y
3.1	0.1	10.6	3.5	9.0	0.1	6.7	3.1	16.7	2.7	5.7	-16.3	-5.7	-12.8	-7.3	-16.3	-9.7	Y

3.2	-9.9	8.5	-2.1	6.4	-9.9	3.1	3.2	16.4	2.4	5.4	-26.2	-7.8	-18.4	-9.9	-26.2	-13.3	Y
3.3	-8.6	5.9	-8.4	3.0	-8.6	-2.0	3.3	16.0	2.0	5.0	-24.9	-10.4	-24.7	-13.3	-24.9	-18.4	Y
3.4	-0.3	2.4	-2.4	-1.6	-0.3	-10.8	3.4	15.7	1.7	4.7	-16.7	-13.9	-18.7	-17.9	-16.7	-27.1	Y
3.5	3.7	-3.4	2.5	-9.3	3.7	-5.6	3.5	15.4	1.4	4.4	-12.6	-19.7	-13.8	-25.6	-12.6	-21.9	Y
3.6	6.0	-15.2	5.3	-6.6	6.0	-0.4	3.6	15.1	1.1	4.1	-10.3	-31.5	-11.1	-22.9	-10.3	-16.7	Y
3.7	7.8	-7.3	7.4	-0.9	7.8	3.1	3.7	14.8	0.8	3.8	-8.5	-23.7	-9.0	-17.2	-8.5	-13.2	Y
3.8	9.0	-1.0	8.8	2.5	9.0	5.2	3.8	14.5	0.5	3.5	-7.3	-17.3	-7.6	-13.9	-7.3	-11.1	Y
3.9	10.0	2.4	9.8	4.6	10.0	6.7	3.9	14.2	0.2	3.2	-6.4	-13.9	-6.5	-11.7	-6.4	-9.6	Y
4	10.6	4.5	10.6	6.1	10.6	7.8	4	13.9	-0.1	2.9	-5.7	-11.9	-5.7	-10.3	-5.7	-8.6	Y
4.1	11.1	6.0	11.2	7.2	11.1	8.6	4.1	13.7	-0.3	2.7	-5.2	-10.3	-5.1	-9.1	-5.2	-7.8	Y
4.2	11.5	7.1	11.6	8.0	11.5	9.1	4.2	13.4	-0.6	2.4	-4.9	-9.3	-4.7	-8.3	-4.9	-7.2	Y
4.3	11.6	7.9	11.9	8.6	11.6	9.5	4.3	13.2	-0.8	2.2	-4.7	-8.5	-4.4	-7.7	-4.7	-6.8	Y
4.4	11.7	8.5	12.1	9.0	11.7	9.8	4.4	12.9	-1.1	1.9	-4.6	-7.8	-4.2	-7.3	-4.6	-6.5	Y
4.5	11.7	8.9	12.2	9.3	11.7	9.9	4.5	12.7	-1.3	1.7	-4.6	-7.4	-4.2	-7.0	-4.6	-6.4	Y
4.6	11.6	9.2	12.1	9.5	11.6	9.9	4.6	12.4	-1.6	1.4	-4.7	-7.2	-4.2	-6.9	-4.7	-6.4	Y
4.7	11.4	9.3	12.0	9.5	11.4	9.9	4.7	12.2	-1.8	1.2	-5.0	-7.0	-4.3	-6.8	-5.0	-6.5	Y
4.8	11.1	9.4	11.8	9.5	11.1	9.7	4.8	12.0	-2.0	1.0	-5.3	-7.0	-4.5	-6.9	-5.3	-6.7	Y
4.9	10.7	9.3	11.5	9.3	10.7	9.4	4.9	11.7	-2.3	0.7	-5.6	-7.0	-4.8	-7.0	-5.6	-6.9	Y
5	10.2	9.2	11.1	9.1	10.2	9.0	5	11.5	-2.5	0.5	-6.1	-7.2	-5.2	-7.2	-6.1	-7.3	Y
5.1	9.7	8.9	10.6	8.8	9.7	8.6	5.1	11.3	-2.7	0.3	-6.6	-7.4	-5.7	-7.6	-6.6	-7.7	Y
5.2	9.1	8.6	10.1	8.4	9.1	8.0	5.2	11.1	-2.9	0.1	-7.3	-7.7	-6.3	-7.9	-7.3	-8.3	Y
5.3	8.3	8.2	9.4	7.9	8.3	7.4	5.3	10.9	-3.1	-0.1	-8.0	-8.1	-6.9	-8.4	-8.0	-8.9	Y
5.4	7.5	7.7	8.7	7.4	7.5	6.7	5.4	10.7	-3.3	-0.3	-8.8	-8.6	-7.6	-8.9	-8.8	-9.6	Y
5.5	6.6	7.2	7.9	6.8	6.6	5.9	5.5	10.5	-3.5	-0.5	-9.7	-9.2	-8.5	-9.6	-9.7	-10.4	Y
5.6	5.6	6.5	6.9	6.1	5.6	5.0	5.6	10.3	-3.7	-0.7	-10.7	-9.8	-9.4	-10.3	-10.7	-11.3	Y
5.7	4.5	5.8	5.8	5.3	4.5	4.0	5.7	10.1	-3.9	-0.9	-11.8	-10.5	-10.5	-11.1	-11.8	-12.4	Y
5.8	3.2	5.0	4.6	4.3	3.2	2.8	5.8	9.9	-4.1	-1.1	-13.1	-11.4	-11.8	-12.0	-13.1	-13.5	Y
5.9	1.8	4.1	3.2	3.4	1.8	1.5	5.9	9.7	-4.3	-1.3	-14.6	-12.3	-13.2	-13.0	-14.6	-14.8	Y
6	0.1	3.0	1.5	2.3	0.1	0.0	6	9.5	-4.5	-1.5	-16.2	-13.3	-14.8	-14.1	-16.2	-16.3	Y
6.1	-1.6	1.9	-0.3	1.1	-1.6	-1.6	6.1	9.4	-4.6	-1.6	-18.0	-14.4	-16.6	-15.3	-18.0	-17.9	Y
6.2	-3.6	0.7	-2.4	-0.2	-3.6	-3.5	6.2	9.2	-4.8	-1.8	-19.9	-15.7	-18.7	-16.6	-19.9	-19.8	Y
6.3	-5.6	-0.8	-4.8	-1.7	-5.6	-5.6	6.3	9.0	-5.0	-2.0	-21.9	-17.1	-21.1	-18.0	-21.9	-22.0	Y
6.4	-7.2	-2.4	-7.0	-3.4	-7.2	-8.3	6.4	8.8	-5.2	-2.2	-23.6	-18.8	-23.4	-19.7	-23.6	-24.7	Y
6.5	-8.0	-4.2	-8.1	-5.2	-8.0	-11.3	6.5	8.7	-5.3	-2.3	-24.3	-20.5	-24.4	-21.5	-24.3	-27.6	Y
6.6	-7.7	-6.3	-7.4	-7.2	-7.7	-14.6	6.6	8.5	-5.5	-2.5	-24.1	-22.6	-23.8	-23.6	-24.1	-31.0	Y

6.7	-6.9	-8.8	-6.0	-9.5	-6.9	-17.3	6.7	8.3	-5.7	-2.7	-23.3	-25.1	-22.3	-25.8	-23.3	-33.6	Y
6.8	-6.0	-11.9	-4.5	-12.0	-6.0	-17.1	6.8	8.2	-5.8	-2.8	-22.3	-28.3	-20.8	-28.3	-22.3	-33.4	Y
6.9	-5.2	-15.9	-3.2	-14.2	-5.2	-15.5	6.9	8.0	-6.0	-3.0	-21.5	-32.3	-19.5	-30.6	-21.5	-31.8	Y
7	-4.5	-22.1	-2.3	-15.9	-4.5	-14.0	7	7.9	-6.1	-3.1	-20.8	-38.4	-18.6	-32.2	-20.8	-30.3	Y
7.1	-4.0	-39.9	-1.5	-16.2	-4.0	-13.0	7.1	8.0	-6.0	-3.3	-20.3	-56.3	-17.9	-32.6	-20.3	-29.3	Y
7.2	-3.7	-27.4	-1.0	-15.6	-3.7	-12.4	7.2	8.0	-6.0	-3.4	-20.0	-43.7	-17.3	-32.0	-20.0	-28.8	Y
7.3	-3.6	-21.8	-0.7	-14.7	-3.6	-12.4	7.3	8.0	-6.0	-3.6	-19.9	-38.1	-17.0	-31.1	-19.9	-28.7	Y
7.4	-3.6	-19.1	-0.5	-13.9	-3.6	-12.6	7.4	8.0	-6.0	-3.7	-19.9	-35.4	-16.8	-30.3	-19.9	-28.9	Y
7.5	-3.7	-18.1	-0.5	-13.2	-3.7	-13.1	7.5	8.0	-6.0	-3.9	-20.1	-34.4	-16.8	-29.5	-20.1	-29.4	Y
7.6	-4.0	-17.6	-0.6	-12.6	-4.0	-13.7	7.6	8.0	-6.0	-4.0	-20.3	-34.0	-16.9	-28.9	-20.3	-30.1	Y
7.7	-4.4	-17.8	-0.8	-12.0	-4.4	-14.4	7.7	8.0	-6.0	-4.2	-20.7	-34.2	-17.2	-28.3	-20.7	-30.7	Y
7.8	-4.9	-18.6	-1.2	-11.2	-4.9	-14.8	7.8	8.0	-6.0	-4.3	-21.3	-34.9	-17.5	-27.6	-21.3	-31.1	Y
7.9	-5.6	-19.3	-1.7	-10.5	-5.6	-14.6	7.9	8.0	-6.0	-4.4	-21.9	-35.7	-18.0	-26.8	-21.9	-30.9	Y
8	-6.4	-19.7	-2.3	-9.6	-6.4	-13.6	8	8.0	-6.0	-4.6	-22.7	-36.1	-18.6	-25.9	-22.7	-30.0	Y
8.1	-7.3	-18.9	-3.0	-8.7	-7.3	-12.2	8.1	8.0	-6.0	-4.7	-23.6	-35.3	-19.3	-25.0	-23.6	-28.6	Y
8.2	-8.4	-17.2	-3.8	-7.8	-8.4	-10.9	8.2	8.0	-6.0	-4.8	-24.7	-33.6	-20.2	-24.1	-24.7	-27.2	Y
8.3	-9.6	-15.2	-4.8	-6.9	-9.6	-9.6	8.3	8.0	-6.0	-5.0	-25.9	-31.5	-21.1	-23.3	-25.9	-25.9	Y
8.4	-10.9	-13.3	-5.9	-6.1	-10.9	-8.4	8.4	8.0	-6.0	-5.1	-27.2	-29.6	-22.3	-22.5	-27.2	-24.7	Y
8.5	-12.4	-11.6	-7.2	-5.4	-12.4	-7.4	8.5	8.0	-6.0	-5.2	-28.8	-27.9	-23.6	-21.7	-28.8	-23.7	Y
8.6	-14.0	-10.1	-8.6	-4.7	-14.0	-6.6	8.6	8.0	-6.0	-5.4	-30.3	-26.4	-24.9	-21.1	-30.3	-22.9	Y
8.7	-15.8	-8.8	-10.3	-4.2	-15.8	-5.9	8.7	8.0	-6.0	-5.5	-32.1	-25.2	-26.7	-20.5	-32.1	-22.2	Y
8.8	-17.3	-7.7	-12.2	-3.6	-17.3	-5.3	8.8	8.0	-6.0	-5.6	-33.6	-24.0	-28.5	-20.0	-33.6	-21.6	Y
8.9	-18.3	-6.9	-13.8	-3.2	-18.3	-4.9	8.9	8.0	-6.0	-5.7	-34.7	-23.2	-30.2	-19.5	-34.7	-21.3	Y
9	-18.6	-6.1	-15.2	-2.9	-18.6	-4.7	9	8.0	-6.0	-5.9	-34.9	-22.5	-31.5	-19.2	-34.9	-21.0	Y
9.1	-18.5	-5.6	-16.0	-2.6	-18.5	-4.5	9.1	8.0	-6.0	-6.0	-34.8	-21.9	-32.3	-19.0	-34.8	-20.8	Y
9.2	-18.1	-5.1	-15.9	-2.5	-18.1	-4.5	9.2	8.0	-6.0	-6.1	-34.5	-21.5	-32.3	-18.8	-34.5	-20.8	Y
9.3	-18.0	-4.8	-15.5	-2.4	-18.0	-4.6	9.3	7.8	-6.2	-6.2	-34.4	-21.2	-31.8	-18.7	-34.4	-21.0	Y
9.4	-17.9	-4.7	-15.0	-2.4	-17.9	-4.8	9.4	7.7	-6.3	-6.3	-34.3	-21.0	-31.3	-18.8	-34.3	-21.2	Y
9.5	-18.1	-4.6	-14.6	-2.5	-18.1	-5.3	9.5	7.6	-6.4	-6.4	-34.5	-21.0	-30.9	-18.9	-34.5	-21.6	Y
9.6	-18.6	-4.7	-14.4	-2.8	-18.6	-5.9	9.6	7.4	-6.6	-6.6	-34.9	-21.0	-30.7	-19.1	-34.9	-22.2	Y
9.7	-19.4	-4.9	-14.5	-3.1	-19.4	-6.7	9.7	7.3	-6.7	-6.7	-35.8	-21.2	-30.8	-19.4	-35.8	-23.0	Y
9.8	-20.5	-5.2	-14.9	-3.5	-20.5	-7.6	9.8	7.2	-6.8	-6.8	-36.8	-21.5	-31.2	-19.8	-36.8	-23.9	Y
9.9	-21.8	-5.7	-15.6	-4.0	-21.8	-8.8	9.9	7.1	-6.9	-6.9	-38.2	-22.0	-32.0	-20.3	-38.2	-25.2	Y
10	-22.7	-6.3	-16.5	-4.7	-22.7	-10.4	10	7.0	-7.0	-7.0	-39.0	-22.6	-32.8	-21.0	-39.0	-26.7	Y
15.0	-3.7	-8.7	-4.9	-8.6	-3.7	-4.7	15	2.6	-11.4	-11.4	-20.1	-25.1	-21.2	-24.9	-20.1	-21.0	Y

20.0	-8.1	-12.4	-6.2	-11.8	-8.1	-12.8	20	-0.5	-14.5	-14.5	-24.4	-28.7	-22.6	-28.1	-24.4	-29.1	Y
25.0	-12.9	-18.5	-20.1	-16.6	-12.9	-35.2	25	-2.9	-16.9	-16.9	-29.3	-34.9	-36.5	-32.9	-29.3	-51.5	Y
30.0	-17.8	-15.5	-17.9	-30.1	-17.8	-14.7	30	-4.9	-18.9	-18.9	-34.2	-31.9	-34.2	-46.4	-34.2	-31.0	Y
35.0	-12.7	-9.4	-19.0	-14.3	-12.7	-14.6	35	-6.6	-20.6	-20.6	-29.0	-25.8	-35.3	-30.7	-29.0	-31.0	Y
40.0	-13.7	-13.5	-18.1	-16.3	-13.7	-21.3	40	-8.1	-22.1	-22.1	-30.1	-29.8	-34.4	-32.6	-30.1	-37.6	Y
45.0	-15.7	-21.8	-16.4	-18.5	-15.7	-24.8	45	-9.3	-23.3	-23.3	-32.1	-38.1	-32.7	-34.8	-32.1	-41.1	Y
50.0	-23.1	-19.1	-22.6	-11.0	-23.1	-22.8	50	-10.0	-24.0	-24.0	-39.4	-35.4	-38.9	-27.4	-39.4	-39.2	Y
55.0	-16.0	-13.4	-28.4	-7.7	-16.0	-16.2	55	-10.0	-24.0	-24.0	-32.3	-29.8	-44.8	-24.1	-32.3	-32.6	Y
60.0	-21.5	-18.0	-11.9	-12.6	-21.5	-14.1	60	-10.0	-24.0	-24.0	-37.8	-34.3	-28.3	-28.9	-37.8	-30.4	Y
65.0	-11.2	-17.3	-11.8	-18.9	-11.2	-26.8	65	-10.0	-24.0	-24.0	-27.5	-33.6	-28.1	-35.3	-27.5	-43.1	Y
70.0	-22.4	-18.4	-23.0	-16.6	-22.4	-26.4	70	-10.0	-24.0	-24.0	-38.8	-34.7	-39.3	-33.0	-38.8	-42.7	Y
75.0	-22.5	-22.5	-21.8	-26.5	-22.5	-20.3	75	-10.0	-24.0	-24.0	-38.8	-38.9	-38.1	-42.9	-38.8	-36.6	Y
80.0	-13.1	-22.4	-16.4	-20.2	-13.1	-23.8	80	-10.0	-24.0	-24.0	-29.4	-38.7	-32.7	-36.6	-29.4	-40.1	Y
85.0	-14.8	-18.9	-21.5	-18.9	-14.8	-17.5	85	-10.0	-24.0	-24.0	-31.2	-35.2	-37.9	-35.3	-31.2	-33.8	Y
90.0	-13.8	-21.8	-17.0	-20.7	-13.8	-24.2	90	0.0	-14.0	-14.0	-30.1	-38.2	-33.3	-37.1	-30.1	-40.5	Y
95.0	-18.3	-24.0	-25.4	-17.9	-18.3	-21.5	95	0.0	-14.0	-14.0	-34.7	-40.3	-41.7	-34.3	-34.7	-37.8	Y
100.0	-19.2	-15.2	-22.0	-15.1	-19.2	-23.7	100	0.0	-14.0	-14.0	-35.6	-31.5	-38.3	-31.5	-35.6	-40.0	Y
105.0	-31.5	-17.3	-13.3	-15.9	-31.5	-22.3	105	0.0	-14.0	-14.0	-47.8	-33.6	-29.6	-32.2	-47.8	-38.7	Y
110.0	-28.2	-16.8	-18.8	-22.9	-28.2	-23.6	110	0.0	-14.0	-14.0	-44.5	-33.1	-35.1	-39.3	-44.5	-40.0	Y
115.0	-29.1	-28.8	-24.9	-22.1	-29.1	-23.0	115	0.0	-14.0	-14.0	-45.5	-45.2	-41.3	-38.5	-45.5	-39.4	Y
120.0	-23.2	-30.1	-19.2	-22.0	-23.2	-37.2	120	0.0	-14.0	-14.0	-39.5	-46.5	-35.5	-38.4	-39.5	-53.6	Y
125.0	-26.7	-35.0	-30.9	-21.5	-26.7	-28.7	125	0.0	-14.0	-14.0	-43.0	-51.4	-47.2	-37.9	-43.0	-45.1	Y
130.0	-36.1	-25.7	-26.3	-29.6	-36.1	-21.9	130	0.0	-14.0	-14.0	-52.4	-42.0	-42.7	-45.9	-52.4	-38.2	Y
135.0	-31.2	-20.9	-24.1	-32.5	-31.2	-25.7	135	0.0	-14.0	-14.0	-47.5	-37.2	-40.4	-48.8	-47.5	-42.1	Y
140.0	-28.5	-32.7	-32.7	-30.1	-28.5	-27.1	140	0.0	-14.0	-14.0	-44.8	-49.1	-49.1	-46.5	-44.8	-43.5	Y
145.0	-23.6	-29.4	-33.4	-26.6	-23.6	-48.4	145	0.0	-14.0	-14.0	-39.9	-45.8	-49.8	-42.9	-39.9	-64.7	Y
150.0	-33.2	-27.0	-25.8	-26.8	-33.2	-27.6	150	0.0	-14.0	-14.0	-49.5	-43.3	-42.1	-43.1	-49.5	-43.9	Y
155.0	-19.2	-22.5	-32.1	-26.0	-19.2	-37.1	155	0.0	-14.0	-14.0	-35.5	-38.9	-48.4	-42.4	-35.5	-53.5	Y
160.0	-24.4	-21.1	-26.6	-23.1	-24.4	-30.6	160	0.0	-14.0	-14.0	-40.8	-37.5	-42.9	-39.4	-40.8	-46.9	Y
165.0	-23.4	-30.8	-31.0	-27.5	-23.4	-33.7	165	0.0	-14.0	-14.0	-39.7	-47.1	-47.3	-43.8	-39.7	-50.0	Y
170.0	-29.4	-33.4	-29.0	-30.3	-29.4	-45.7	170	0.0	-14.0	-14.0	-45.7	-49.7	-45.3	-46.6	-45.7	-62.1	Y
175.0	-25.6	-36.8	-27.7	-40.0	-25.6	-35.1	175	0.0	-14.0	-14.0	-41.9	-53.1	-44.0	-56.4	-41.9	-51.4	Y
180.0	25.4	27.0	26.2	28.1	25.4	26.0	180	0.0	-14.0	-14.0	9.1	10.7	9.8	11.7	9.1	9.6	N

I, Timothy Joyce, hereby certify under penalty of perjury that I am the technically qualified person responsible for the preparation of the technical materials contained in the Gogo Application for Aeronautical Mobile Satellite Service and the Technical Appendix, that I am familiar with Part 25 of the Commission's Rules (47 C.F.R. Part 25), and that I have either prepared or reviewed the technical information submitted in this application and found it to be complete and accurate to the best of my knowledge and belief.

By: */s/ Timothy Joyce*

Timothy Joyce

VP of RF Engineering

Gogo LLC

June 18, 2012

ATTACHMENT A: Radiation Hazard Analysis

ATTACHMENT A: Radiation Hazard Analysis

AES

This analysis predicts the radiation levels around a proposed earth station terminal, comprised of one array type antenna. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01, pp 26-30. The maximum level of non-ionizing radiation to which employees may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment. Note that the worst-case radiation hazards exist along the beam axis. Under normal circumstances, it is highly unlikely that the antenna axis will be aligned with any occupied area since that would represent a blockage to the desired signals, thus rendering the link unusable.

Earth Station Technical Parameter Table

Antenna Aperture Width	0.62484125 meters
Antenna Aperture Height	0.17272 meters
Antenna Surface Area	.1069 sq. meters
Antenna Isotropic Gain	29.0 dBi
Number of Identical Adjacent Antennas	1
Nominal Frequency	14.25 GHz
Nominal Wavelength (λ)	0.0211 meters
Maximum Transmit Power / Carrier	35.0 Watts
Number of Carriers	1
Total Transmit Power	35.0 Watts
W/G Loss from Transmitter to Feed	0.0 dB
Total Feed Input Power	35 Watts
Near Field Limit	$R_{nf} = D^2/4\lambda$ =4.64 meters
Far Field Limit	$R_{ff} = 0.6\ D^2/\lambda$ = 11.13 meters
Transition Region	R_{nf} to R_{ff}

In the following sections, the power density in the above regions, as well as other critically important areas will be calculated and evaluated. The calculations are done in the order discussed in OET Bulletin 65.

1.0 At the Antenna Surface

The power density at the antenna radiating surface can be calculated from the expression:

$PD_{refl} = 4P/A =$ **126.758** mW/cm² (1)

Where: P = total power at feed, milliwatts

A = Total area of reflector, sq. cm

In the normal range of transmit powers for satellite antennas, the power densities at or around the reflector surface are expected to exceed safe levels. This area will not be accessible to the general public. Operators and technicians should receive training specifying this area as a high exposure area. Procedures must be established that will assure that all transmitters are rerouted or turned off before access by maintenance personnel to this area is possible.

2.0 On-Axis Near Field Region

The geometrical limits of the radiated power in the near field approximate a cylindrical volume with a diameter equal to that of the antenna. In the near field, the power density is neither uniform nor does its value vary uniformly with distance from the antenna. For the purpose of considering radiation hazard it is assumed that the on-axis flux density is at its maximum value throughout the length of this region. The length of this region, i.e., the distance from the antenna to the end of the near field, is computed as Rnf above.

The maximum power density in the near field is given by:

$PD_{nf} = (16\varepsilon P)/(\pi D^2) =$ **32.957** mW/cm² (2)

from 0 to 4.64 meters

Evaluation

Uncontrolled Environment: **Does Not Meet Uncontrolled Limits**

Controlled Environment: **Does not Meet Controlled Limits**

3.0 On-Axis Transition Region

The transition region is located between the near and far field regions. As stated in Bulletin 65, the power density begins to vary inversely with distance in the transition region. The maximum power density in the transition region will not exceed that calculated for the near field region, and the transition region begins at that value. The maximum value for a given distance within the transition region may be computed for the point of interest according to:

$PD_t = (PD_{nf})(R_{nf})/R$ = dependent on R (3)

where: PD_{nf} = near field power density

R_{nf} = near field distance

R = distance to point of interest

For: 4.64 < R < 11.1 meters

We use Eq (3) to determine the safe on-axis distances required for the two occupancy conditions:

Evaluation

Uncontrolled Environment Safe Operating Distance,(meters), R_{safeu}: 150.0

Controlled Environment Safe Operating Distance,(meters), R_{safec}: 30.0

4.0 On-Axis Far-Field Region

The on- axis power density in the far field region (PD_{ff}) varies inversely with the square of the distance as follows:

$PD_{ff} = PG/(4\pi R^2)$ = dependent on R (4)

where: P = total power at feed

G = Numeric Antenna gain in the direction of interest relative to isotropic radiator

R = distance to the point of interest

For: $R > R_{ff}$ = 11.1 meters

PD_{ff} = **1.840** mW/cm² at R_{ff}

We use Eq (4) to determine the safe on-axis distances required for the two occupancy conditions:

Evaluation

Uncontrolled Environment Safe Operating Distance,(meters), R_{safeu} : See Section 3

Controlled Environment Safe Operating Distance,(meters), R_{safec} : See Section 3

5.0 Off-Axis Levels at the Far Field Limit and Beyond

In the far field region, the power is distributed in a pattern of maxima and minima (side lobes) as a function of the off-axis angle between the antenna center line and the point of interest. Off-axis power density in the far field can be estimated using the antenna radiation patterns prescribed for the antenna in use. This will correspond to the antenna gain pattern for an off-axis angle. For the Gogo AES antenna at 1 degree off axis the antenna gain is:

G_{off} = 25.7 dBi at 1 degree

Considering that satellite antenna beams are aimed skyward, power density in the far field will usually not be a problem except at low look angles. In these cases, the off axis gain reduction may be used to further reduce the power density levels.

For example: At one (1) degree off axis at the far-field limit, we can calculate the power density as:

G_{off} = 25.7 dBi = 371.5 numeric

$PD_{1\ deg\ off\text{-}axis} = PD_{ff} x\ 371.5/G = .8671\ mW/cm^2$ (5)

6.0 Off-Axis power density in the Near Field and Transitional Regions

According to Bulletin 65, off-axis calculations in the near field may be performed as follows: assuming that the point of interest is at least one antenna diameter removed from the center of the main beam, the power density at that point is at least a factor of 100 (20 dB) less than the value calculated for the equivalent on-axis power density in the main beam. Therefore, for regions at least Deff meters away from the center line of the antenna in any direction, the power density exposure is at least 20 dB below the main beam level as follows:

$PD_{nf(off\text{-}axis)} = PD_{nf}$ /100 = **0.32957** mW/cm^2 at D off axis (6)

See Section 7 for the calculation of the distance vs. elevation angle required to achieve this rule for a given object height.

7.0 Evaluation of Safe Occupancy Area in Front of Antenna

The distance (S) from a vertical axis passing through the antenna center to a safe off axis location in front of the antenna can be determined based on the effective antenna diameter rule (Item 6.0). Assuming a flat area in front of the antenna, the relationship is:

$S = (Deff/\sin\alpha) + (2(h\text{-}GDeff) - Deff - 2)/(2\tan\alpha)$ (7)

Where: α = minimum elevation angle of antenna

D = effective antenna diameter in meters

h = maximum height of object to be cleared, meters

For distances equal or greater than determined by equation (7), the radiation hazard will be below safe levels for all but the most powerful stations (> 4 kilowatts RF at the feed).

For D = 0.62484125 meters

h = 2.0 meters

GD = 1.0 meters - elevated height of earth station above ground (min)

Then:

α	S
10	7.5 meters
15	5.0meters
20	3.7 meters
25	3.0 meters
30	2.4 meters

This is fuselage mounted antenna, and all persons working on or near the antenna will be properly trained regarding radiation hazard. The antenna transmitter will be disabled any time work inside the radome is in progress.

Summary

The earth station site will be on top of the fuselage and will be protected from uncontrolled access. There will also be proper emission warning signs placed and all operating personnel will be aware of the human exposure levels at and around the earth station. The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

> *Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.*

The following table summarizes all of the above calculations:

Table - Summary of All RadHaz Parameters				**AES**
Parameter	Abbr.		Units	Formula
Dish #		Hub		
Antenna Dimenstions	Dma	0.619126238	meters	major axis (azimuth)
Effective Aperture Diameter	Deff	0.375	meters	
Antenna Centerline	h	0.5	meters	
Antenna Surface Area	Sa	0.1069	$meters^2$	$(\pi * Deff^2)/ 4$
Frequency of Operation	f	14.25	GHz	
Wavelength	λ	0.0211	meters	c / f
HPA Output Power	P_{HPA}	35.0	watts	
HPA to Antenna Loss	L_{tx}	0.0	dB	
Transmit Power at Flange	P	15.4	dBW	$10 * Log(P_{HPA}) - L_{tx}$
		35		
Antenna Gain	G_{es}	29.0	dBi	
		788.3	n/a	
PI	π	3.1415927	n/a	
Antenna Aperture Efficiency	η	26.00%	n/a	$G_{es} / (PI * Df /λ)^2$
1. Reflector Surface Region Calculations				
Reflector Surface Power Density	PDas	1267.58	W/m^2	$(16 * P)/(\pi * Deff^2)$
		126.758	mW/cm^2	**Does Not Meet Uncontrolled Limits**
				Does not Meet Controlled Limits
2. On-Axis Near Field Calculations				
Extent of Near Field	Rn	4.55	meters	$Dma^2 / (4 *λ)$
		14.93	feet	
Near Field Power Density	PDnf	329.57	W/m^2	$(16 * η * P)/ (\pi *Deff^2)$
		32.957	mW/cm^2	**Does Not Meet Uncontrolled Limits**
				Does not Meet Controlled Limits
3. On-Axis Transition Region Calculations				
Extent of Transition Region (min)	Rtr	4.55	meters	$Dma^2 / (4 *λ)$
Extent of Transition Region (min)		14.93	feet	
Extent of Transition Region (max)	Rtr	10.92	meters	$(0.6 * Dma^2) /λ$
Extent of Transition Region (max)		35.83	feet	
Worst Case Transition Region Power Density	PDtr	329.57	W/m^2	$(16 *η * P)/ (\pi * Deff^2)$
		32.957	mW/cm^2	**Does Not Meet Uncontrolled Limits**
				Does not Meet Controlled Limits
Uncontrolled Environment Safe Operating Distan	Rsu	150.0	m	=(PDnf)*(Rnf)/Rsu
Controlled Environment Safe Operating Distance	Rsc	30.0	m	=(PDnf)*(Rnf)/Rsc
4. On-Axis Far Field Calculations				
Distance to the Far Field Region	Rf	10.9	meters	$(0.6 * Dma^2) /λ$
		35.83	feet	
On-Axis Power Density in the Far Field	PDff	18.40	W/m^2	$(G_{es} * P) / (4 * \pi * Rf^2)$
		1.840	mW/cm^2	**Does Not Meet Uncontrolled Limits**
				Meets Controlled Limits
5. Off-Axis Levels at the Far Field Limit and Beyond				
Reflector Surface Power Density	PDs	8.671	W/m^2	$(G_{es} * P) / (4 * \pi * Rf^2)*(Goa/Ges)$
Goa/Ges at example angle θ 1 degree		0.471		Goa =25.7 dBi at 2deg.
		0.8671	mW/cm^2	**Meets Controlled Limits**
6. Off-axis Power Density in the Near Field and Transitional Regions Calculations				
Power density 1/100 of Wn for one diameter removed	PDs	3.2957	W/m^2	$((16 * η * P)/ (\pi *Deff^2))/100$
		0.32957	mW/cm^2	**Meets Uncontrolled Limits**
7. Off-Axis Safe Distances from Earth Station				$S = (Dma/ \sin α) + (2h - Dma - 2)/(2 \tan α)$
α = minimum elevation angle of antenna		10	deg	
h = maximum height of object to be cleared, meters		2.0	m	
GD = Ground Elevation Delta antenna-obstacle		0.0	m	
elevation angle	10	7.5	m	
	15	5.0	m	
	20	3.7	m	
	25	2.9	m	
	30	2.4	m	
Note: Maximum FCC power density limits for 6 GHz is 1 mW/cm^2 for general population/uncontrolled exposure as per				
FCC OE&T Bulletin No. 65, Edition 97-01 August 1997, Appendix A page 67.				

ATTACHMENT B: Satellite Company Letters

15 June 2012

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

Subject: Certification of SES regarding initiation of adjacent satellite network coordination

To Whom It May Concern:

This letter confirms that SES has initiated coordination of the planned Gogo non-conforming aircraft earth station operations with all adjacent satellite operators within 6° of orbital separation from SES-1 and NSS-703 pursuant to Section 25.220 of the Commission's rules. In particular, SES has initiated coordination of Gogo's planned operations on SES-1 with Intelsat with respect to Galaxy 3C (95°W), Galaxy 19 (97°W) and Galaxy 16 (99.2°W), and the coordination of GoGo's planned operations on NSS-703 with Intelsat with respect to Intelsat 707 (53°W), Intelsat 1R (50°W), Intelsat 14 (45°W) and Intelsat 11 (43.1°W).

Once the coordination is complete, SES will provide a statement certifying that the necessary coordination pursuant to Section 25.220 of the Commission's rules has been completed.

Sincerely,

Kimberly M. Baum
Vice President
Spectrum Management & Development
SES

June 17, 2012

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

INTELSAT

Re: **Summary of Intelsat Coordination Agreement and Affidavit Status relating to Gogo LLC License Application**

To Whom It May Concern:

The status of existing coordination agreements and affidavit requirements for the Gogo FCC license application are shown below. This letter certifies that Intelsat has the agreements cited, and they are in effect.

Only two affidavits are required, one for IS-21 (302°) and the other for IS-27 (304.5°E), both of these affidavits have been sent to the operators concerned. Intelsat coordination agreements with other operators cover all other situations where a satellite is operating in the same frequency band as the Gogo system within +/- 6° of the Intelsat satellite.

IS-19 (166°E)
No affidavits are required for IS-19 (166°E). Intelsat has coordination agreements in place with Optus, Sky Perfect JSAT and GE, who are the operators of all satellites operational in the bands used by the Gogo system within +/- 6° of IS-19. The Gogo system parameters are within the scope of the agreements.

IS-21 (302°E)
One affidavit is required from EchoStar for IS-21 (302°). The affidavit has been sent to the consultant working for Echostar.

Intelsat has coordination agreements in place with Hispamar and Telesat Canada, who are the operators of the only other satellites operational within +/- 6° of IS-21 in the bands that are used by the Gogo system. The Gogo system parameters are within the scope of the agreements.

IS-27 (304.5°E)
No affidavits are required for IS-27 (304.5°E). Intelsat has a coordination agreement in effect with Hispamar, which is the only operator of satellites operational within +/- 6° of IS-27 in the bands that are used by the Gogo system. The Gogo system parameters are within the scope of the agreement.

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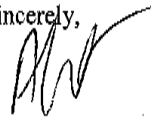
3400 International Drive NW, Washington DC 20008-3006 USA **www.intelsat.com** T +1 202-944-6800 F +1 202-944-7898

IS-14 (315°E)
One affidavit is required for SES World Skies for IS-27 (315°). There are no other operators with satellites operating within +/- 6° of IS-14 in the bands used by the Gogo system.

Sincerely,



Alan Yates
Senior Technical Advisor, Spectrum Strategy
Intelsat, LLC

ATTACHMENT C: Certification of Coordination Agreements

15 June 2012

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

Re: Certification of Agreements for IS-19 166E

INTELSAT.

To Whom It May Concern:

Intelsat is aware that Gogo LLC. ("Gogo") is seeking a blanket authorization from the Federal Communications Commission ("FCC") for authority to operate, on a non-conforming basis transmit/receive antennas for aeronautical mobile-satellite services ("AMSS") using fixed-satellite service ("FSS") frequencies pursuant to ITU RR 5.504A. Gogo is seeking an FCC authorization to utilize Intelsat's IS-19 satellite at 166°E.

This letter certifies that Intelsat has coordination agreements in effect with the operators of all satellites within +/- 6° of Intelsat's IS-19 satellite at 166E longitude that operate in the 14.00-14.5 GHz frequency band. The scope of these agreements encompasses the technical and operational characteristics of the Gogo system as contained in Gogo's license application to the FCC.

Sincerely,

15 June 2012

Alan Yates,
Senior Technical Advisor,
Spectrum Strategy
Intelsat, LLC

Intelsat Corporation
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15 June 2012

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

Re: Certification of Agreements for IS-27 304.5°E

INTELSAT

To Whom It May Concern:

Intelsat is aware that Gogo LLC. ("Gogo") is seeking a blanket authorization from the Federal Communications Commission ("FCC") for authority to operate, on a non-conforming basis transmit/receive antennas for aeronautical mobile-satellite services ("AMSS") using fixed-satellite service ("FSS") frequencies pursuant to ITU RR 5.504A. Gogo is seeking an FCC authorization to utilize Intelsat's IS-27 satellite at 304.5°E.

This letter certifies that Intelsat has coordination agreements in effect with the operators of all satellites within +/- 6° of Intelsat's IS-27 satellite at 304.5°E longitude that operate in the 14.00-14.5 GHz frequency band. The scope of these agreements encompasses the technical and operational characteristics of the Gogo system as contained in Gogo's license application to the FCC.

Sincerely,

15 June 2012

Alan Yates,
Senior Technical Advisor,
Spectrum Strategy
Intelsat, LLC

Intelsat Corporation
3400 International Drive NW, Washington DC 20008-3006 USA **www.intelsat.com** T +1 202-944-6800 F +1 202-944-7898

AMENDMENT EXHIBIT A: Satellite Company Letters

July 17, 2012

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

INTELSAT

Re: **Summary of Intelsat Coordination Agreement and Affidavit Status relating to Gogo LLC License Application**

To Whom It May Concern:

The status of existing coordination agreements and affidavit requirements for the Gogo FCC license application are shown below. This letter certifies that Intelsat has the agreements cited, and they are in effect.

A signed copy of the one affidavit required, which is in respect of Gogo's use of the Intelsat IS-14 (315°) satellite in relation SES satellites, is included in the Gogo application. Intelsat coordination agreements with other satellite operators cover all other situations where a satellite is operating in the same frequency band as the Gogo system within +/- 6° of the Intelsat satellite.

IS-19 (166°E)
No affidavits are required for IS-19 (166°E). Intelsat has coordination agreements in place with Optus, Sky Perfect JSAT and GE, who are the operators of all satellites operational in the bands used by the Gogo system within +/- 6° of IS-19. The Gogo system parameters are within the scope of the agreements.

IS-21 (302°E)
No affidavits are required for IS-21 (302°E). Within +/- 6° of IS-21 Intelsat operates the Galaxy 11 (304.5°E) and IS-707 (307°E) satellites. (The Echostar satellites operating at 298.2°E, 298.41°E and 298.64°E do not use the same frequency bands as the Gogo system.)

Intelsat has coordination agreements in place with Hispamar and Telesat Canada, who are the operators of the only other satellites operational within +/- 6° of IS-21 in the bands that are used by the Gogo system. The Gogo system parameters are within the scope of the agreements.

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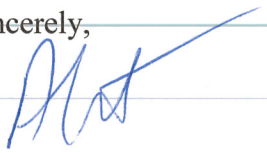
IS-27 (304.5°E)

No affidavits are required for IS-27 (304.5°E). Intelsat will operate the IS-21 (302°E) satellite 2.5° from IS-27. Intelsat has a coordination agreement in effect with Hispamar, which is the only operator of satellites operational within +/- 6° of IS-27 in the bands that are used by the Gogo system. The Gogo system parameters are within the scope of the agreement.

IS-14 (315°E)

One affidavit has been obtained for IS-14 (315°) and a copy of the document, signed by SES, is included in the application. There are no other operators with satellites operating within +/- 6° of IS-14 in the bands used by the Gogo system.

Sincerely,



Alan Yates
Senior Technical Advisor, Spectrum Strategy
Intelsat, LLC

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

Re: Engineering Certification of Intelsat

INTELSAT

To Whom It May Concern:

This letter certifies that Intelsat is aware that Gogo LLC. ("Gogo") is seeking a blanket authorization from the Federal Communications Commission ("FCC") for authority to operate, on a non-conforming basis transmit/receive antennas for aeronautical mobile-satellite services ("AMSS") using fixed-satellite service ("FSS") frequencies pursuant to ITU RR 5.504A. Gogo is seeking an FCC authorization to utilize Intelsat's IS-14 satellite at 315°E.

Intelsat understands that Gogo's transmit/receive antenna is an AMSS steerable antenna manufactured by Aerosat Corporation that is designed to provide bi-directional broadband services to aircraft in flight. It supports reception and transmission in the 10.7-12.75 GHz/14.0-14.5 GHz bands respectively, with linear polarized array antennas to and from a geostationary satellite in space. The antenna is two rows of 32 element array with each lensed-horn element being 3.4 X .75 inches. The antenna operates under gimbaled motor control to orient the antenna in azimuth, elevation and polarization and achieves better than a ± 0.2 degree rms pointing accuracy during active tracking of the intended satellite. All emissions automatically cease at pointing errors greater than 0.5^0 , and transmission is not resumed until the angle is verified to be less than 0.2°. The antenna complies with the off-axis EIRP density level requirements specified in Sections §25.222 and §25.226 of the Commission's Rules, at all off-axis angles up to and including 6 degrees off-axis angle. This compliance will be maintained by signal spreading and power adjustments made into the antenna.

When communicating with the IS-14 satellite, Gogo will operate its antenna within the 14.00-14.5 GHz FSS uplink band and the 11.7-11.95 GHz FSS downlink band with a maximum equivalent isotropically radiated power (EIRP) of 43.91 dBW and the maximum power density at the antenna flange is -16.91 dBW/4kHz and is compliant with FCC rules.

Intelsat further accepts that the forward downlink (hub to Aircraft Earth Station) maximum EIRP density at the beam peak is 11.77 dBW/4kHz, which is routinely used at 2-degree spacing without causing unacceptable interference to adjacent satellite operators. Gogo will maintain the forward downlink EIRP density and the off-axis EIRP spectral density by tight control of system operation that includes:

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1) maintaining rms pointing error to be ≤ 0.2 degrees relative to the intended satellite;

2) fault detection that terminates transmissions when out of tolerance conditions (including the antenna pointing error) are detected; and

3) continuous monitoring/oversight by the ground network operations center (NOC).

Intelsat acknowledges that the use of the above referenced transmit/receive antenna by Gogo, installed and operated in accordance with the above conditions should not cause unacceptable interference into an adjacent satellite operating in accordance with the FCC's two-degree spacing policy, and is consistent with existing coordination agreements with all adjacent satellite operators. If the FCC authorizes the operations proposed by Gogo in its application, Intelsat will include the antenna, as described above, in all future satellite network coordinations with other adjacent satellite operators. Gogo shall comply with all such coordination agreements reached by the satellite operators.

In order to prevent unacceptable interference into adjacent satellites, Intelsat has been informed, and Gogo acknowledges, that the antennas will be installed and operated in accordance with the above conditions and/or any other operational requirements specified in the FCC license ultimately granted to Gogo. If the use of this antenna should cause unacceptable interference into other systems, Gogo has agreed it will terminate transmissions immediately upon notice from the affected parties.

Sincerely,

7/9/2012

Alan Yates,
Senior Technical Advisor, Spectrum Strategy
Intelsat, LLC

Date

Acceptance by Gogo, LLC:

Gogo affirms that the information provided to SES and reflected in this coordination letter is true and accurate to the best of Gogo's knowledge, information and belief, and that it shall comply with all relevant SES coordination agreements, as provided herein.

Timothy Joyce
VP of RF Engineering
Gogo LLC

7/3/12
Date

Acceptance by SES:

SES agrees to the operation of the above antenna with the technical parameters described herein with respect to its SES satellites at 313°E and 319.5E, which operate within 6 degrees of Intelsat's IS-14 satellite at 315°E

Harold J. Ng
Director, spectrum Management & Develop.
SES Americom, Inc.

7/10/2012
Date

SES

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

July 2, 2012

Subject Re: Engineering Certification of SES Satellites (Gibraltar) Limited

SES Americom, Inc.
4 Research Way
Princeton, NJ 08540
USA
Tel. +1 609 987 4000
Fax +1 609 987 4517
www.ses.com

To Whom It May Concern:

This letter certifies that SES Satellite (Gibraltar) Limited ("SES Gibraltar") is aware that Gogo LLC ("Gogo") is seeking a blanket authorization, from the Federal Communications Commission ("FCC"), to operate technically identical non-conforming Ku-band transmit/receive earth stations for the provision of Aeronautical Mobile Satellite Service (AMSS), pursuant to ITU RR 5.504A, on domestic and international flights. Gogo also seeks authorization, from FCC, for these non-conforming aeronautical Ku-band earth stations to communicate with (e.g., points of communication) NSS-703 at 47.05 WL.

In its FCC application, Gogo stated that their AMSS aircraft remote terminals use the AeroSat HR6400 antenna model which supports reception and transmission in the Ku-band, with linear polarized array antennas to and from a geostationary satellite in space. The HR6400 antenna is two rows of 32 element array with each lensed-horn element being 3.4 X .75 inches. The antenna operates under gimbaled motor control to orient the antenna in azimuth, elevation and polarization and achieves better than a ± 0.2 degree rms pointing accuracy during active tracking of the intended satellite. All emissions automatically cease within 100 ms if the pointing error exceeds 0.5^0, and transmission is not resumed until the angle is verified to be less than 0.2°. In its application, Gogo indicated that the AMSS antenna complies with the off-axis EIRP density level requirements specified in Sections §25.222 and §25.226 of the Commission's Rules, at all off-axis angles up to and including 6 degrees off-axis angle.

Gogo stated in its application and also informed SES Gibraltar that when their AMSS aircraft remote terminals communicate with NSS-703 satellite, using the

14.0-14.5 GHZ band, the maximum EIRP equal to 44.4 dBW and the corresponding maximum power density, at the antenna flange, is -16.3 dBW/4 kHz. In addition, Gogo also informed SES Gibraltar that when Gogo operates its AMSS antennas within the following Ku-bands and within the respective NSS-703 coverage area

NSS-703 beam coverage area	Downlink receive frequency (GHz)
S2 – North Atlantic	11.7-11.95
S1 – North Atlantic	10.95-11.2 11.45-11.7
S3 – North Atlantic	12.5-12.75

it will maintain the forward downlink EIRP density, at the beam peak, equal to or less than 13.0 dBW/4 kHz which is routinely used at 2-degree spacing without causing unacceptable interference to adjacent satellite operators, at the respective spacecraft Ku-band downlink-beam peaks.

SES Gibraltar acknowledges that the use of the above referenced AMSS transmit/receive antenna by Gogo, installed and operated in accordance with the Gogo application and the above conditions should not cause unacceptable interference into an adjacent satellite operating in accordance with the FCC's 2-degree spacing policy, and is consistent with existing coordination agreements with all adjacent satellite operators, within +/- 6 degrees of NSS-703 at 47.05 WL.

In order to prevent unacceptable interference into adjacent satellites, SES Gibraltar has been informed, and Gogo acknowledges, that the AMSS antennas will be installed and operated in accordance with the above conditions and/or any other operational requirements specified in the FCC license ultimately granted to Gogo. If the use of this antenna should cause unacceptable interference into other systems, Gogo has agreed it will terminate transmissions immediately upon notice from the affected parties.

Yours sincerely,

Harold J. Ng
Director, Spectrum Management & Develop.
SES Americom, Inc.
for
SES Satellites (Gibraltar) Limited

7/3/2012
Date

Acceptance by Gogo, LLC:

Gogo affirms that the information provided to SES Gibraltar and reflected in this coordination letter is true and accurate to the best of Gogo's knowledge, information and belief, and that it shall comply with all relevant SES Gibraltar coordination agreements, as provided herein.

7/6/2012

Timothy Joyce
VP of RF Engineering
Gogo LLC

Date

Acceptance by Intelsat:

Intelsat agrees to the operation of the above Gogo AMSS antenna with the technical parameters described herein with respect to Intelsat 707 at 53 WL, Intelsat 1R at 50 WL, Intelsat 14 at 45 WL and Intelsat 11 at 43.1 WL are operating within 6 degrees of NSS-703 at 47.05 WL.

7/9/2012

Alan Yates
Senior Technical Advisor, Spectrum Strategy
Intelsat, LLC

Date

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

July 2, 2012

SES Americom, Inc.
4 Research Way
Princeton, NJ 08540
USA
Tel. +1 609 987 4000
Fax +1 609 987 4517
www.ses.com

Subject: Re: Engineering Certification of SES Americom, Inc.

To Whom It May Concern:

This letter certifies that SES Americom, Inc. (SES) is aware that Gogo LLC ("Gogo") is seeking a blanket authorization, from the Federal Communications Commission ("FCC"), to operate technically identical non-conforming Ku-band transmit/receive earth stations for the provision of Aeronautical Mobile Satellite Service (AMSS), pursuant to ITU RR 5.504A, on domestic and international flights. Gogo also seeks authorization, from FCC, for these non-conforming aeronautical Ku-band earth stations to communicate with (e.g., points of communication) SES-1 at 101 WL.

In its FCC application, Gogo stated that their AMSS aircraft remote terminals use the AeroSat HR6400 antenna model which supports reception and transmission in the 11.7-12.2 GHz and 14.0-14.5 GHz bands respectively, with linear polarized array antennas to and from a geostationary satellite in space. The HR6400 antenna is two rows of 32 element array with each lensed-horn element being 3.4 X .75 inches. The antenna operates under gimbaled motor control to orient the antenna in azimuth, elevation and polarization and achieves better than a ± 0.2 degree rms pointing accuracy during active tracking of the intended satellite. All emissions automatically cease within 100 ms if the pointing error exceeds 0.5^0, and transmission is not resumed until the angle is verified to be less than 0.2°. In its application, Gogo indicated that the AMSS antenna complies with the

off-axis EIRP density level requirements specified in Sections §25.222 and §25.226 of the Commission's Rules, at all off-axis angles up to and including 6 degrees off-axis angle.

Gogo stated in its application and also informed SES that when their AMSS aircraft remote terminals communicate with SES-1 satellite, using the 14.0-14.5 GHZ band, the maximum EIRP equal to 44.4 dBW and the corresponding maximum power density, at the antenna flange, is -16.3 dBW/4kHz. In addition, Gogo also informed SES that when Gogo operates its AMSS antennas within the 11.7-12.2 GHz band, it will maintain the forward downlink EIRP density at beam peak equal to, or less than 13.0 dBW/4 kHz, which is routinely used at 2-degree spacing without causing unacceptable interference to adjacent satellite operators, at the spacecraft downlink-beam peak.

SES acknowledges that the use of the above referenced AMSS transmit/receive antenna by Gogo, installed and operated in accordance with the Gogo application and the above conditions should not cause unacceptable interference into an adjacent satellite operating in accordance with the FCC's 2-degree spacing policy, and is consistent with existing coordination agreements with all adjacent satellite operators, within +/- 6 degrees of SES-1.

In order to prevent unacceptable interference into adjacent satellites, SES has been informed, and Gogo acknowledges, that the AMSS antennas will be installed and operated in accordance with the above conditions and/or any other operational requirements specified in the FCC license ultimately granted to Gogo. If the use of this antenna should cause unacceptable interference into other systems, Gogo has agreed it will terminate transmissions immediately upon notice from the affected parties.

Yours sincerely,

Harold J. Ng
Director, Spectrum Management & Develop.
SES Americom, Inc.

7/3/2012
Date

Acceptance by Gogo, LLC:

Gogo affirms that the information provided to SES and reflected in this coordination letter is true and accurate to the best of Gogo's knowledge, information and belief, and that it shall comply with all relevant SES coordination agreements, as provided herein.

Timothy Joyce
VP of RF Engineering
Gogo LLC

7/6/2012
Date

Acceptance by Intelsat:

Intelsat agrees to the operation of the above Gogo AMSS antenna with the technical parameters described herein with respect to Galaxy 16 at 99.2 WL, Galaxy 19 at 97 WL and Galaxy3C at 95 WL which are operating within 6 degrees of SES-1 at 101 WL.

Alan Yates
Senior Technical Advisor, Spectrum Strategy
Intelsat, LLC

7/9/2012
Date

AMENDMENT EXHIBIT B: NSF Coordination Agreement

TECHNICAL OPERATIONAL COORDINATION AGREEMENT FOR THE JOINT USAGE OF THE BAND 14.0 - 14.5 GHz BETWEEN THE NATIONAL SCIENCE FOUNDATION AND AERONAUTICAL MOBILE-SATELLITE SERVICE EARTH STATIONS (AMSS) OPERATED BY GOGO, LLC.

July 3rd, 2012

TECHNICAL OPERATIONAL COORDINATION AGREEMENT FOR THE JOINT USAGE OF THE BAND 14.0 - 14.5 GHz BETWEEN THE NATIONAL SCIENCE FOUNDATION AND AERONAUTICAL MOBILE SATELLITE SERVICE EARTH STATIONS (AMSS) OPERATED BY GOGO, LLC

Radio Astronomy observations are conducted in the 14.47-14.5 GHz band in the USA at a number of radio astronomy sites. Gogo, LLC ("Gogo") desires to operate a global satellite based, in-flight, broadband communications Aeronautical Mobile-Satellite Service, which will operate in the 14.0 to 14.5 GHz transmit and the 11.7 to 12.2 GHz receive band. The present agreement is intended to facilitate operation of the Gogo system, without causing interference to radio astronomy stations.

1. General Information

1.1 The band 14.47 to 14.5 GHz is allocated to the radio astronomy service on a secondary basis, for observations of the formaldehyde (H_2CO) line.

1.2 Under the rules of the Federal Communications Commission, the band 14.0 – 14.5 GHz is allocated to the aeronautical mobile-satellite service ("AMSS") on a secondary basis, provided that AMSS stations include special protection to radio astronomy stations that observe in this band.

1.3 Gogo plans to file an application with the FCC to operate up to 1000 technically identical transmit/receive aeronautical earth stations (AES) to operate in the 11.7 – 12.2 and 14.0 – 14.5 GHz frequency bands.

1.4 This agreement document has been developed to govern the use of all Gogo terminals operating in the United States and its territories to ensure the protection of radio astronomy stations operations in the 14.47 to 14.5 band.

1.5 The Electromagnetic Spectrum Unit of the National Science Foundation (NSF) has the authority to negotiate and sign this agreement for the radio astronomy sites listed in Section 2.1, and Gogo has the authority to negotiate and sign this agreement on behalf of itself.

2. List of NSF supported Radio Astronomy observatories observing or planning to observe in the band 14.47 - 14.5 GHz within the US and its territories

2.1 The following is a list of radio astronomy sites supported by NSF that are included in this agreement. There are 12 sites, two of which (Green Bank, WV and Socorro, NM) require

more stringent levels of protection, while ten sites associated with the Very Long Baseline Array (VLBA) require less protection(see section 3.1 below).

Name	Latitude	Longitude	Type
Green Bank, WV	38.4331	-79.8397	GBT
Socorro, NM	34.0789	-107.6183	VLA
Brewster, WA	48.1311	-119.6833	VLBA
Owens Valley, CA	37.2317	-118.2769	VLBA
Kitt Peak, AZ	31.9564	-111.6125	VLBA
Pie Town, NM	34.3011	-108.1192	VLBA
Los Alamos, NM	35.775	-106.2456	VLBA
Fort Davis, TX	30.635	-103.9447	VLBA
North Liberty, IA	41.7714	-91.5742	VLBA
Hancock, NH	42.9336	-71.9866	VLBA
St. Croix, USVI	17.7567	-64.5836	VLBA
Mauna Kea, HI	19.8014	-155.4556	VLBA

NSF shall give Gogo no less than 2 months advance notice of changes in the status of existing sites, or of any additional radio astronomy site being brought into use in the 14.47 - 14.5 GHz band.

3. Technical Operational Coordination Agreement

NSF and Gogo agree to the following:

3.1 The purpose of this agreement is to provide protection to the radio astronomy sites listed in Section 2.1 during periods of radio astronomy observations in the 14.47 - 14.5 GHz band to the following aggregate pfd levels within that band:

- -221 dB(W/m^2/Hz) for the Green Bank and Socorro sites
- -189 dB(W/m^2/Hz) for the ten VLBA sites

3.2 This agreement should be reviewed typically on an annual basis by all parties signing this document beginning within one year after Gogo has informed NSF of the start of service under an operational license. The purpose of this review is to assess the effectiveness of this agreement as well as to update as applicable this or successor operational coordination agreements.

3.3 Each party shall inform the other party in a timely manner of changes in the points of contact as defined in Section 5.

Gogo agrees to:

Gogo will respond promptly to any NSF request for protection as described above for interference occurring at any site listed in Table 2.1.

NSF agrees to:

3.5 Maintain an observation schedule for the band 14.47 - 14.5 GHz for the sites listed in Section 2.1 and make this schedule available upon request to the designated Gogo point-of-contact listed in Section 5.2.

3.6 Provide full access to Gogo representatives to data on interference that may be collected during observations that fall within the scope of this agreement.

4. Assignment and Termination

4.1 This agreement shall be binding upon the parties hereto and their respective successors and assigns.

4.2 This agreement may be terminated by mutual agreement of the parties upon 6 months notice.

5 Points of Contact

5.1 Points of contact concerning this agreement.

Name: Dr. Andrew W. Clegg	Name: William J. Gordon
Organization: National Science Foundation	Organization: Gogo, LLC
Title: Program Director, Electromagnetic Spectrum Management Unit	Title: VP, Regulatory Affairs
Address: 4201 Wilson Boulevard, Room 1045	Address: Gogo, LLC 5505 Connecticut Avenue, NW #288
City State Zip: Arlington VA 22230	City State Zip: Washington, DC 20015
Phone: (703) 292-4892	Phone: 202 680-0576
Fax: (703) 292-9034	Fax:
E-mail: esm@nsf.gov	E-mail: bgordon@gogoair.com

5.2 Contacts concerning the notification of radio astronomy observation schedules:

Dr. Harvey Liszt	Tim Joyce
Title: Director, Spectrum Management	Title: Director, RF Engineering
Organization: NRAO	Organization: Gogo, LLC
Address: NRAO 520 Edgemont Road Charlottesville, VA 22903-2475	Address: Gogo, LLC 1250 N. Arlington Heights Rd Itasca, IL 60153
Phone 434.296.0344	Phone: 630.647.1427
Fax: 434.296.0278	Fax: 630.647.1627
E-mail: hliszt@nrao.edu	E-mail: TJoyce@gogoair.com

6 Signatures

This Agreement is being made in good faith by both parties and is effective on the date on which the last party signs it. It may be executed in one or more counterparts, each of which will be deemed an original and all of which together will constitute one and the same instrument.

For the National Science Foundation

By: A W. Clegg

Name: Dr. Andrew W. Clegg

Title: Program Director, Electromagnetic Spectrum Management Unit

Date: June 6th, 2012

For Gogo, LLC

By: William J Gordon

Name: William J. Gordon

Title: VP, Regulatory Affairs

Date: 7/5/2012