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GSAA FCC Experimental Filing Narrative

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1 Purpose of Experiment

Row 44[1] is seeking a license in the Experimental Radio Service for a one year period to operate up to four Aircraft Earth Stations (AESs) in North America pursuant to Sections 5.3 (e), (h) and (j) of the Commission's Rules. Reference 47 Code of Federal Regulations (CFR) Part 5.3(e), (h) and (j) for specific filing requirements. The purpose of this operation is to test and evaluate the terminal antenna for provision of commercial service under the Commission's rules governing Earth Stations Aboard Aircraft (ESAA). Reference 47 CFR Part 25.227 for specific filing requirements. Row 44 understands that experimental operation must operate on a non-interference basis with respect to primary users in the band, and must accept any interference caused by these licensees. To facilitate processing of this request, Row 44 is submitting the information provided in this attachment in addition to a completed FCC Form 442. This attachment describes the general scope of Row 44's planned experimental operations, the research to be performed, the complete technical details of the operations proposed, the program objectives, and the performance evaluation of these operations.

1.1 Overview of Row 44's Row 44 ESAA System

Row 44 currently offers a broadband Internet data service to passengers and crew abroad commercial aircraft traveling in North American airspace, consistent with the framework that the Commission has adopted for ESAA. The service includes IP data services, IP voice and IPTV. The purpose of the proposed experimental program is to test a new, next generation remote terminal for introduction to the existing Row 44/Row 44 ESAA network (Call Sign E080100). Row 44 notes that its transmission will comply with Part 25.227(a)(1)(i)(A) of the FCC's rules for the uplink Radio Frequency (RF) transmit power density will not exceed as indicated in Table 1 and Table 2 for each skew/elevation combination. A summary of principal transmission parameters is provided in

GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
5	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
10	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
15	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10	5.10
20	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10	5.10
25	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50
30	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50
35	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10
40	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10
45	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70
50	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40
55	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00
60	17.70	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70
65	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70
70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.80	14.90	14.20	13.30	12.30
75	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20
80	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70
85	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70
90	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70

Table 3

Table 1 – GSAA Maximum Flange Spectral Density (in 1.024 MHz bandwidth) to Comply with 47 CFR Part 25.227(a)(1)(i)(A)

GSAA MAXIMUM FLANGE SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	-12.50	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30	-22.60	-23.80	-24.50
5	-12.50	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30	-22.60	-23.80	-24.50
10	-12.50	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30	-22.60	-23.80	-24.50
15	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.80	-14.40	-15.10	-16.00	-17.00	-18.00	-19.20	-20.60	-21.90	-23.20	-24.20
20	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.80	-14.40	-15.10	-16.00	-17.00	-18.00	-19.20	-20.60	-21.90	-23.20	-24.20
25	-11.60	-11.60	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30	-22.60	-23.80
30	-11.60	-11.60	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30	-22.60	-23.80
35	-11.60	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.80	-14.40	-15.10	-16.00	-17.00	-18.00	-19.20	-20.60	-21.90	-23.20
40	-11.60	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.80	-14.40	-15.10	-16.00	-17.00	-18.00	-19.20	-20.60	-21.90	-23.20
45	-11.60	-11.60	-11.60	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30	-22.60
50	-11.60	-11.60	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.80	-14.40	-15.10	-16.00	-17.00	-18.00	-19.20	-20.60	-21.90
55	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60	-19.90	-21.30
60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.80	-14.40	-15.10	-16.00	-17.00	-18.00	-19.20	-20.60
65	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10	-14.80	-15.50	-16.40	-17.50	-18.60
70	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.70	-12.00	-12.30	-12.80	-13.30	-13.50	-14.40	-15.10	-16.00	-17.00
75	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.80	-12.10	-12.50	-13.00	-13.50	-14.10
80	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60
85	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60
90	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60	-11.60

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

Table 2 – GSAA Maximum EIRP Spectral Density to Comply with 47 CFR Part 25.227(a)(1)(i)(A)

GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
5	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
10	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
15	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10	5.10
20	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10	5.10
25	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50
30	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50
35	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10
40	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10
45	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70
50	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40
55	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00
60	17.70	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70
65	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70
70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.80	14.90	14.20	13.30	12.30
75	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20
80	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70
85	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70
90	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70

Table 3 – Row 44 Transmission Parameters for GSAA

Antenna Manufacturer	QEST
Antenna Model Number	GSAA RF Subsystem
Transmitter frequencies	14.05-14.47 GHz ± 10^{-5}%
Modulating waveform	DVB-S2, DVB-S2X, QPSK, 8-PSK
Boresight Gain	33.6 dBi
Antenna Off-axis gain performance	Partially complies with §25.209
High Power Amplifier Maximum	25 watts
Peak power density at the flange	-11.60 dBW/4kHz
Carrier Bandwidth	1.024 MHz (1M02G7D)
Peak Boresight EIRP	41.5 dBW (after cable and radome losses)
Off-axis EIRP Co-pol Spectral Density	Complies with §25.227

Approval of the requested authority will serve the public interest by completely characterizing the performance and non-interference with existing Fixed Satellite Service operations and will permit Row 44 to continue its preparation to upgrade and expand its in-flight mobile broadband service. Row 44's provision of ESAA services is already providing high-speed broadband internet access, interactive entertainment, and also facilitates access by flight crews to important weather updates, and security information. The addition of the proposed Global Satellite Antenna Assembly (GSAA) antenna to Row 44's current operations will promote both improved and expanded service to the traveling public. Accordingly, Row 44 requests that the FCC grant its application for a license in the Experimental Radio Service. Row 44 is able to commence testing immediately.

1.2 Overview of Row 44's ESAA Antenna Experimental Plan

The Ku band AESs used by Row 44 provide two-way broadband communications services to passengers and flight crews, allowing in-flight, real-time access to e-mail, the Internet and virtual private networks. The AESs will operate in conjunction with a Very Small Aperture Terminal (VSAT) network hub station that is licensed to Hughes Network Systems (HNS).

The Row 44 ESAA system provides two-way, broadband communications between multiple aircraft terminals and the Internet via multiple satellite gateways under the control of a Network Operations Center (NOC). Satellite gateways are procured from HNS based on the existing Hughes HX as well as HT architecture. A key element of the HNS's satellite system is a VSAT HX/HT broadband terminal that provides Internet Protocol (IP) connectivity via geostationary satellites, augmented with a mobility feature to offer airborne users broadband IP data service. The airborne platform is comprised of GSAA, a Ku-Band RF Unit (KRFU), a Modem Data Unit (MDU), a Cabin Wireless Local Area Network (LAN) Unit (CWLU), and a Server Management Unit (SMU). The system supports reception and transmission in the 11.70 GHz to 12.20 GHz and 14.05 GHz to 14.47 GHz band respectively, utilizing independent linearly polarized array antennas for communication to and from a geostationary satellite in space. The GSAA supports an elevation range from 90° to 0° of continuous coverage while the azimuth coverage will be continuous over 360°.

Space segment capacity for experimental operations will consist of transponders on AMC-1 (129° W.L.), AMC-9 (83° W.L.), and SES-1 (101° W.L.). The Ground Earth Station (GES) is licensed to Hughes Network Systems under the call sign E940460 and is located in North Las Vegas, Nevada (Latitude: 36°14'11.0"N; Longitude: 115°7'4.0"W – 83-NAD) as well as SES at Woodbine, VA (Latitude: 38°40'3.36"N; Longitude: 77°26'24.0"W – 83-NAD) under the call sign E900448 and E140059. The aircraft used for experimental testing is a HU-16B Albatross test aircraft (US registration N44HQ) outfitted with the Row 44 Broadband System and a Honeywell Aircraft Data Inertial Reference Unit (ADIRU). There will also be units tested at a testing facility in Lombard, IL on a laboratory cart.

Multiple users access the 36 MHz satellite transponder bandwidth using Time Division Multiple Access (TDMA). The 1.024 MHz bandwidth waveform supports adaptive coding and modulation and will be using the latest generation transmission standard Digital Video Broadcasting (DVB-S2 and DVB-S2X). The modulation from the satellite to the AES is either Quadrature Phase Shift Keying (QPSK) or Octal Phase Shift Keying (PSK) at a maximum transmitted signaling rate of 30 mega-symbols/second.

The modulation from the AES to the satellite is offset QPSK with a transmitted signaling rate of 2048, 1024, 512, or 256 kilo-bits/second (kbps). In cases where the baseband modulated signal is not of a 1.024 Msps rate, the transmitter shall employ spreading to convert baseband 256 ksps or 512 ksps signals to occupy the 1.024 MHz bandwidth, thereby maintaining compliance with the 1.024 MHz channel allocation. For robust operation, transmit encoding utilizes multi-rate 1/2, 2/3, 4/5, and 9/10 turbo-coding. Received encoding incorporates a BCH (Bose, Chaudhuri, and Hocquenghem) code with a low density parity check code at rates ranging from 1/4, 1/3, 2/5, 9/20, 1/2, 11/20, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, and 9/10 for QPSK and 1/2, 3/5, 23/36, 2/3, 25/36, 3/4, 4/5, 5/6, 8/9, and 9/10 for 8PSK. These waveforms are modulated/ demodulated in the MDU. For the uplink signal, the Ku KRFU provides the frequency up-conversion from the intermediate L-Band frequencies of 950 to 1450 MHz to the transmit frequency, and the subsequent signal amplification. When the antenna gain is included in the AES link budget, the transmitter emits a maximum effective isotropic radiated power (EIRP) of +41.5 dBW.

Row 44's GSAA antenna is not fully compliant with the off-axis antenna gain envelope established in 47 CFR Part 25.209(a)(2) and 25.209(a)(5), as illustrated in Table 4 and Table 5 which shows compliance by skew

and elevation ("1" indicates the antenna is compliant and "0" indicates the antenna is not compliant to the requirement indicated in the caption).

Table 4 – 47 CFR Part 25.209(a)(2) Azimuth Co-Polarization Gain Envelope Compliance by Skew/Elevation/Frequency/Polarization

Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
5	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
10	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
15	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
20	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
25	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
30	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
35	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
40	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
45	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
50	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
55	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
60	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
65	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
75	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
80	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 5 – 47 CFR Part 25.209(a)(5) Elevation Co-Polarization Gain Envelope Compliance by Skew/Elevation/Frequency/Polarization

Elevation[deg]\Skew[deg]	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
45	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
55	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
65	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
75	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
80	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

However, the AES transmitter shall still be comply with the FCC EIRP spectral density limits as indicated in 47 CFR Part 25.227(a)(1)(i)(A) and is illustrated in Table 1 which indicates the maximum uplink flange densities capable of satisfying the FCC maximum EIRP spectral density limit in a 1.024 MHz bandwidth across all frequency and polarization (Note: the antenna performance is best at 14.50 GHz; it is the performance at this frequency which determines the maximum EIRP spectral density). Table 2 indicates the maximum EIRP spectral density to meet the FCC requirement in a 1.024 MHz bandwidth using a 25 watt sized high power amplifier. Row 44 has obtained the required coordination letters for this antenna pursuant to 47 CFR Part 25.227(b) with SES Americom, the satellite space segment provider. Copies of these letters are attached in Exhibit B. All operations will also be subject to existing coordination agreements executed in 2008 with the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF) covering the transmit band operations of Row 44's license ESAA network.

A radiation hazard study for this antenna is provided as **Appendix C** hereto.

1.3 Antenna Characteristics

[redacted]Transmit Patterns

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

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

The vertical and horizontal polarizations off-axis gain characteristics indicate the antenna can support the EIRP spectral densities as described in section 1.1 while being compliant to 47 CFR Part 25.227, the transmit power being set to values being respectively compatible with the prevailing values of the antenna skew and elevation. In practice, during aircraft movement, the skew angle value is monitored by the GSAA. The aircraft transmitter shall be muted in the event that the skew angle exceeds a specific limit, corresponding to that beyond which, the off-axis EIRP density would otherwise exceed the 47 CFR Part 25.227 EIRP density consistent with those of Row 44's current authorization.

[redacted]Antenna Control

The experimental configuration operates the same way as the existing, licensed configuration. The Antenna Control Unit (ACU), a separate device connected to the existing Satellite Antenna Assembly (SAA) is now integrated within the GSAA. Compensating for the aircraft motion, the GSAA adjusts the antenna's azimuth, elevation, and polarization in maintain the pointing of the antenna toward the target satellite.

The GSAA obtains information on the aircraft's location, velocity, and orientation from the on-board Inertial Navigation System (INS) via either an ARINC 429, ARINC 629, or ARINC 664 data bus. The GSAA antenna is gimbaled, which permits the directing of the transmission beam in azimuth, elevation, and polarization according to the received signal quality and aircraft position data. As with the licensed implementation with the current SAA antenna, the combination of the aircraft's inertial navigation data and measured Es/N0 data (provided to the GSAA from the (MDU)) allow the 0.2° peak error to be maintained under the variety of aircraft motion and orientation scenarios.

[redacted]Antenna Pointing Accuracy and Tracking

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

If, under rare circumstances such as extreme turbulence, the GSAA is incapable of maintaining its pointing towards the satellite, the transmitter shall be muted as mentioned, and only resumed upon the pointing error assuming a value less than 0.2°.

[redacted]Interference Protection-Terrestrial Sites

Row 44 complies with the out–of-band emissions requirements in 47 CFR Part 25.202(f). Row 44 is also cognizant of FCC rules for fixed satellite services and will operate on a non-interfering basis. For purposes of protecting Radio Astronomy sites, consistent with ITU Recommendation M.1643, Part C, Row 44 will limit aggregate power flux density (pfd) in the band 14.47 GHz to 14.5 GHz as follows:

- -221 dBW/m^2/Hz (for protection of Green Bank, Arecibo, and Socorro)
- -189 dBW/m^2/Hz (for protection of 10 Very Long Baseline Array sites)

Row 44 has executed a coordination agreement with the NSF that establishes non-interfering operation with radio observations (see Exhibit B).

Row 44 also acknowledges the utilization of the frequency band from 14.0 GHz to 14.05 GHz and the possible use of the band from 14.05 GHz to 14.2 GHz allocated to NASA Tracking and Data Relay Satellite System (TDRSS) for space research. NASA's protection limits specify that the interference threshold limit is -100 dBW/MHz in the 14.05 GHz to 14.4 GHz band, -146 dBW/MHz in the 14.0 GHz to 14.05 GHz band, and -176 dBW/MHz in the 13.4 GHz to 14.0 GHz band. Row 44 has discussed its planned operation with NASA and by terminating AES transmission in the vicinity of NASA sites located at White Sands, New Mexico and Blossom Point, Maryland. Row 44 will comply with the limits near these earth stations. In the event that Row 44 begins operation in the vicinity of Guam, it will also coordinate this operation with NASA to avoid unacceptable interference. Consistent with the requirements of ITU Recommendation M.1643, Part D, a coordination agreement between Row 44 and NASA has been executed (see Exhibit B).

Finally, Row 44 recognizes that the FCC maintains multiple monitoring stations throughout the US where the received field strength at the monitoring stations must not exceed 10mV/m^2 in the authorized bandwidth.

In summary, Row 44 will mute transmission at a range that would otherwise have the potential to cause interference with any of the above identified terrestrial sites.

[redacted]Interference protection-Adjacent Satellites

Adjacent Satellite Interference (ASI) is mitigated by the sidelobe performance of the GSAA antenna (Satellites at 2° spacing have the greatest potential exposure to interference. It is unlikely that interference occurs for satellites with a spacing that is greater than 2° from the target satellite).
Row 44 shall ensure that:

- GSAA movement and pointing accuracy is accomplished such that the interference to adjacent satellites and/or adjacent transponders within the same satellite does not occur during the more-demanding instances during aircraft taxiing, take-off, in-flight, and landing;
- Under conditions of extreme and abrupt aircraft movement, where the GSAA hardware is incapable of immediately responding, and the pointing error temporarily exceeds 0.2°, that the transmitter is muted.

[redacted]Maximum EIRP

Row 44's maximum power spectral density at the antenna flange is -11.6 dBW/4kHz resulting in a maximum EIRP of 41.5 dBW in a 1.024 MHz bandwidth (cable and radome losses are accounted for). A plot of the EIRP density in a 4 kHz band for horizontal and vertical polarizations at 14.25 GHz with 0 degree skew (with traces covering the range of 15° to 90° elevation) is shown in Figure 1 per 47 CFR Part 25.227(a)(1).

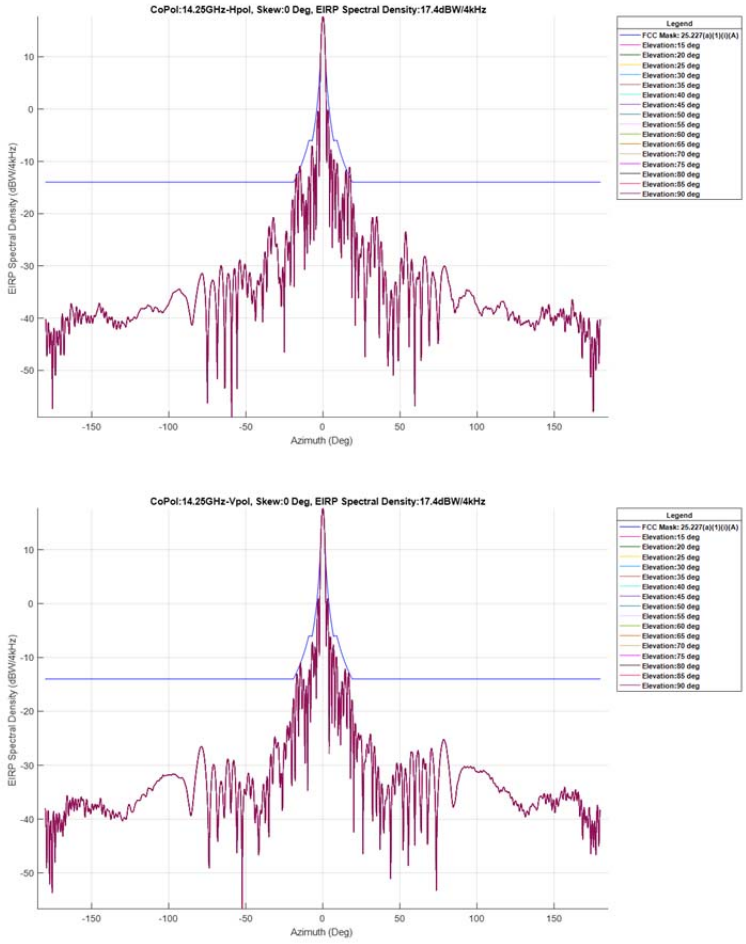


Figure 1 – EIRP Density for Horizontal and Vertical Polarization with 0° Skew (and 15° to 90° elevation) at 14.25 GHz to Show 47 CFR Part 25.227(a)(1)(i)(A) compliance

1.4 Program Objectives

Row 44's GSAA system has several challenges to be met in order to most effectively attain optimal performance. Thus the following issues need to be evaluated under controlled conditions:

1. Maintaining the antenna pointing accuracy during aircraft taxi, take-off, in-flight, and landing, and assuring the 'time-to-mute' (if the 0.5° accuracy is exceeded) is within requirements.
2. Eliminating the potential of adjacent satellite interference for satellites within 2° to 6° spacing of the target satellite, while operating the transmitter at its maximum, authorized level.
3. Assessing the extent of geographic RF coverage regions, performing satellite 'handoffs' as needed, considering prevailing skew angle and GSAA pointing elevation angles
4. Evaluating bit error rate (BER) performance both in clear and severe weather conditions
5. Verifying Doppler compensation performance during moments of rapid aircraft acceleration and high velocity
6. Determining the necessary ranges for avoiding interference to terrestrial locations such as NASA TDRSS sites, NSF Radio Astronomy site, and FCC monitoring sites

1.5 Contributions to the Development of Radio Art

Operation of airborne internet service is a burgeoning field, where airlines anticipate significant increases in passenger traffic as long as satisfactory user experience is maintained. To ensure that users are offered reliable service at speeds commensurate with their expectations, extensive evaluation must be conducted prior to full scale commercial deployment of any enhanced new transmit/receive terminals.

High speed service aboard a commercial aircraft via satellite is markedly dependent on the radio link performance, aircraft motion, and airborne antenna dynamics and characteristics. In addition, this performance must not interfere with existing satellite and ground services making it imperative to identify any situations where interference might occur that require transmitter muting.

APPENDIX A. EIRP Spectral Density Plots

EIRP Spectral Density Plots

GSAA EIRP SPECTRAL DENSITY PLOTS – TANGENT PLANE TO GSO CO POL WITH 25.227(A)(1)(I)(A) MASK

DESCRIPTION

- EIRP Spectral Density plots are at 14.00 GHz, 14.25 GHz and 14.50 GHz for both vertical and horizontal polarization for the following Skew and Elevation Angles as it is mapped to the maximum EIRP Spectral Density in dBW/4kHz in a 1.024 MHz Bandwidth (in **BOLD**):

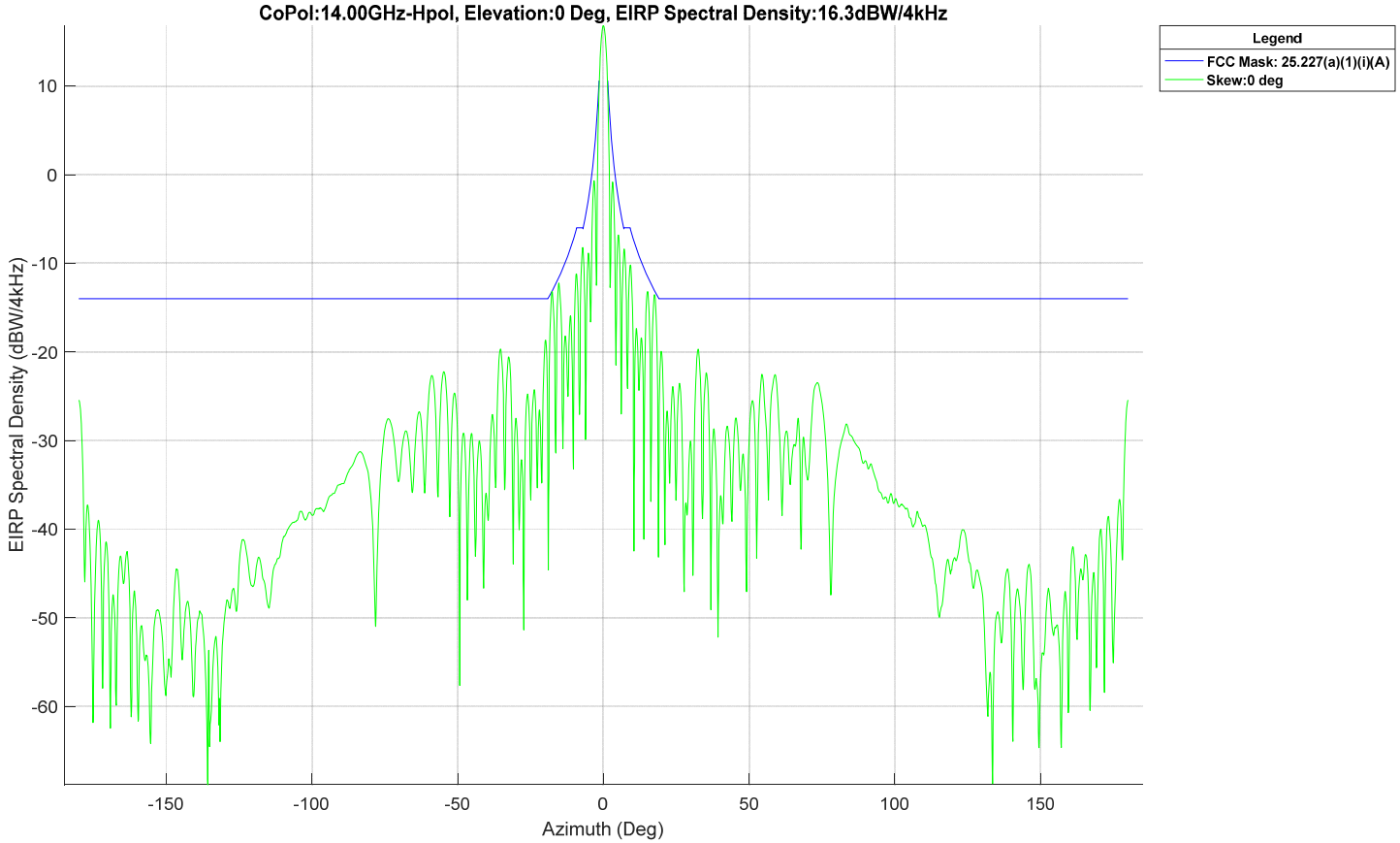
DESCRIPTION

Tangent Plane to GSO Co Pol ESD Plots as they comply to FCC mask 25.227(a)(1)(i)(A)

GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	**16.80**	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	**4.80**
5	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
10	16.80	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50	4.80
15	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10	5.10
20	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10	5.10
25	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50
30	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70	5.50
35	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10
40	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40	6.10
45	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00	6.70
50	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70	7.40
55	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70	9.40	8.00
60	17.70	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.50	14.90	14.20	13.30	12.30	11.30	10.10	8.70
65	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20	14.50	13.80	12.90	11.80	10.70
70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.60	17.30	17.00	16.50	16.00	15.80	14.90	14.20	13.30	12.30
75	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.50	17.20	16.80	16.30	15.80	15.20
80	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70
85	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70
90	**17.70**	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	**17.70**

*Note: Includes Radome and Cable losses

COPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:16.3DBW/4KHZ



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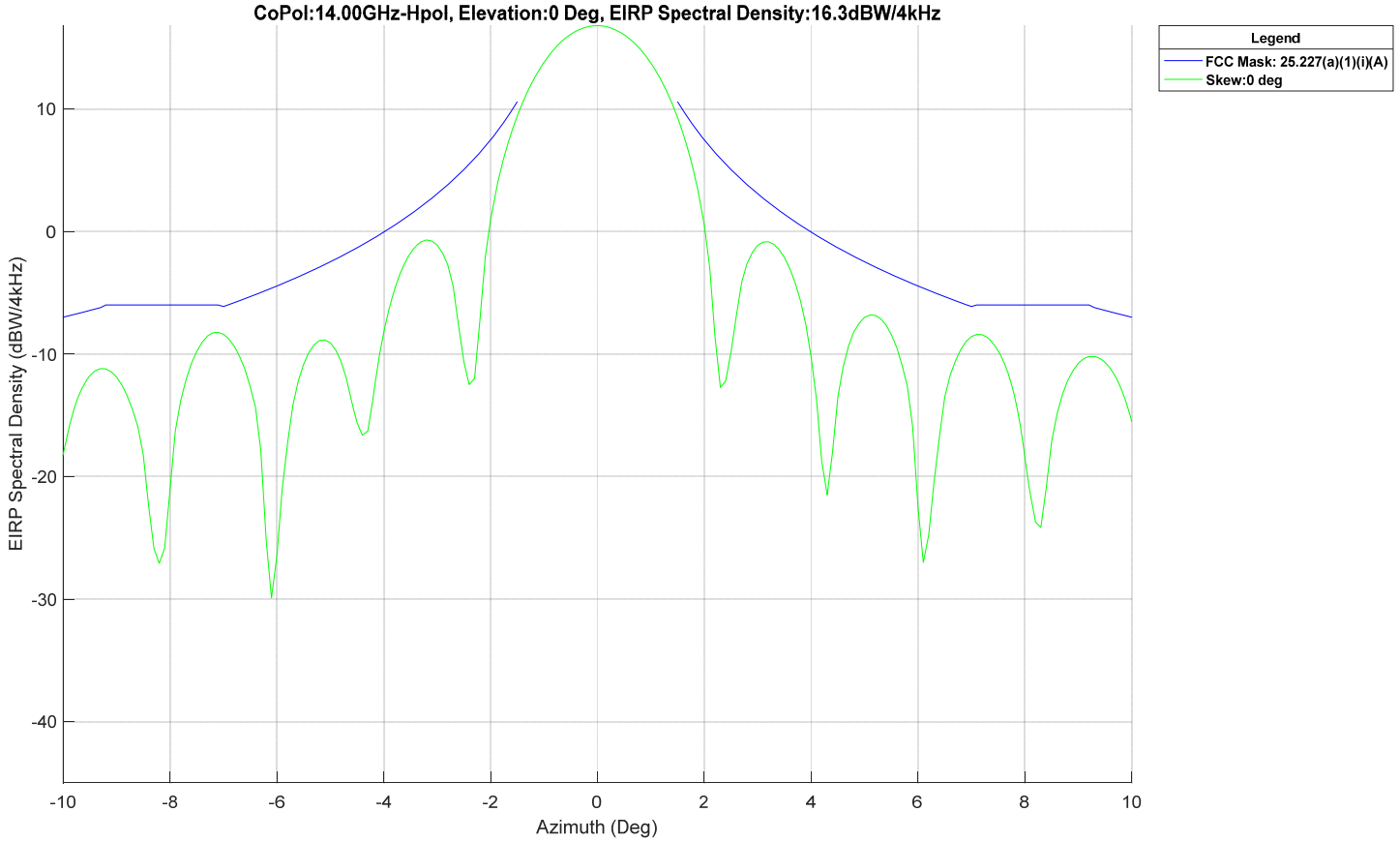
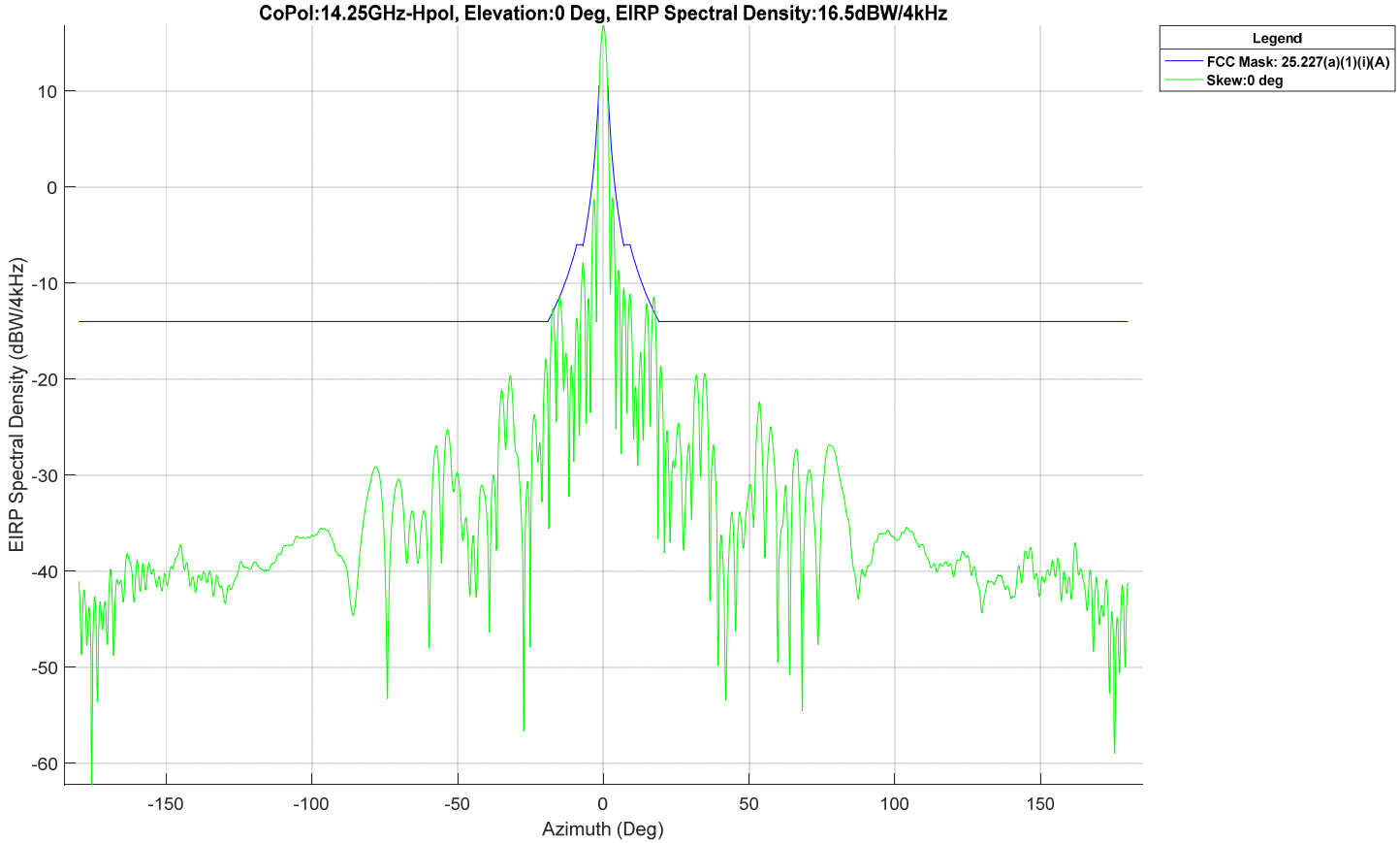


COPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:16.5DBW/4KHZ



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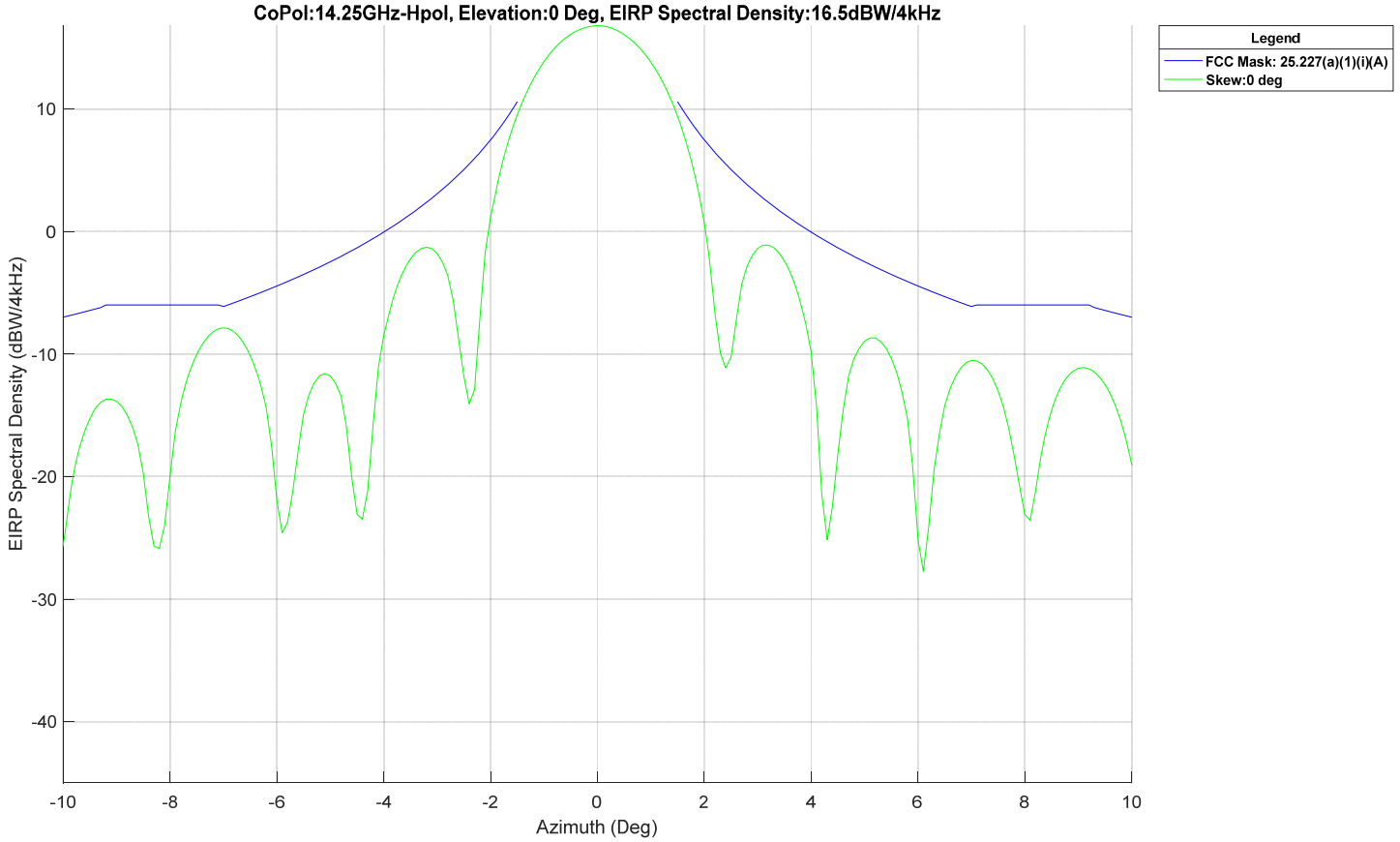

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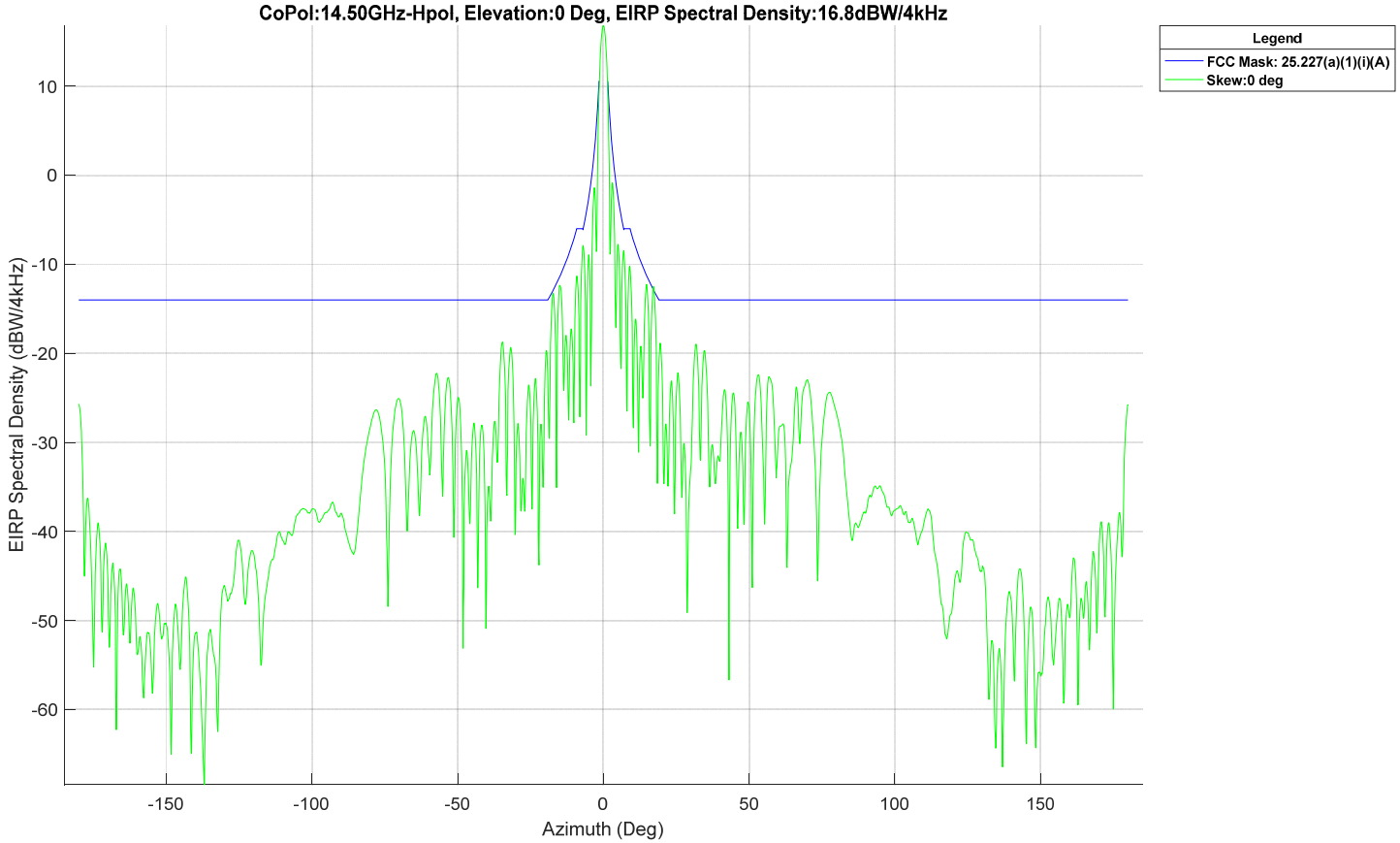

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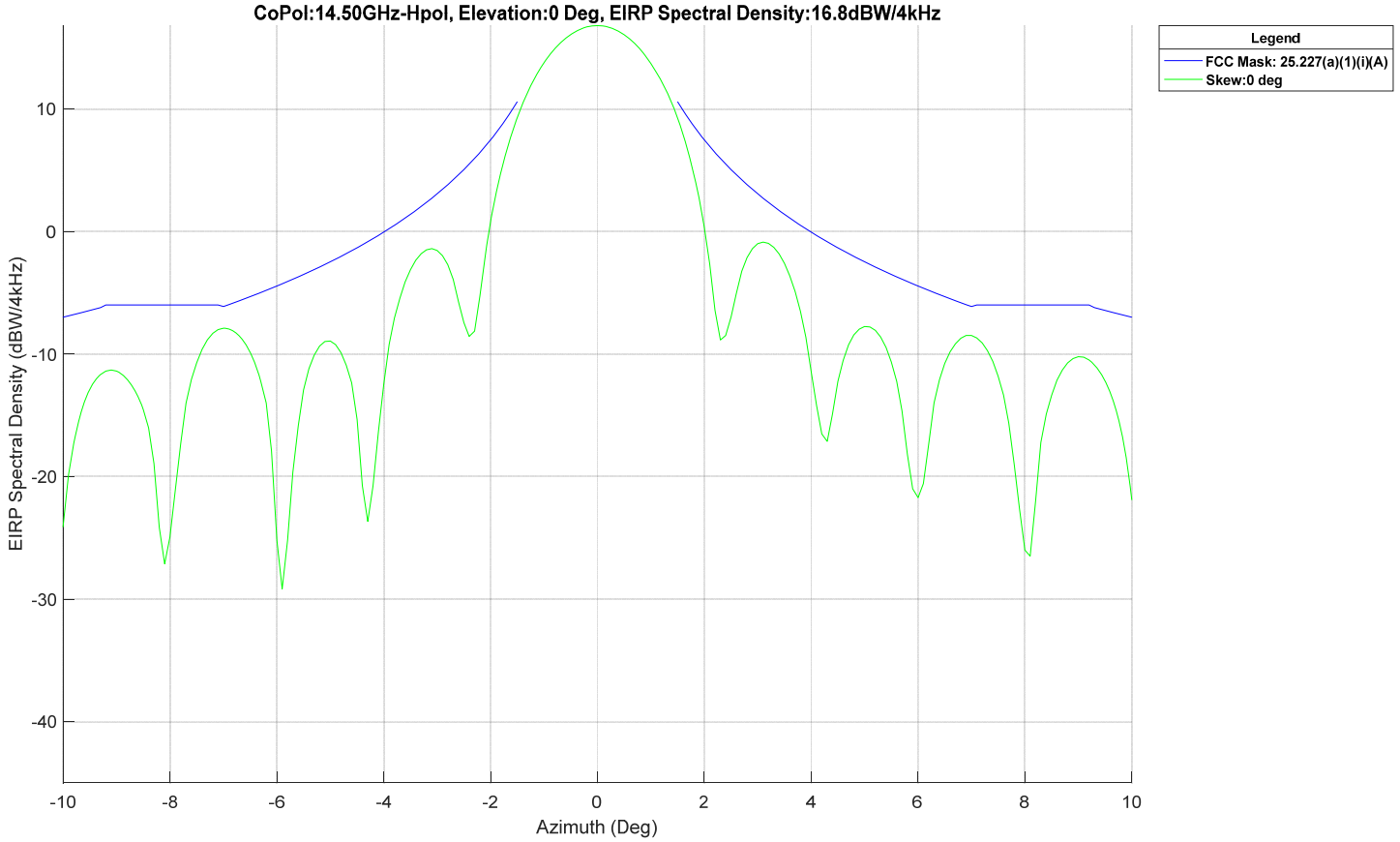

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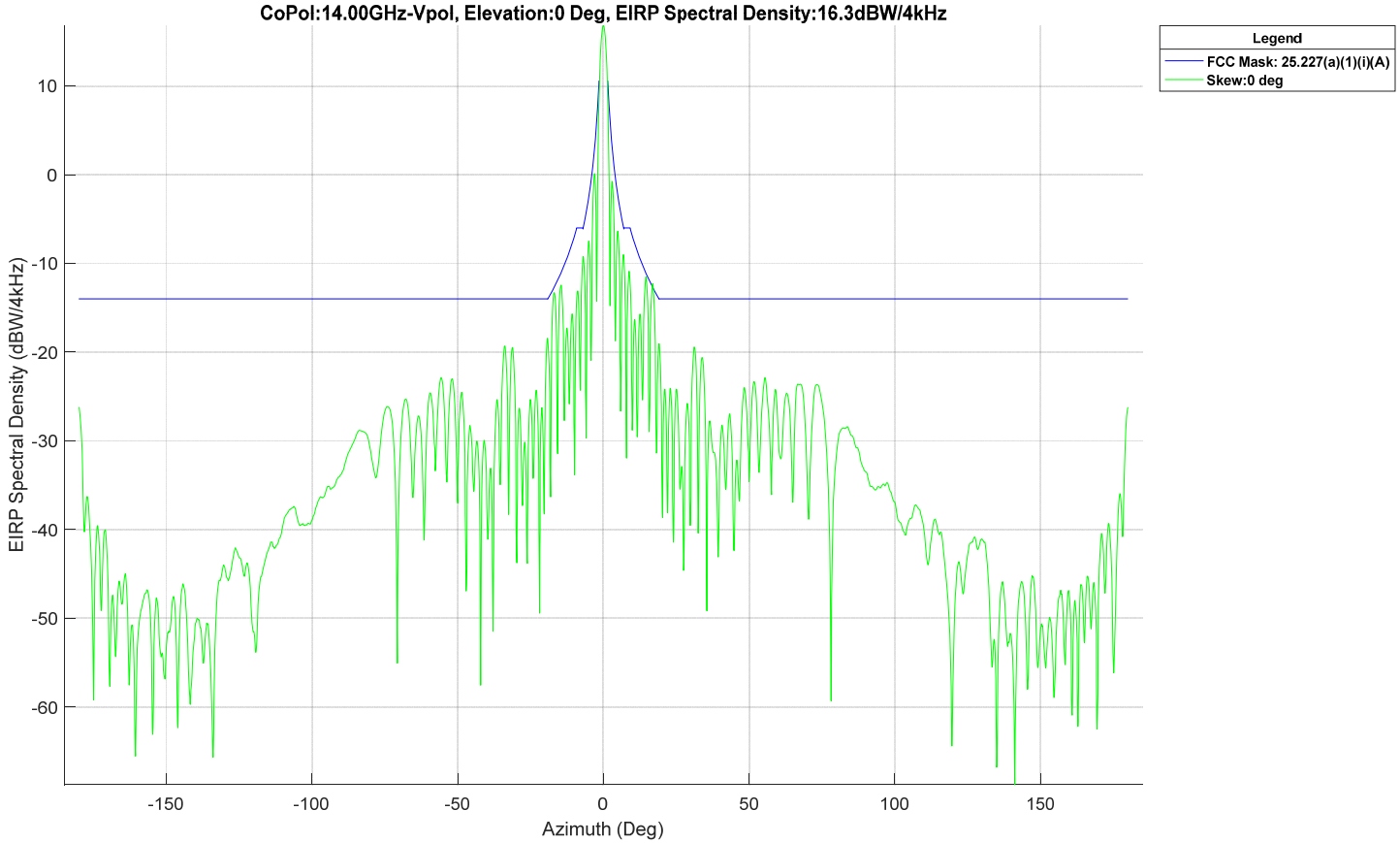

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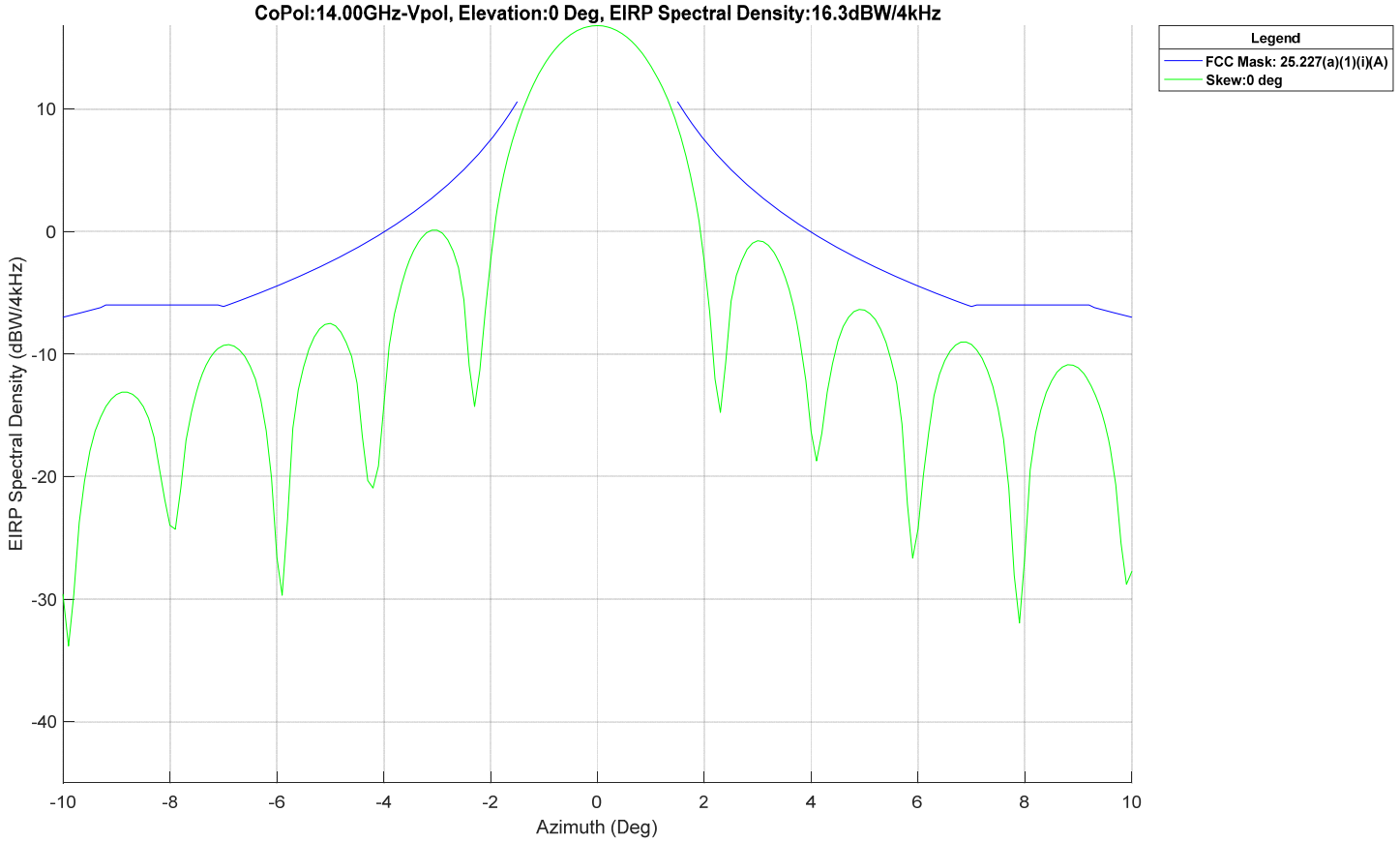

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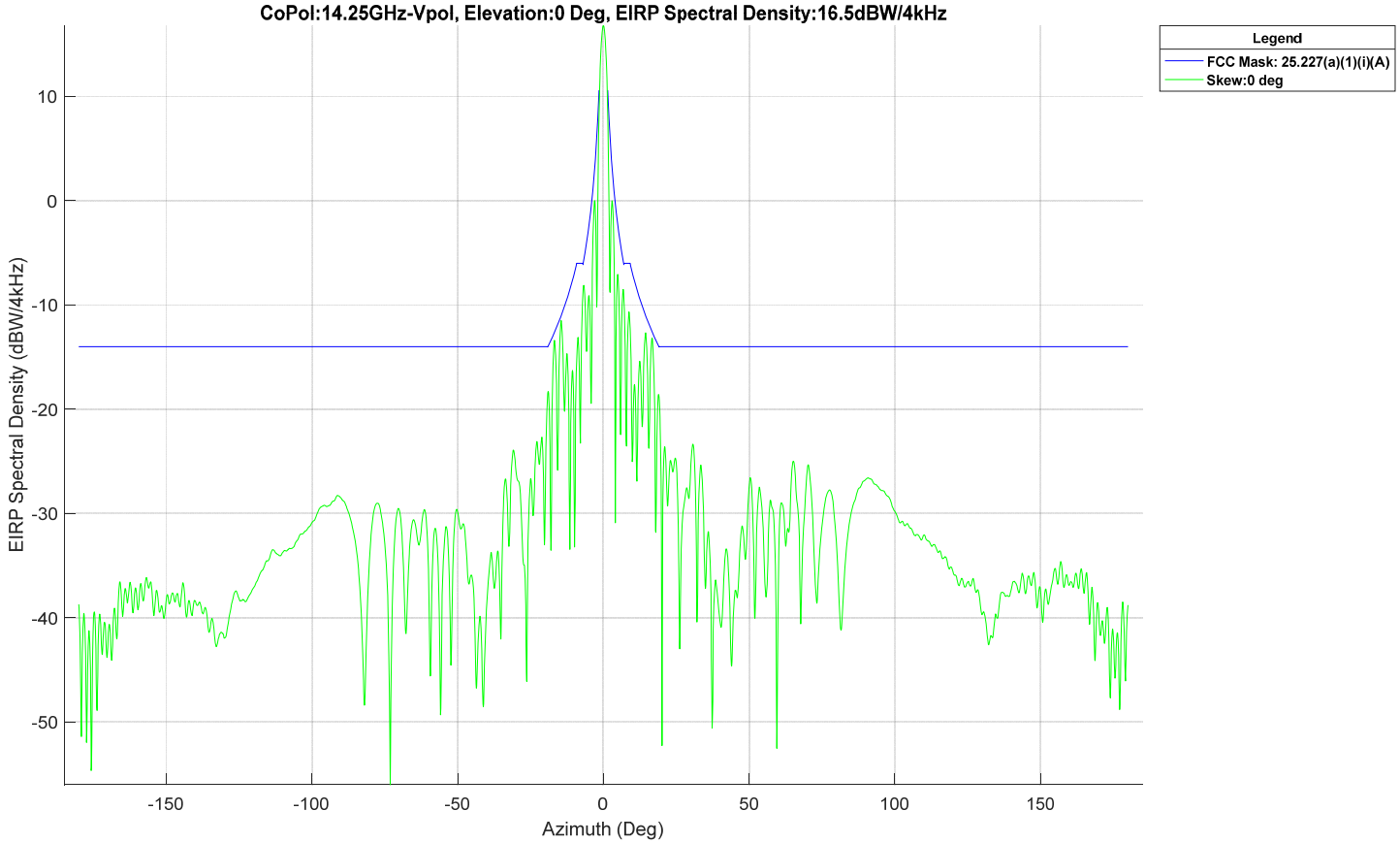

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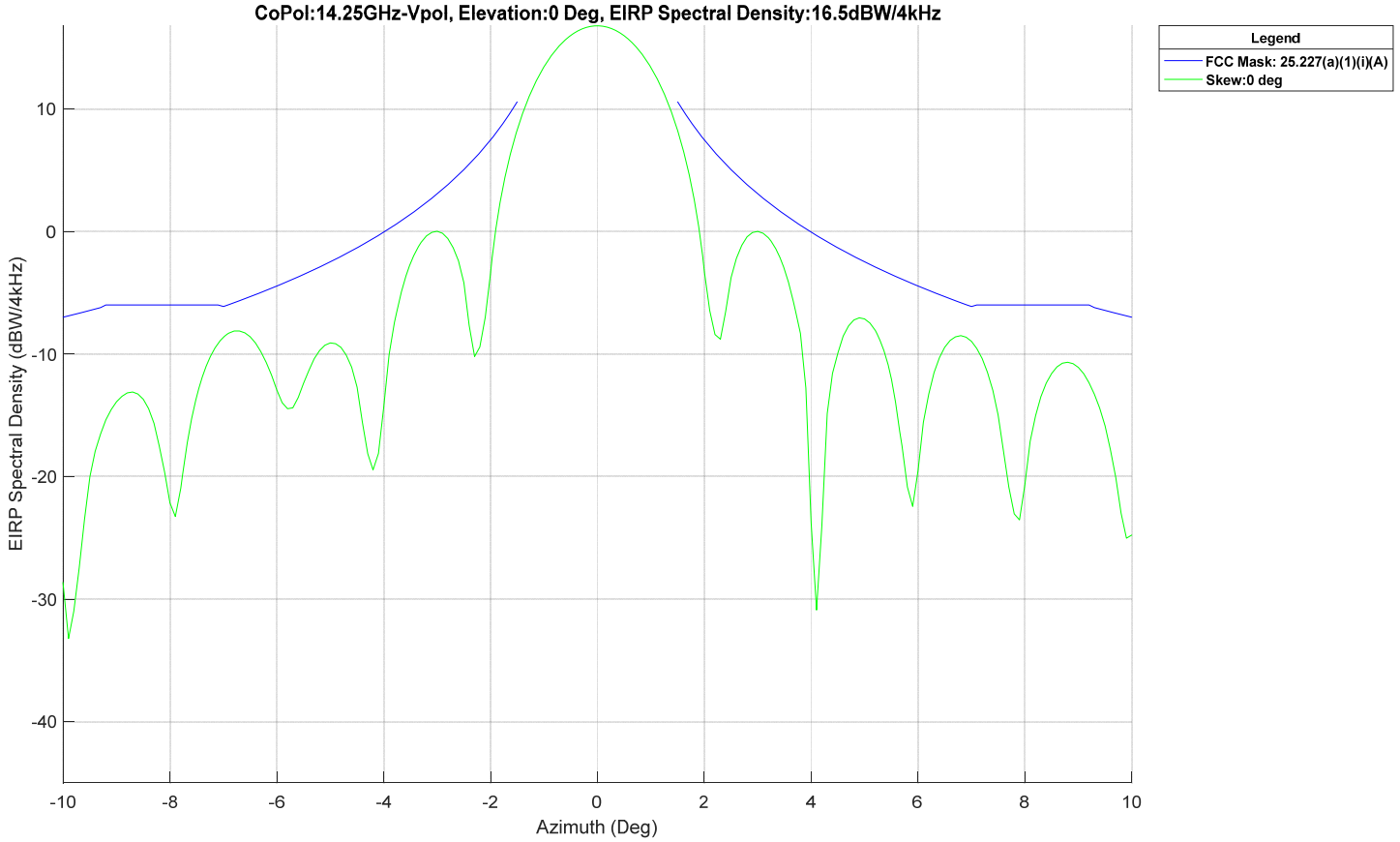

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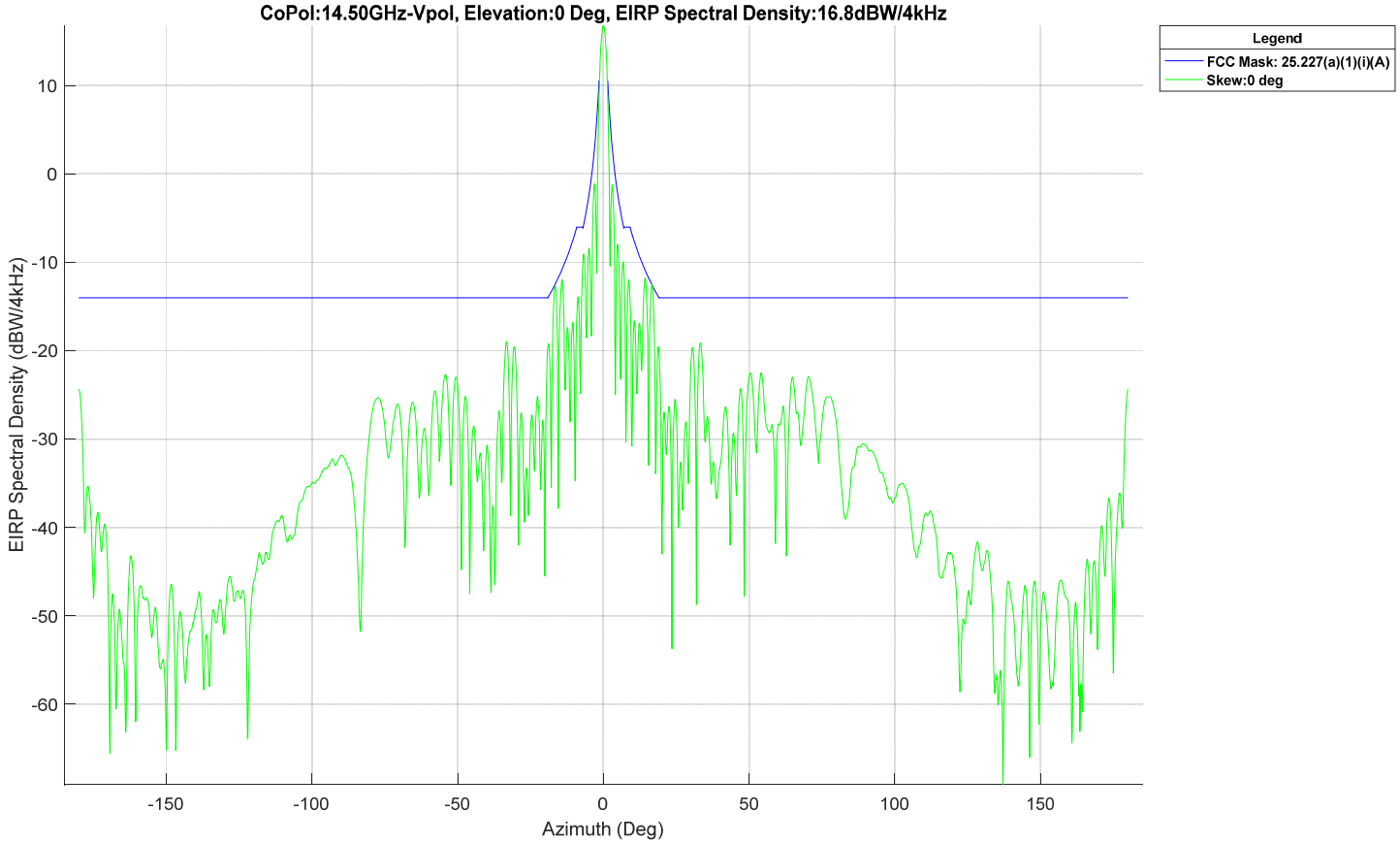

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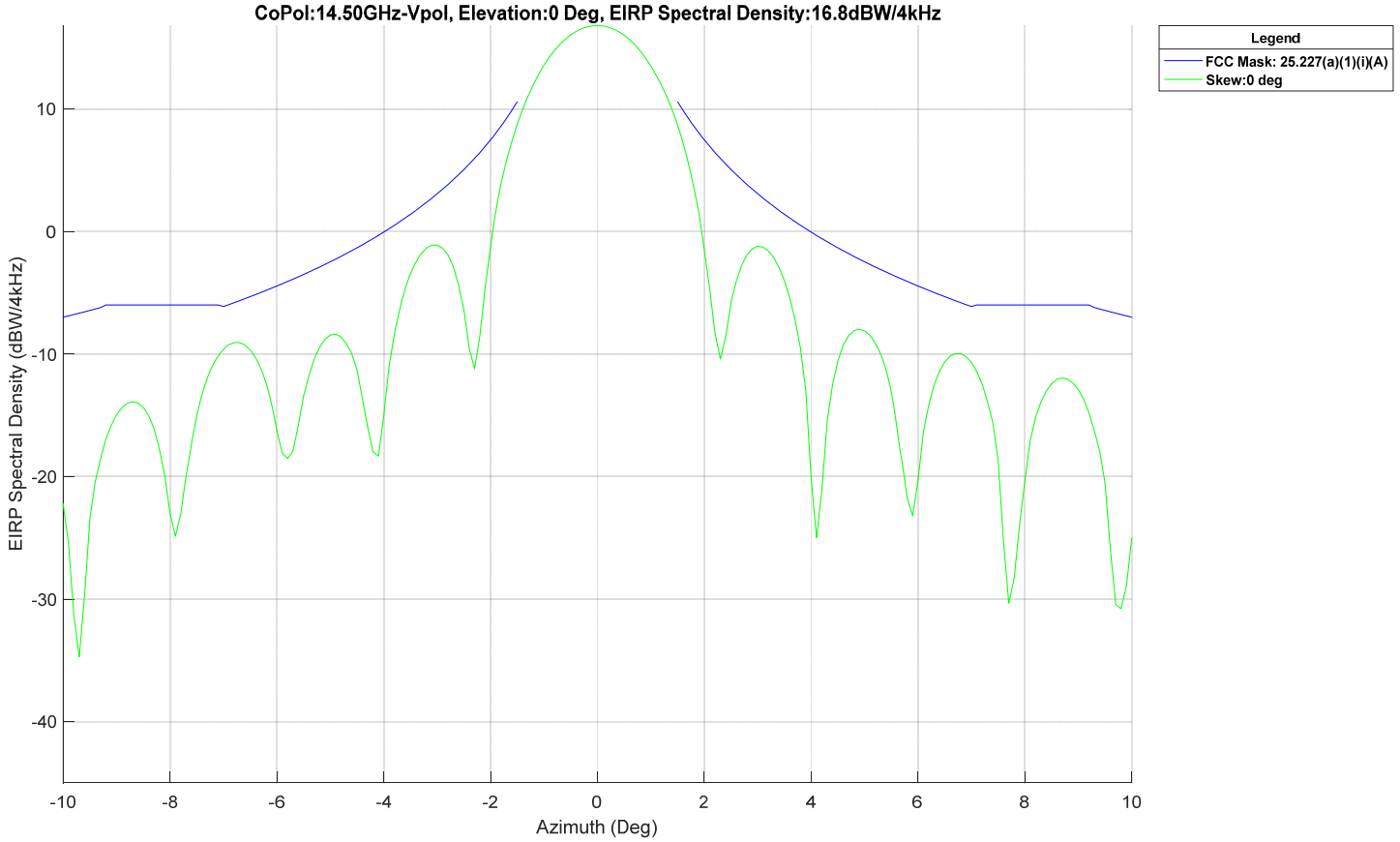

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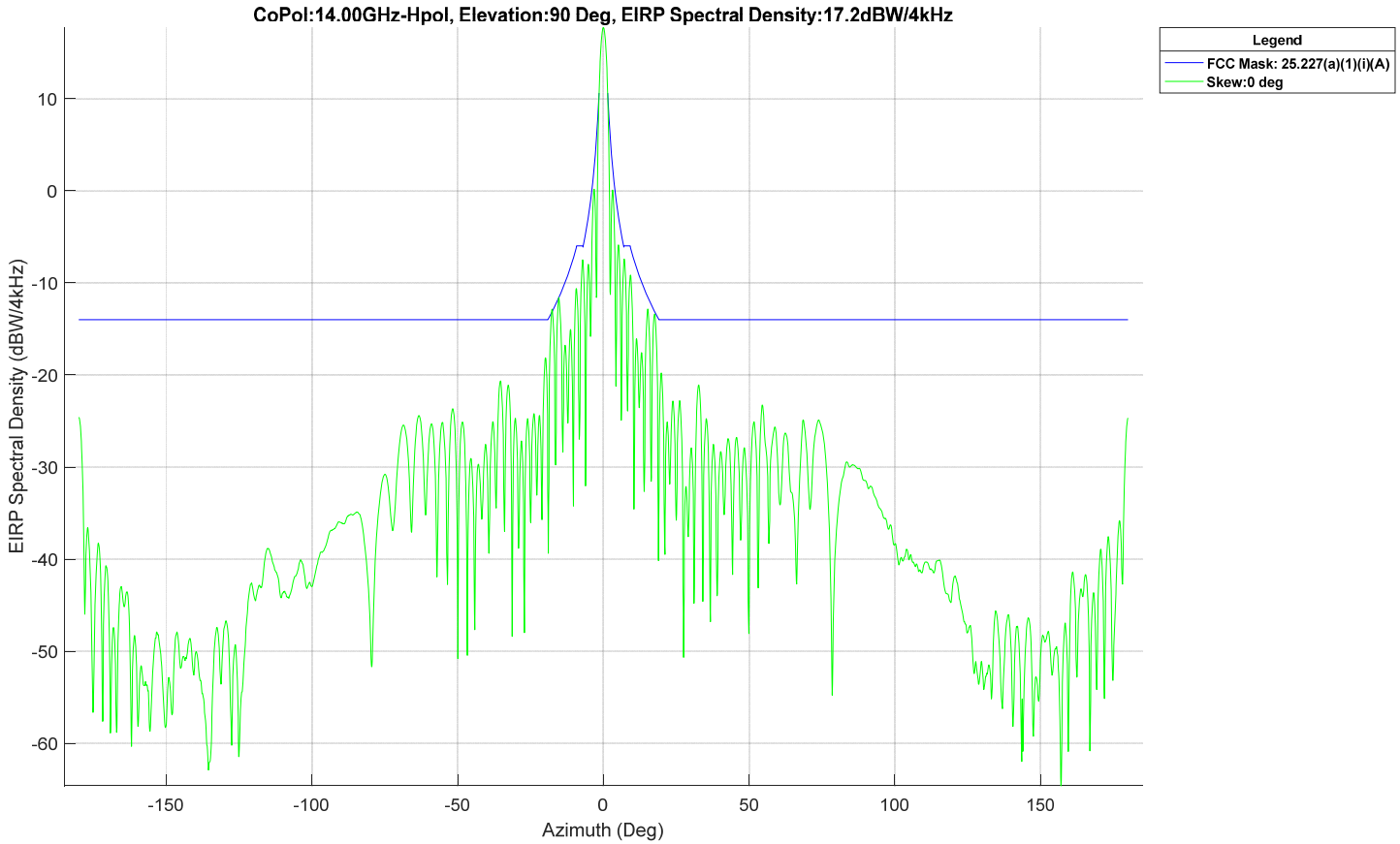
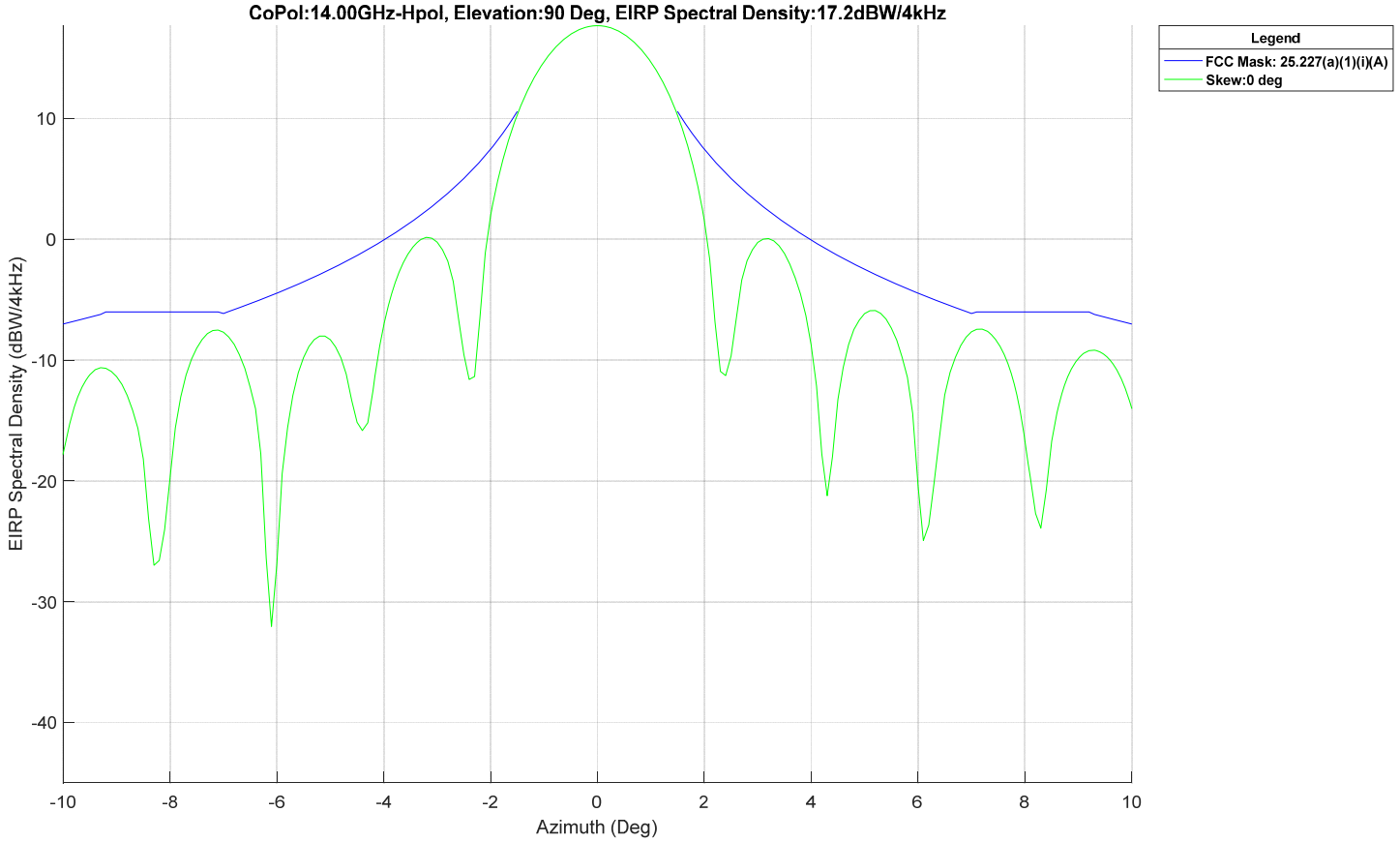


COPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



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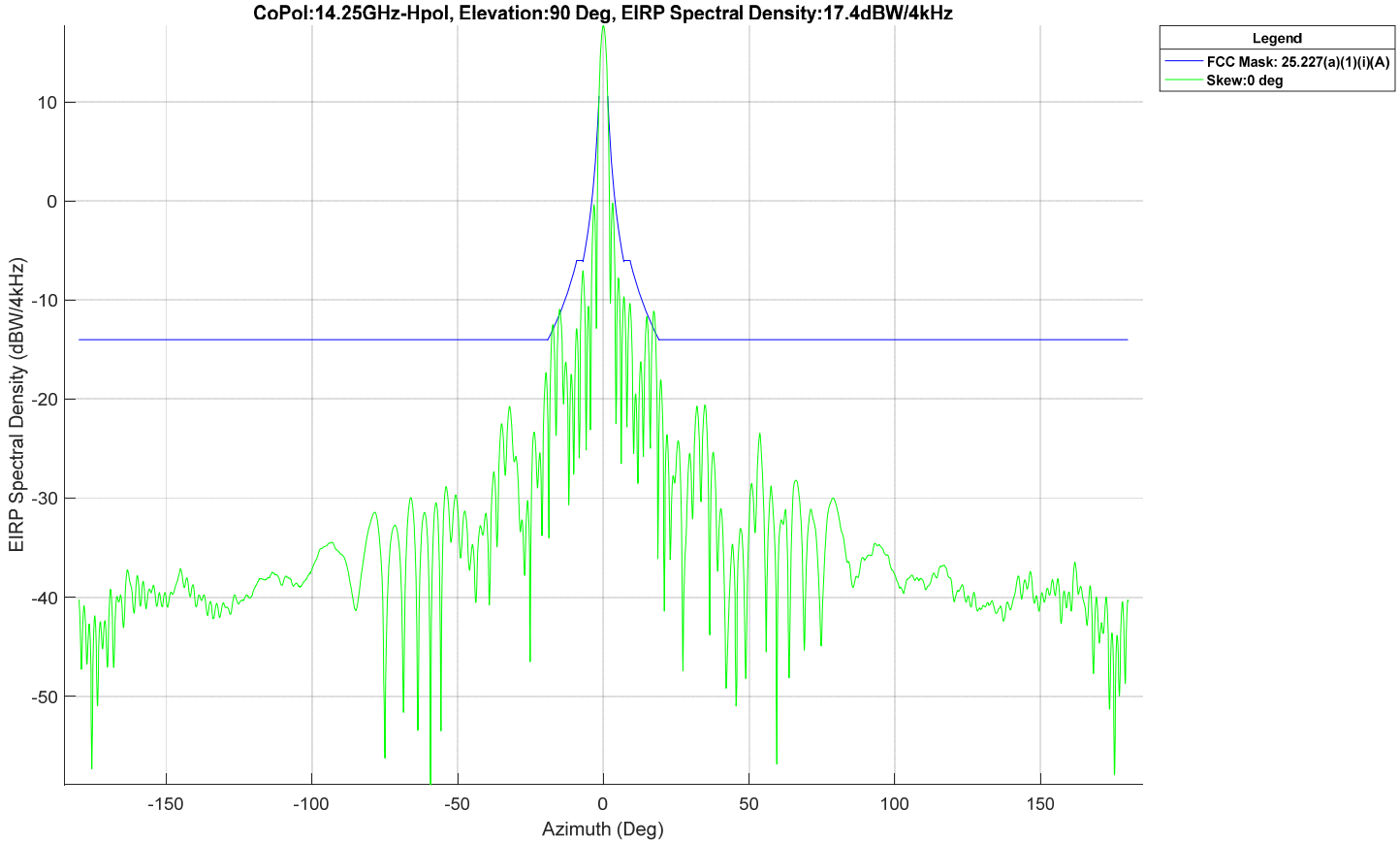
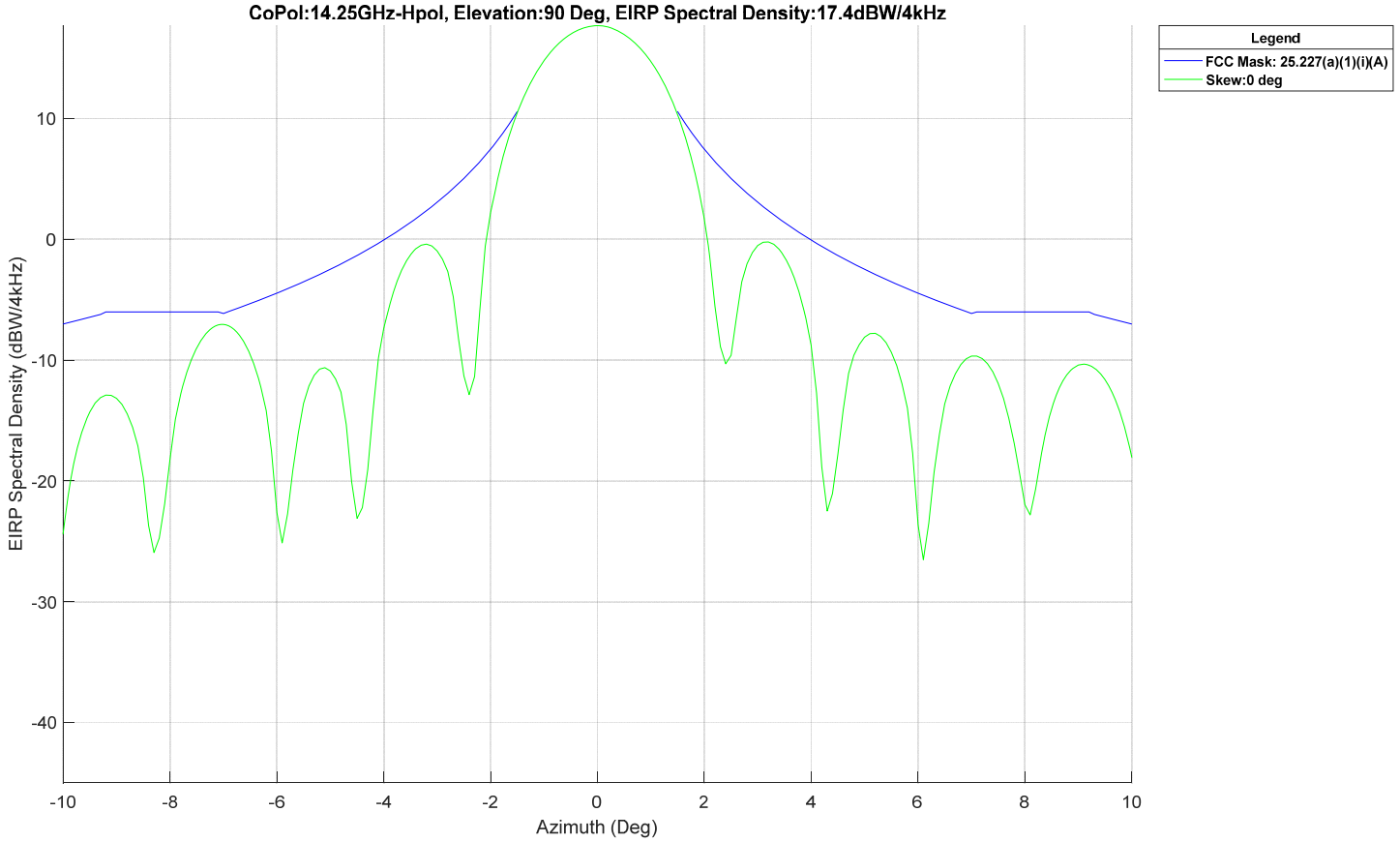
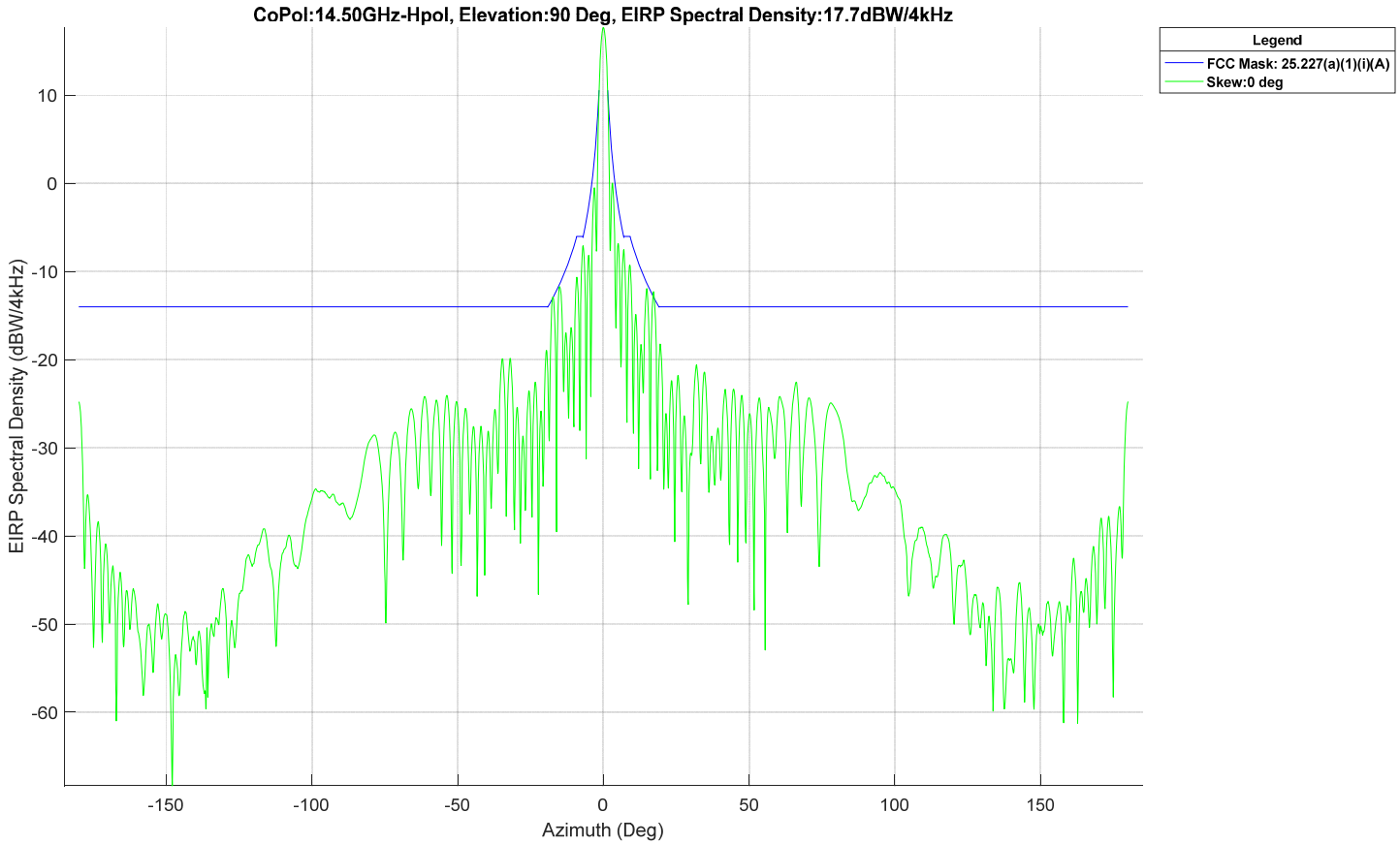


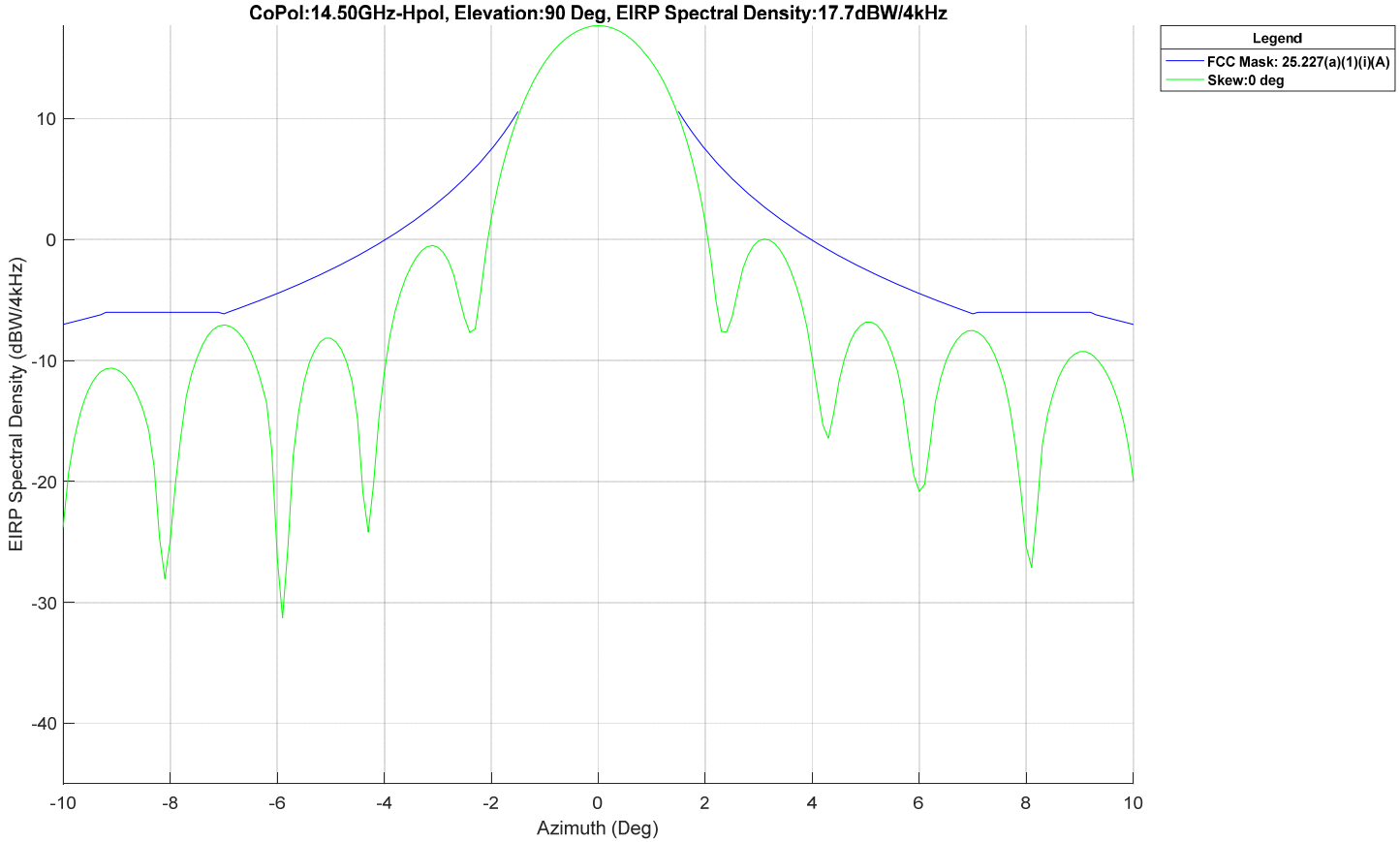
COPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



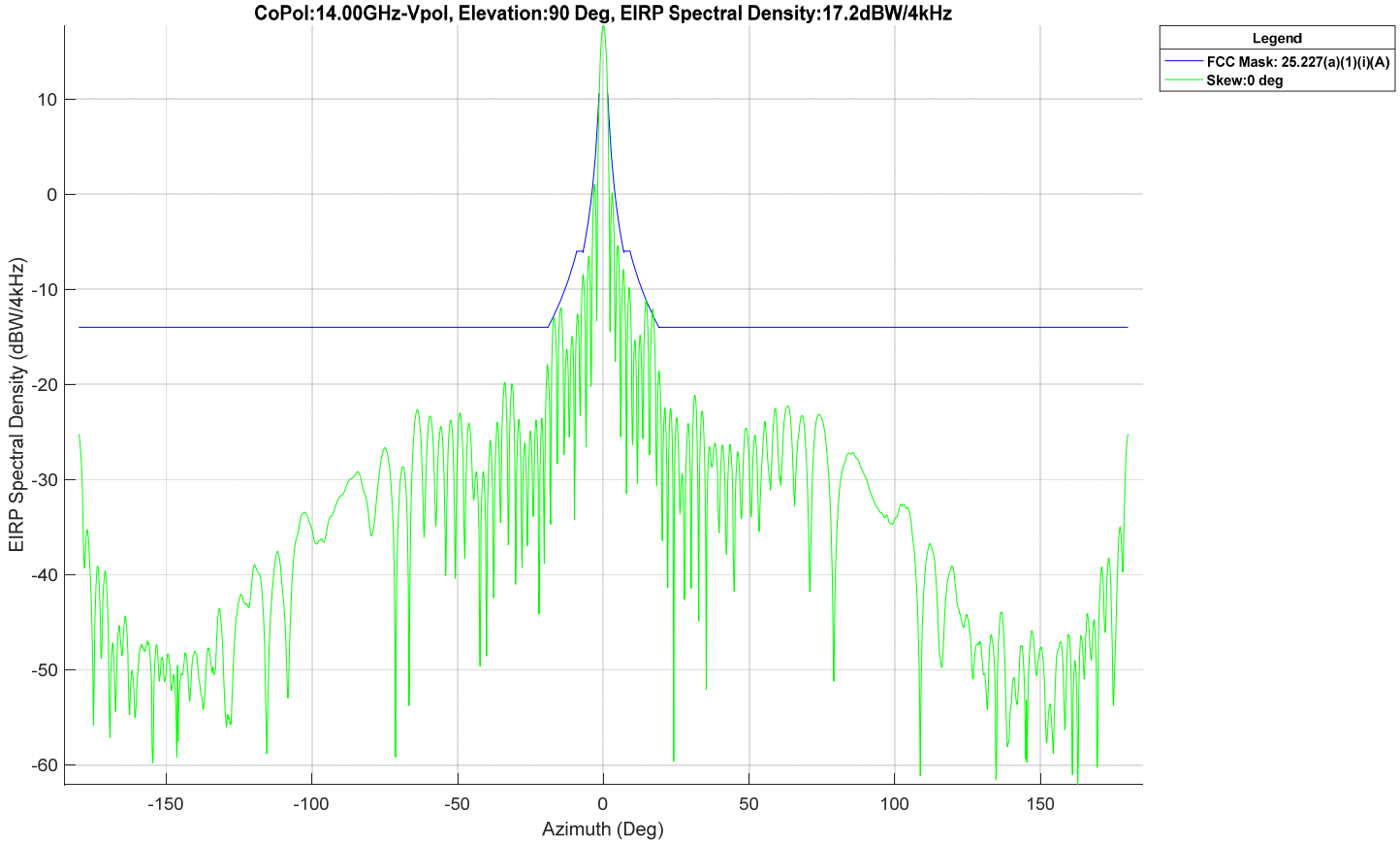
COPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



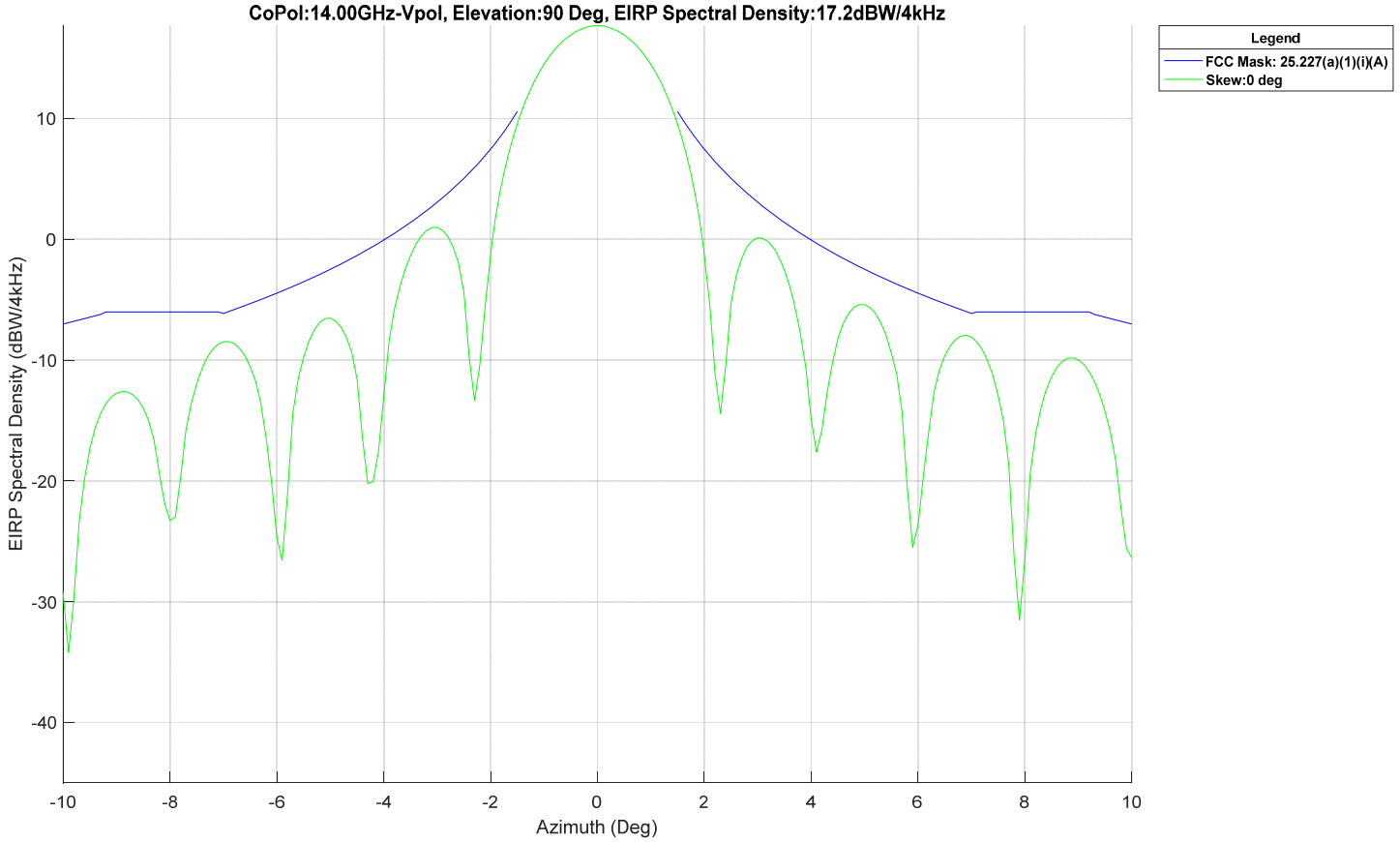
COPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



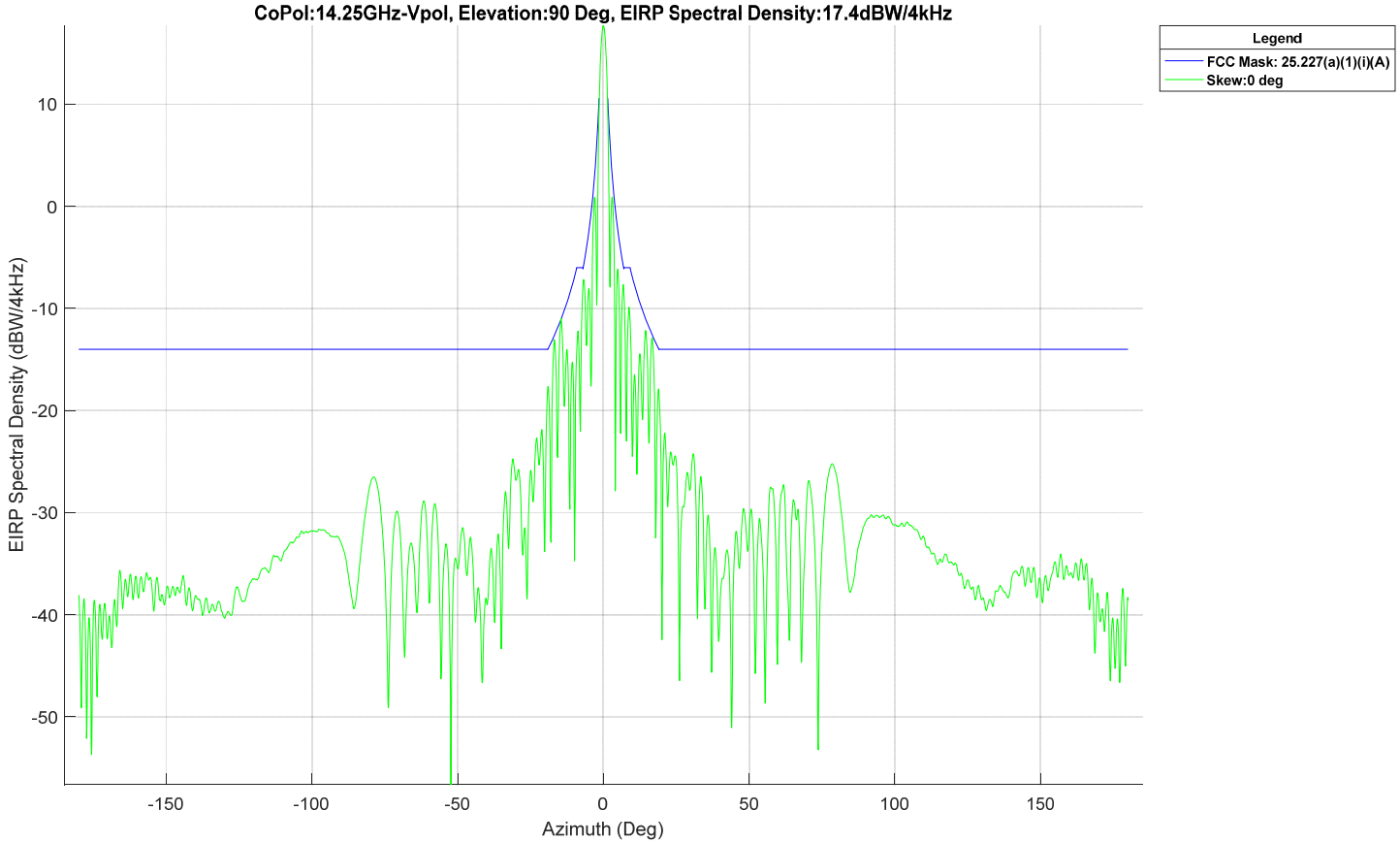
COPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



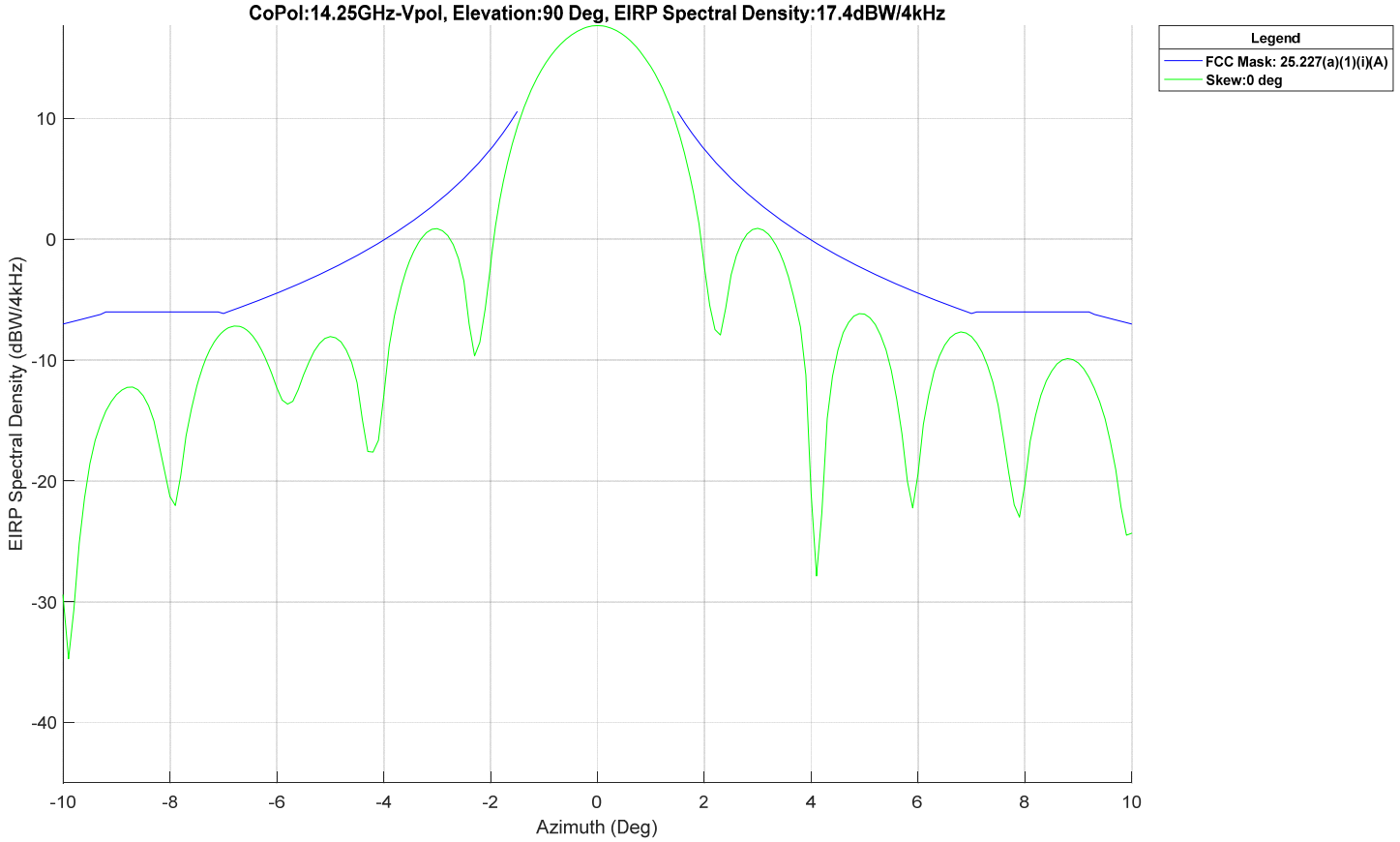
COPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



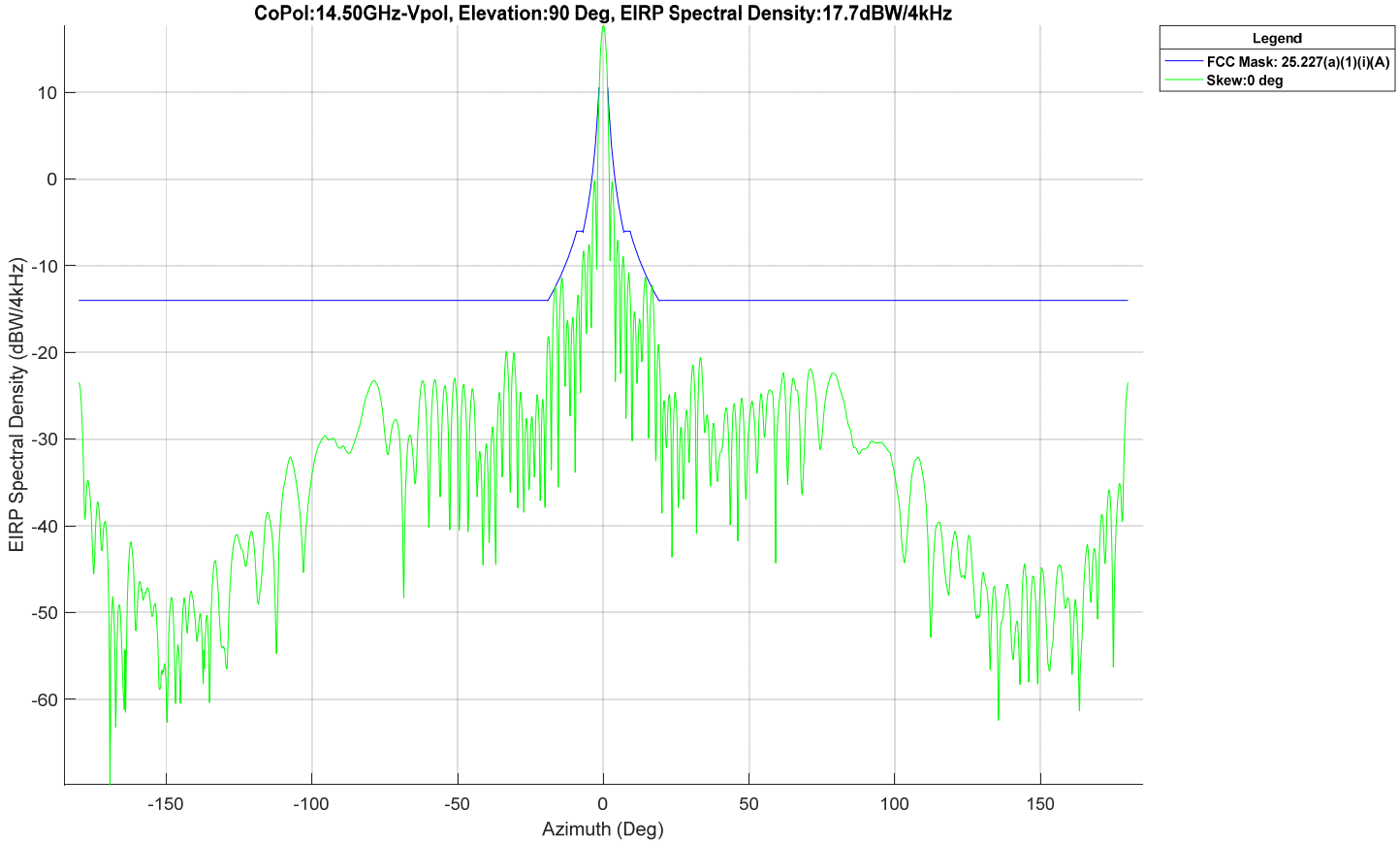
COPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



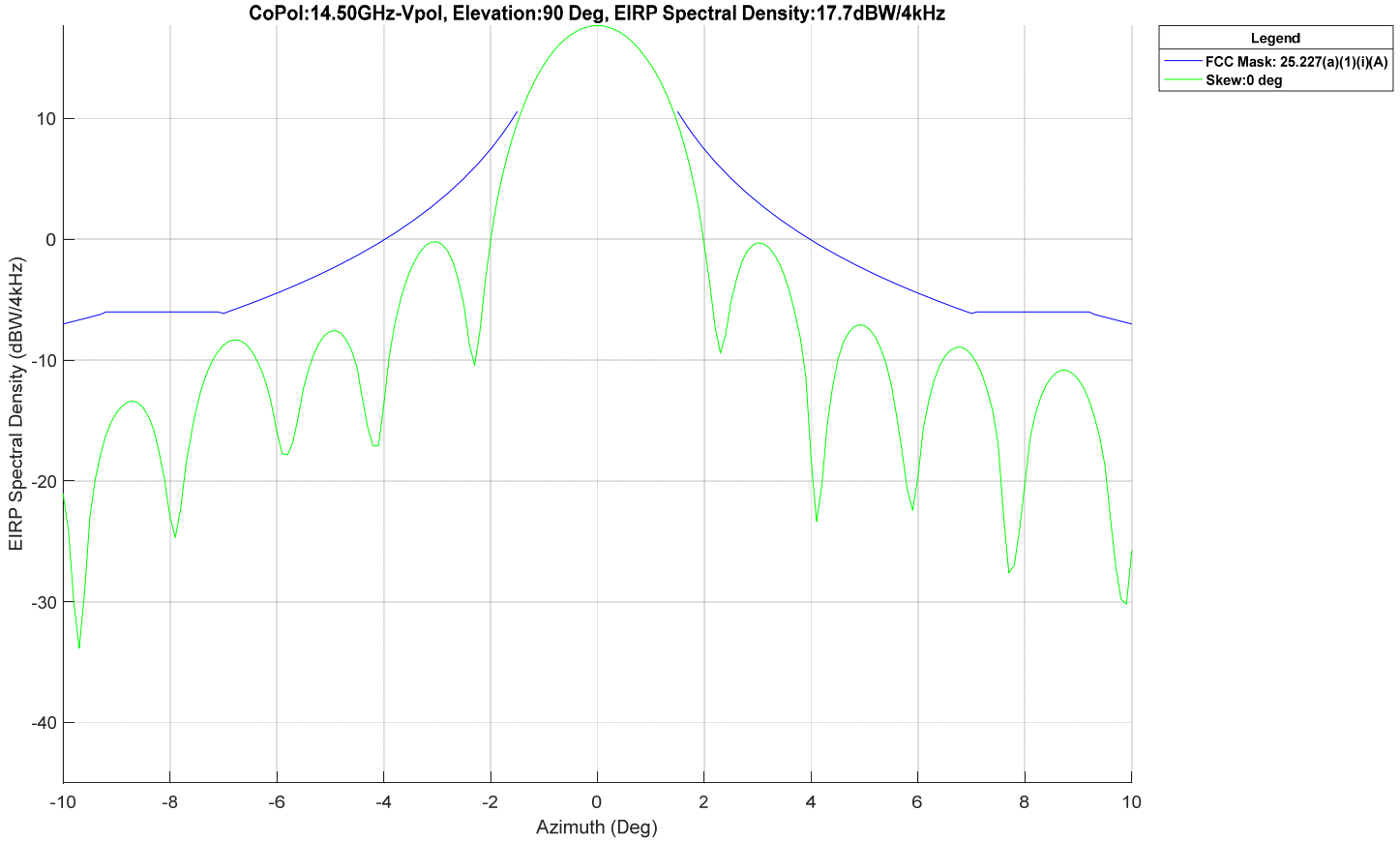
COPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



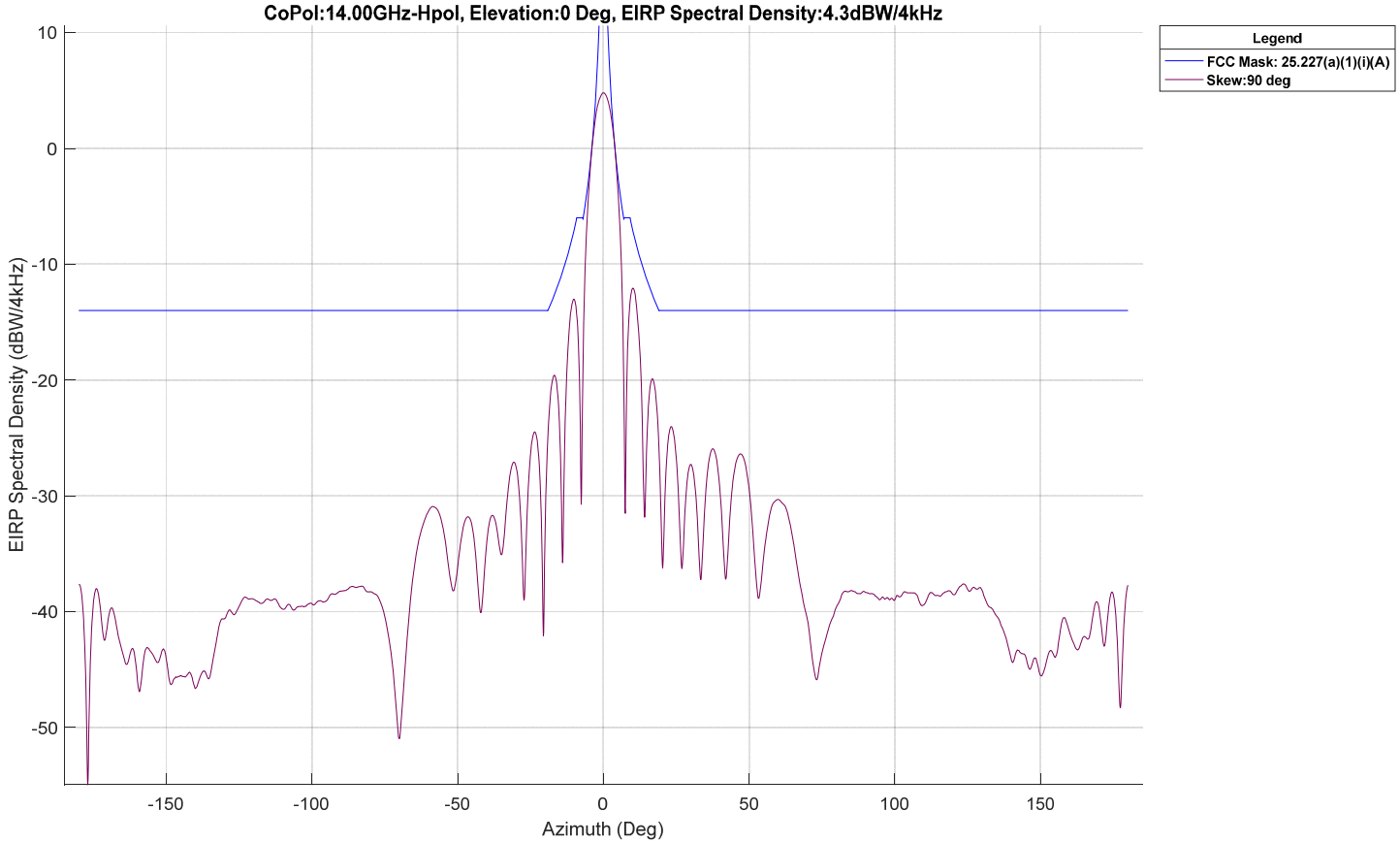
COPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



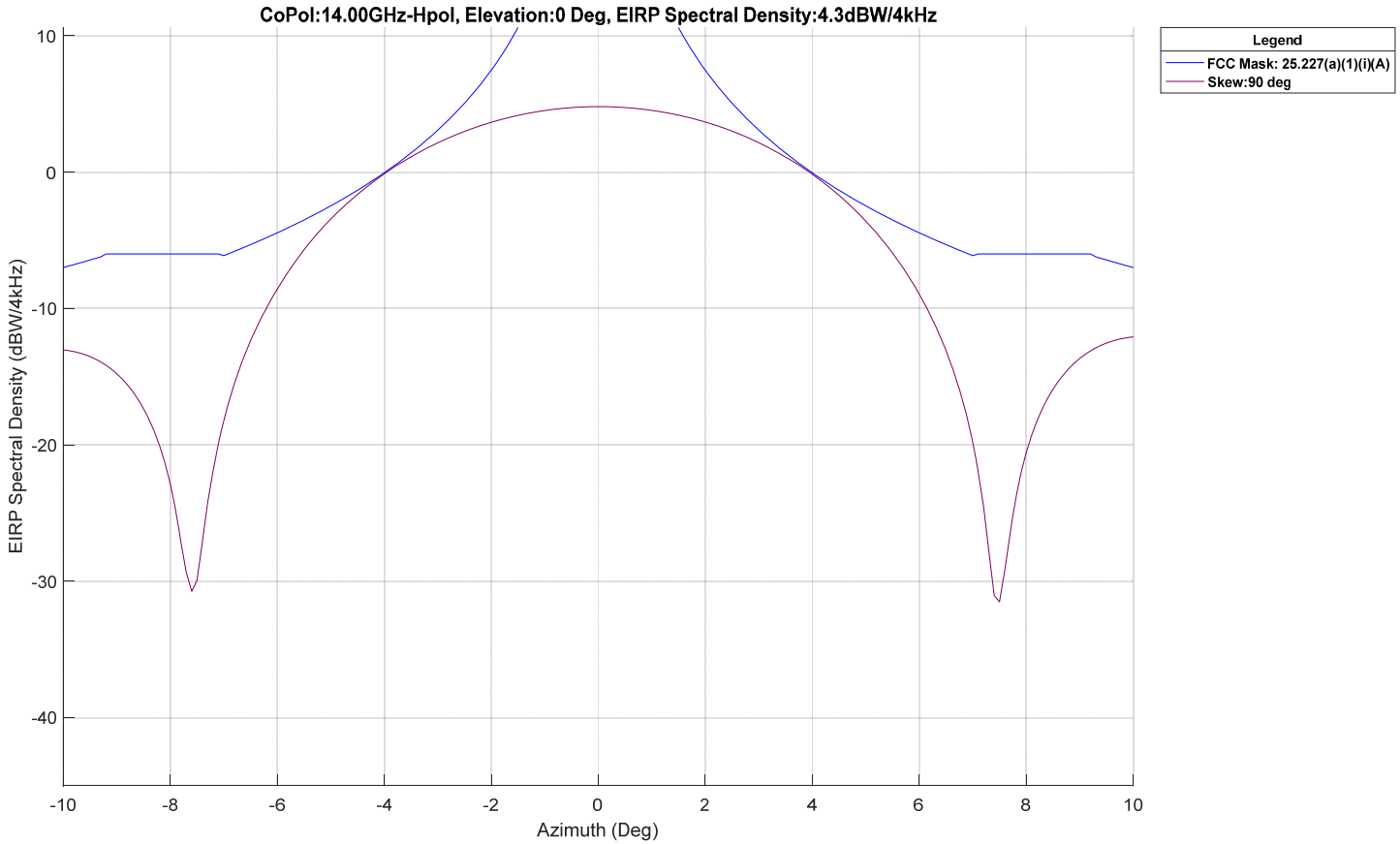
COPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



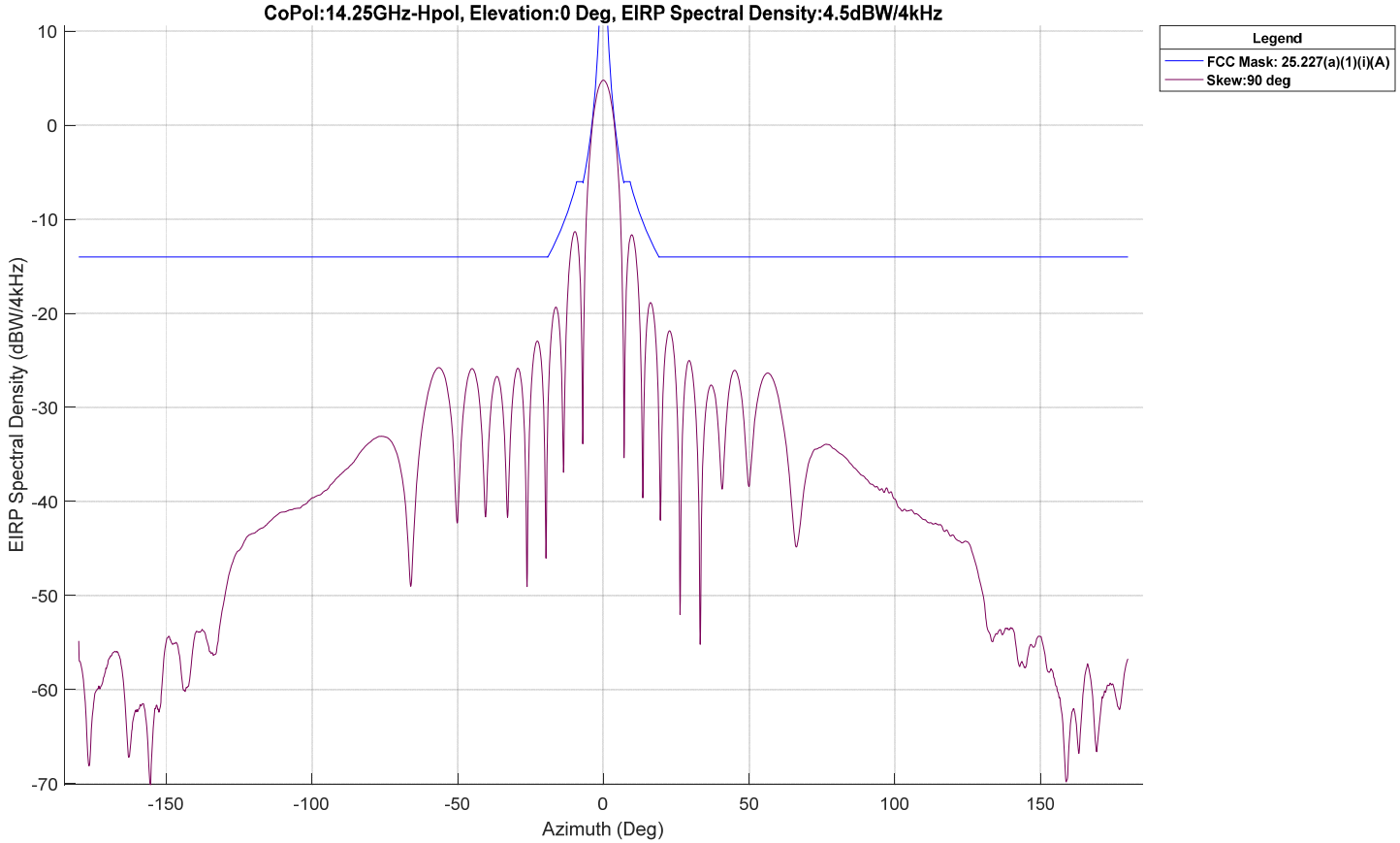
COPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.3DBW/4KHZ



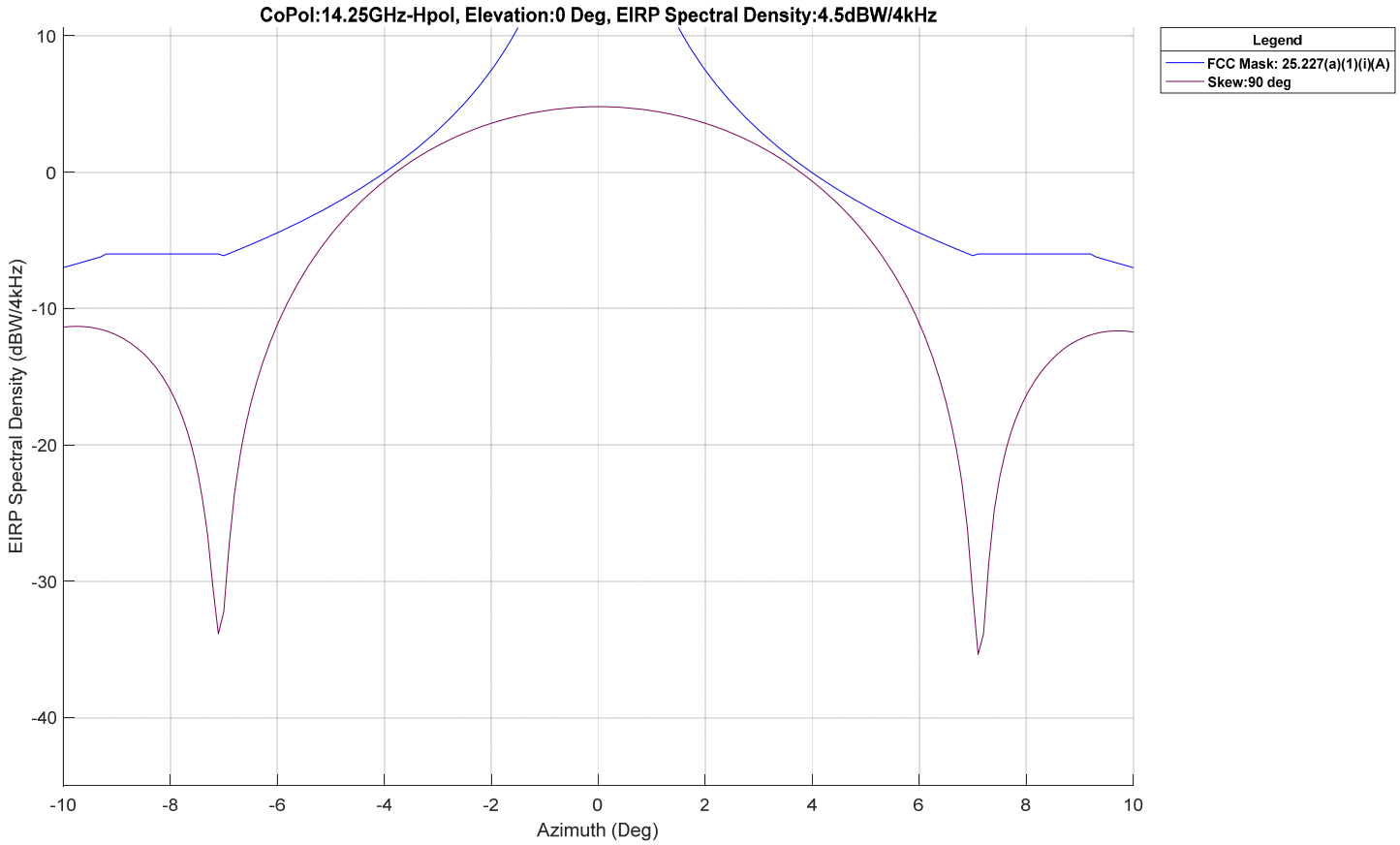
COPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.3DBW/4KHZ



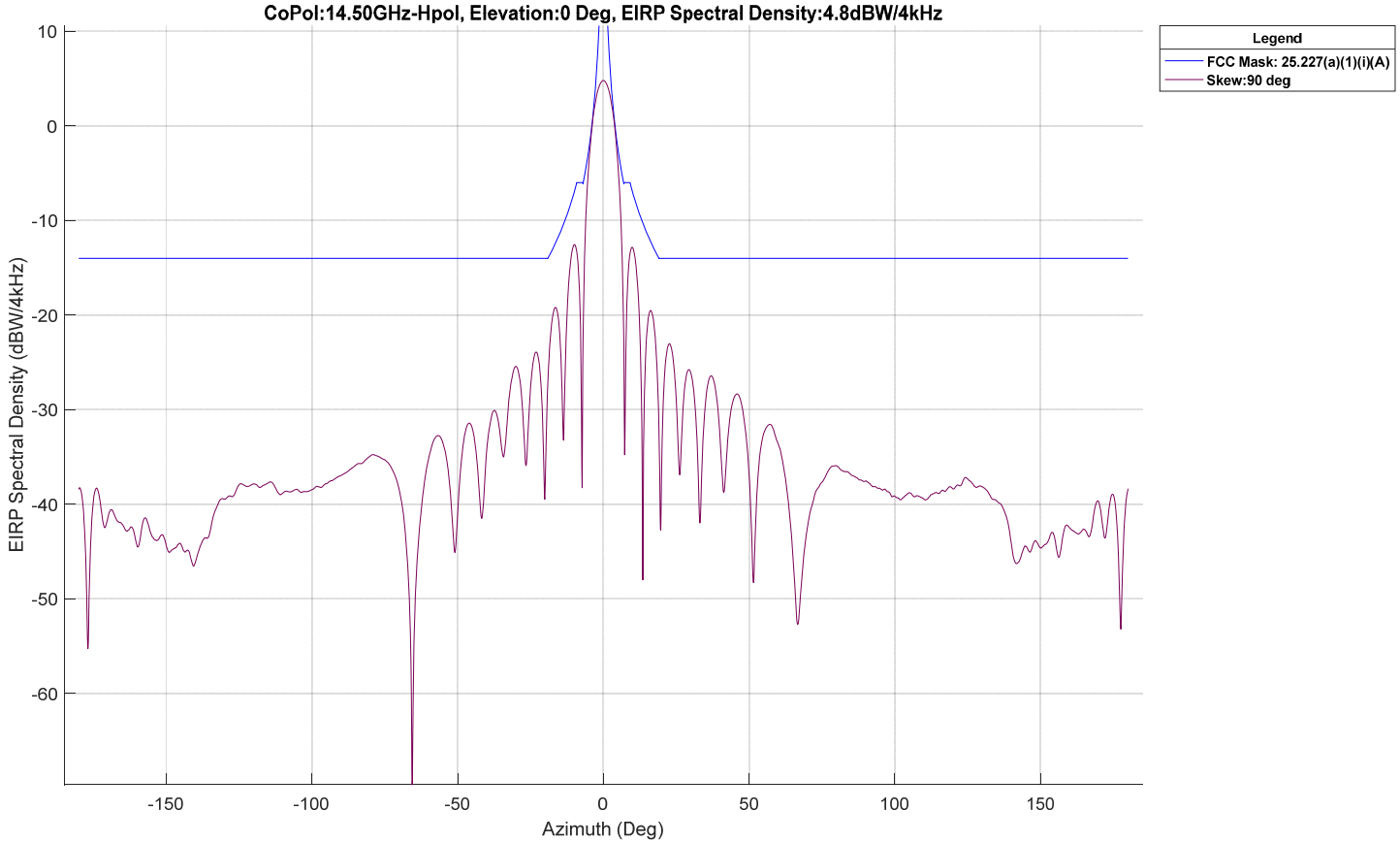
COPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.5DBW/4KHZ



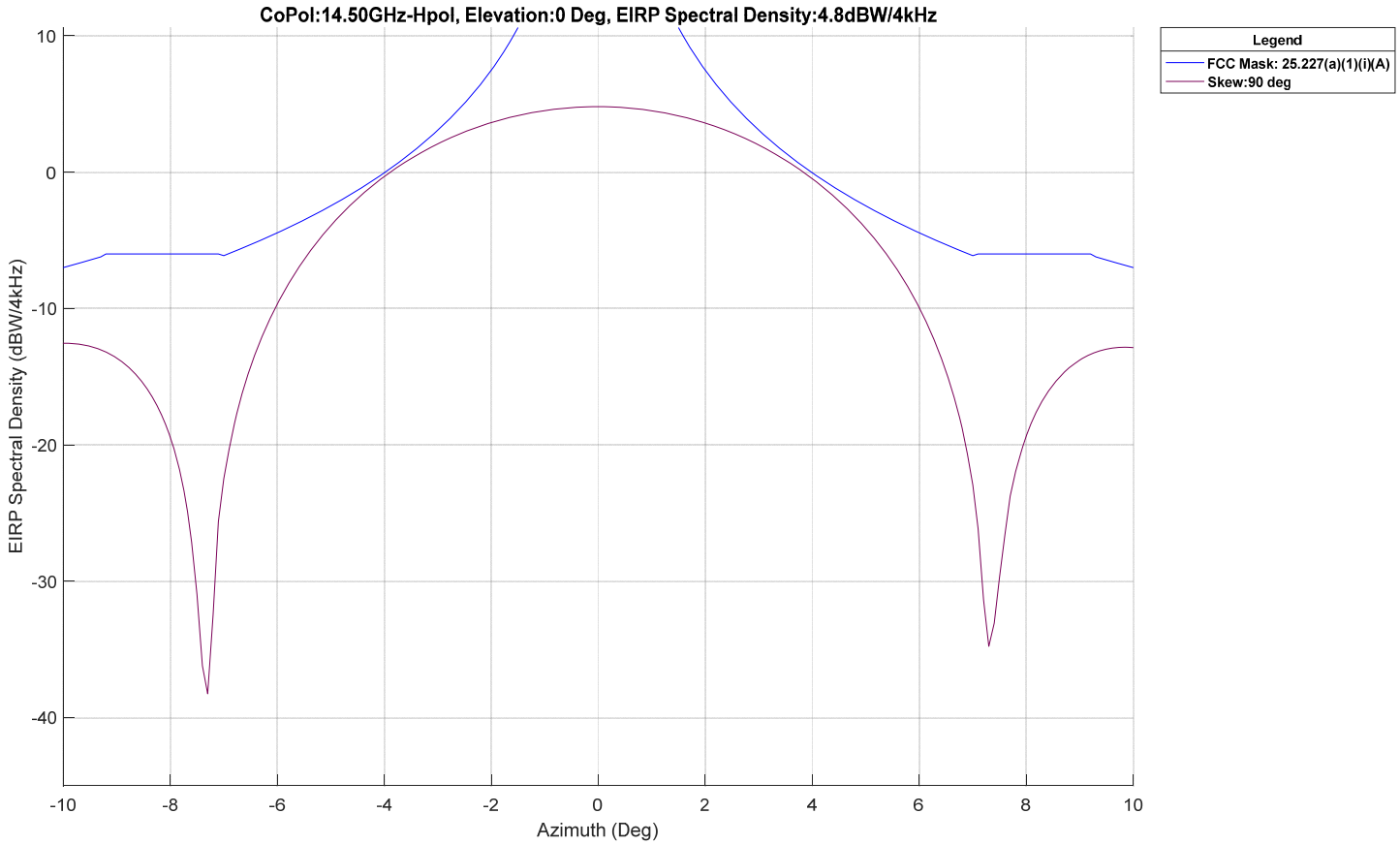
COPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.5DBW/4KHZ



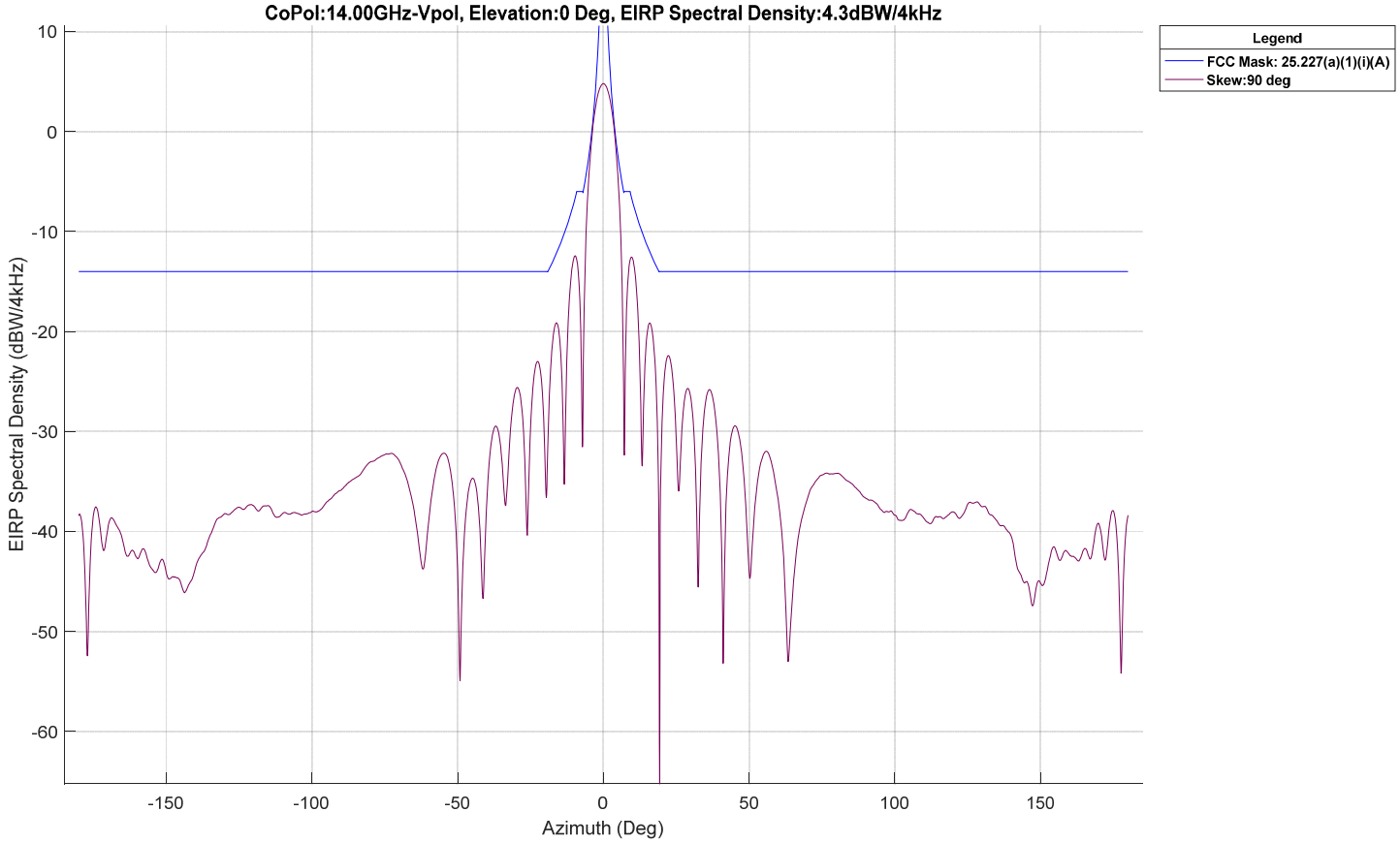
COPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.8DBW/4KHZ



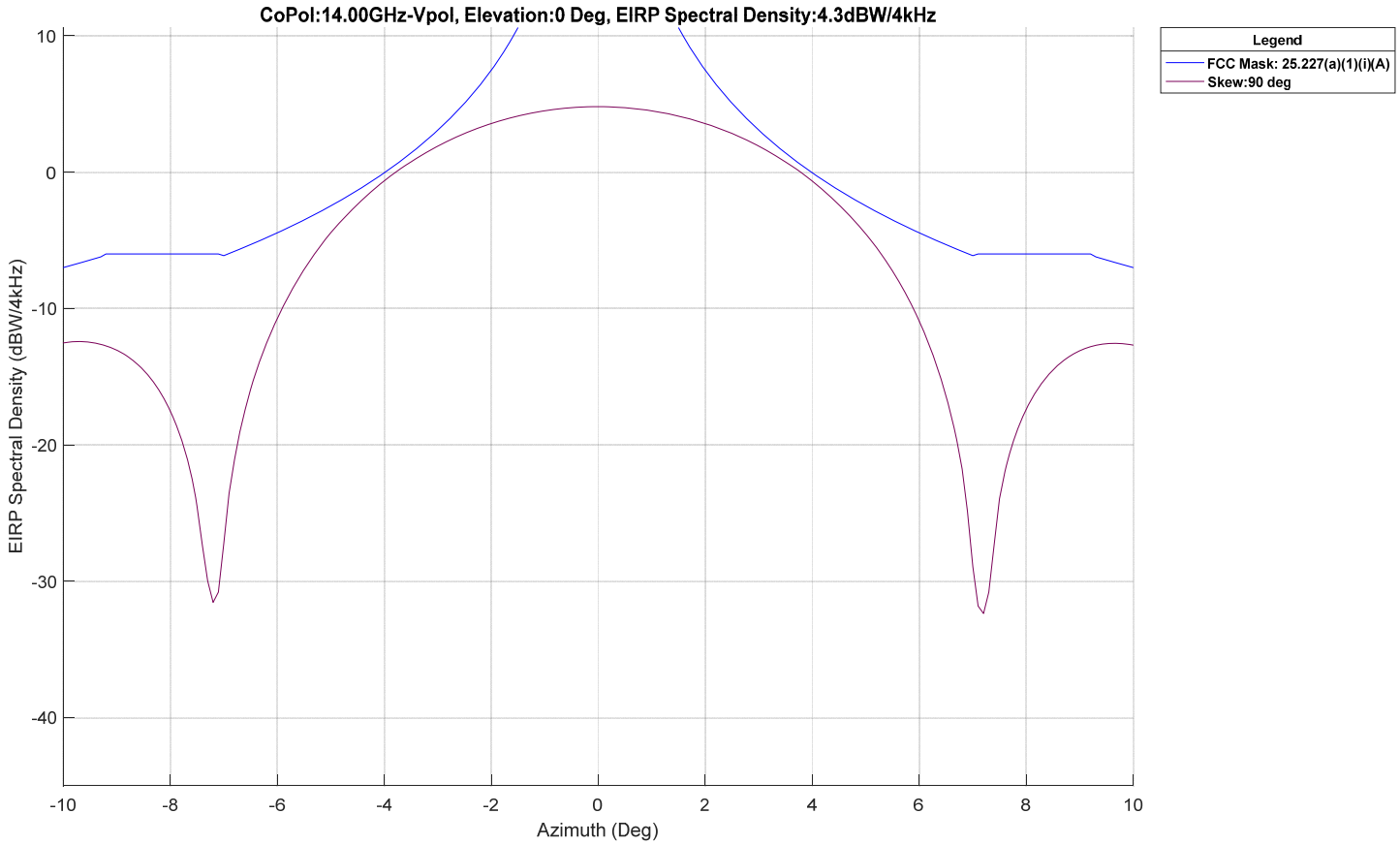
COPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.8DBW/4KHZ



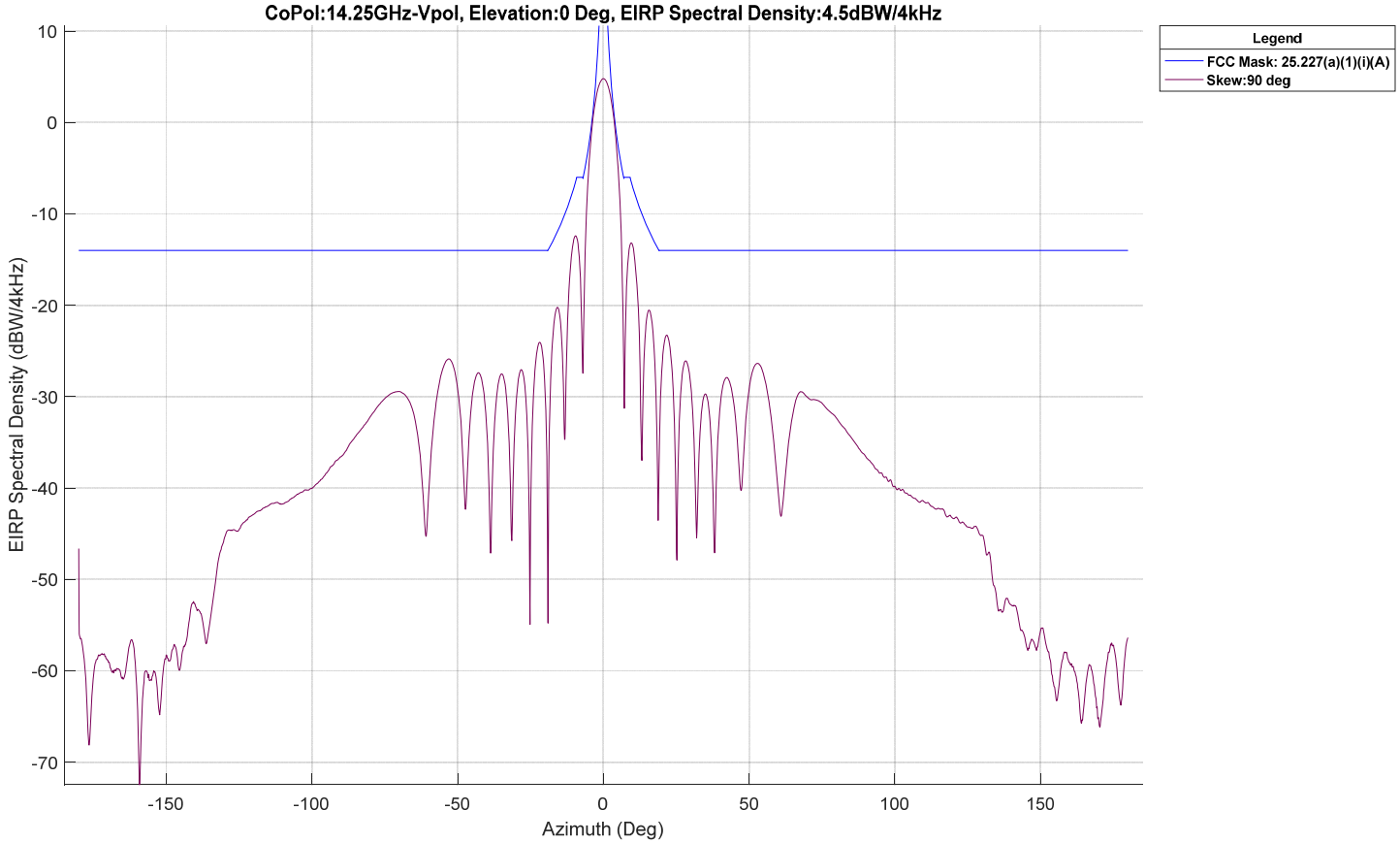
COPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.3DBW/4KHZ



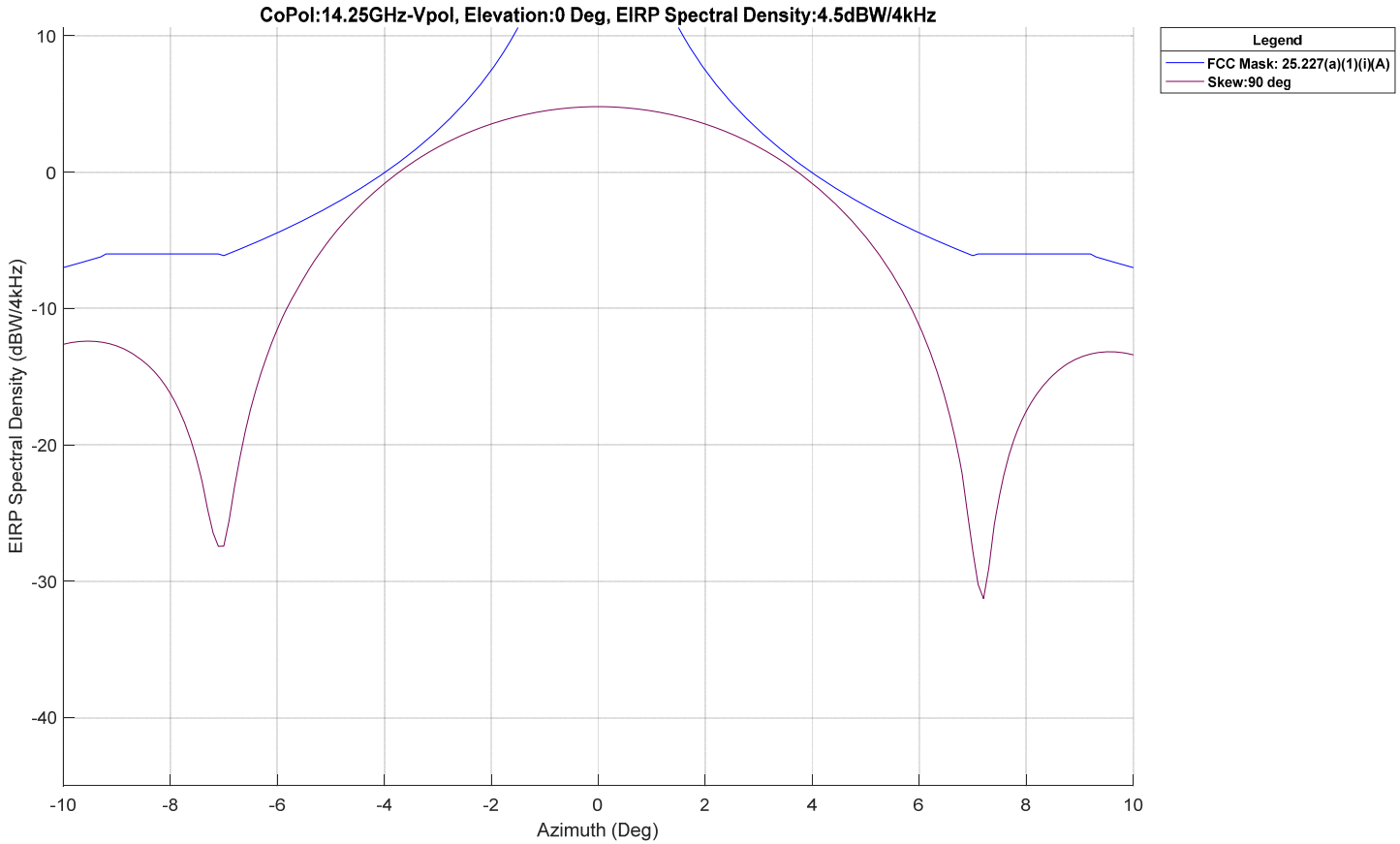
COPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.3DBW/4KHZ



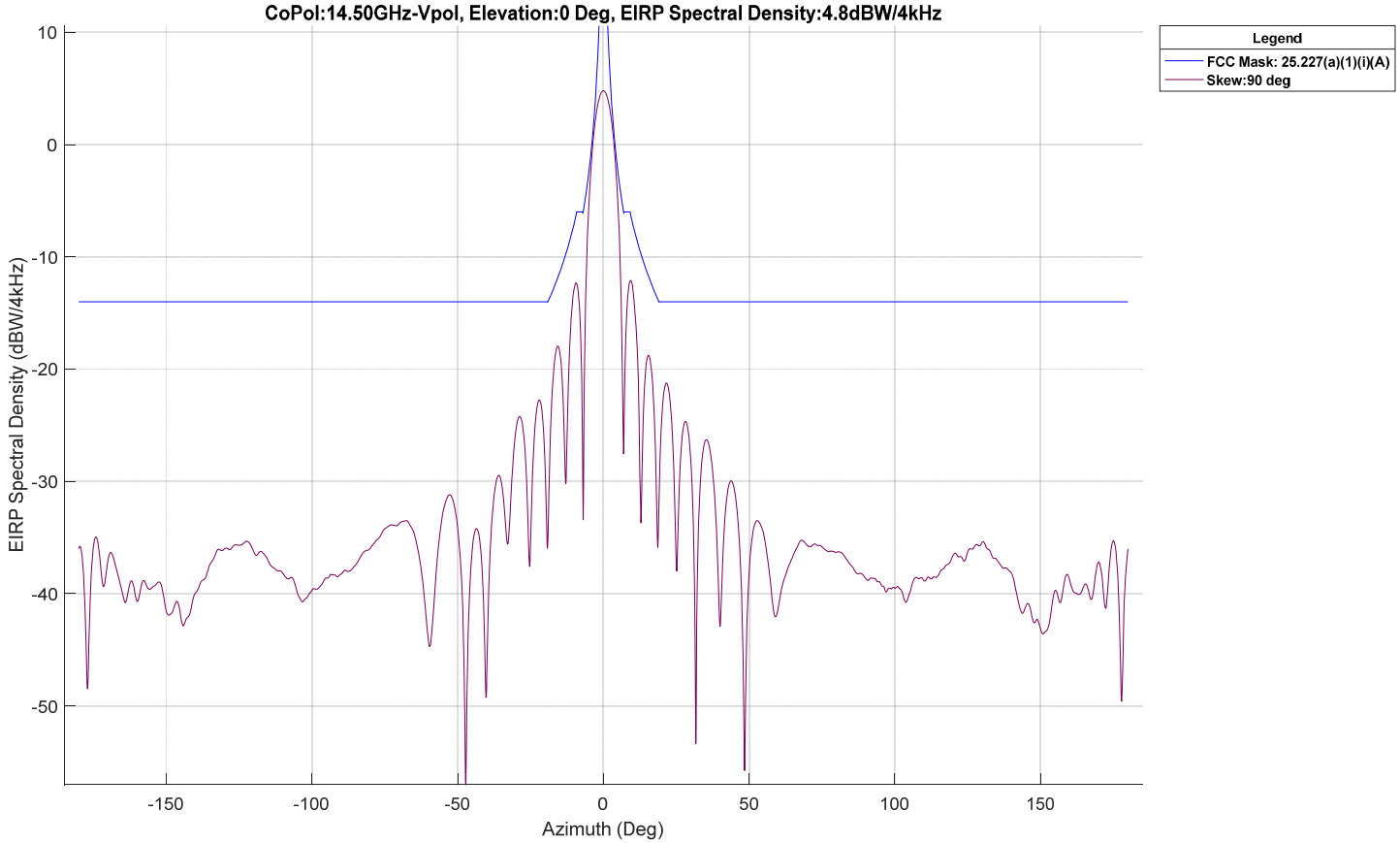
COPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.5DBW/4KHZ



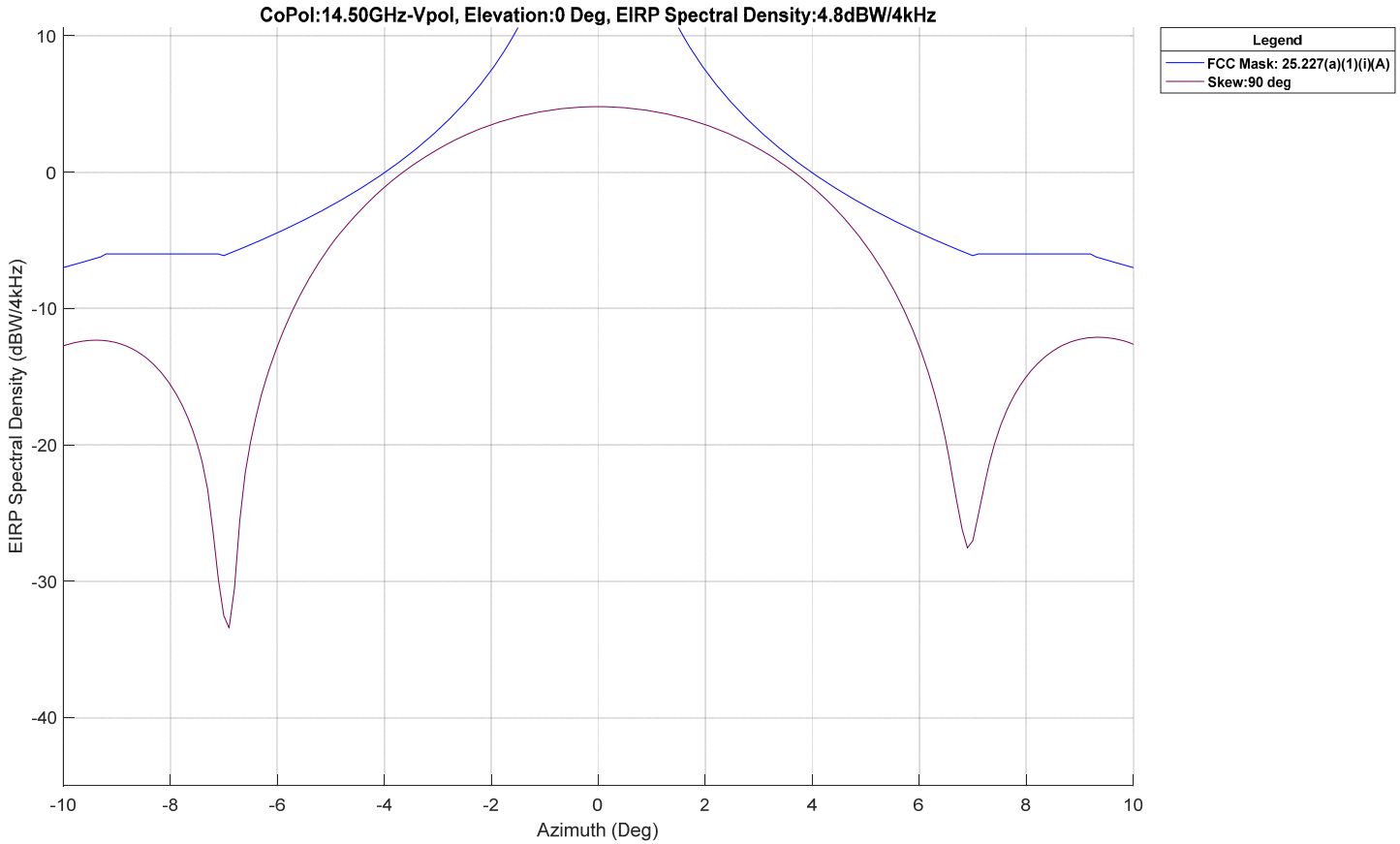
COPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.5DBW/4KHZ



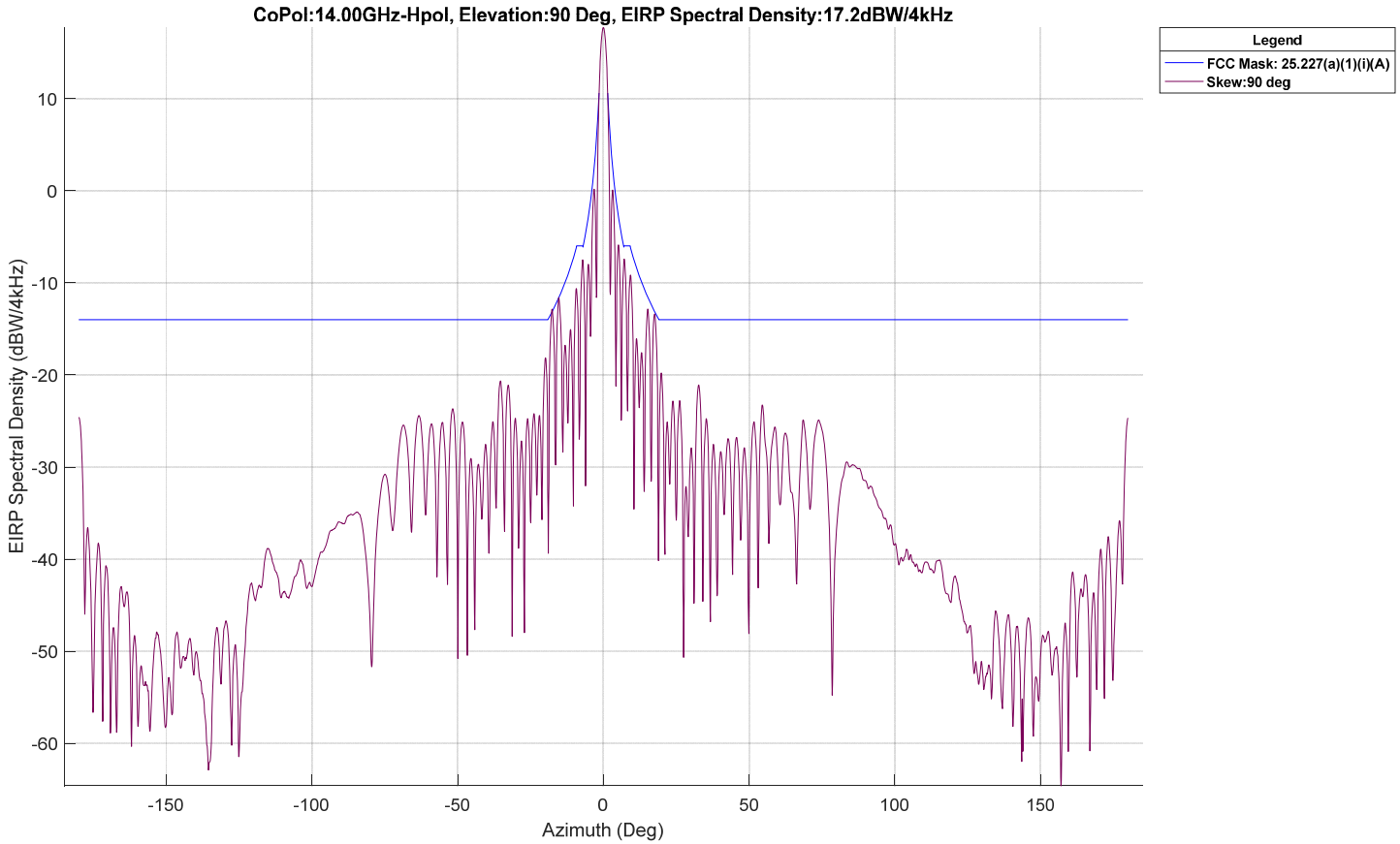
COPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.8DBW/4KHZ



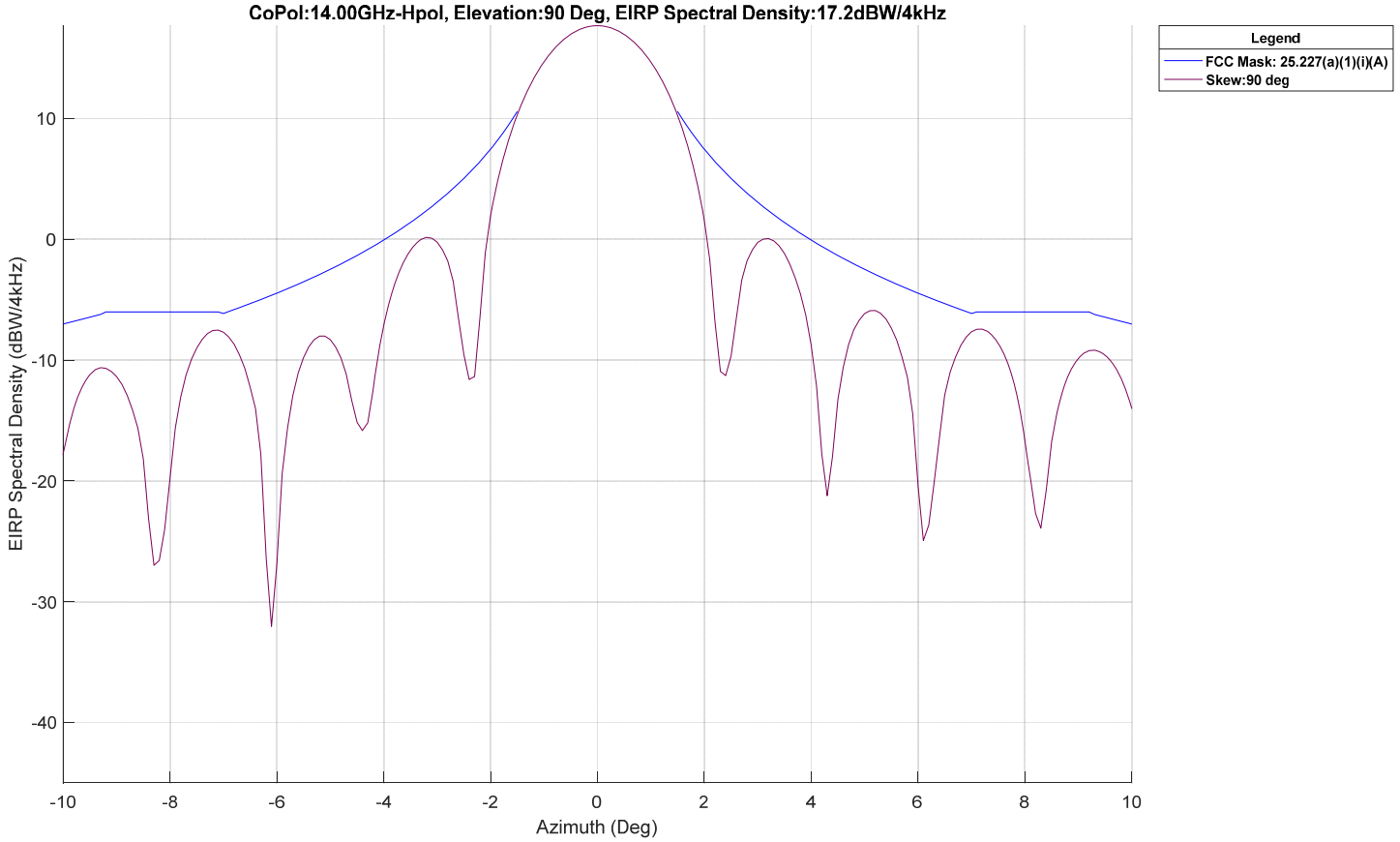
COPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:4.8DBW/4KHZ



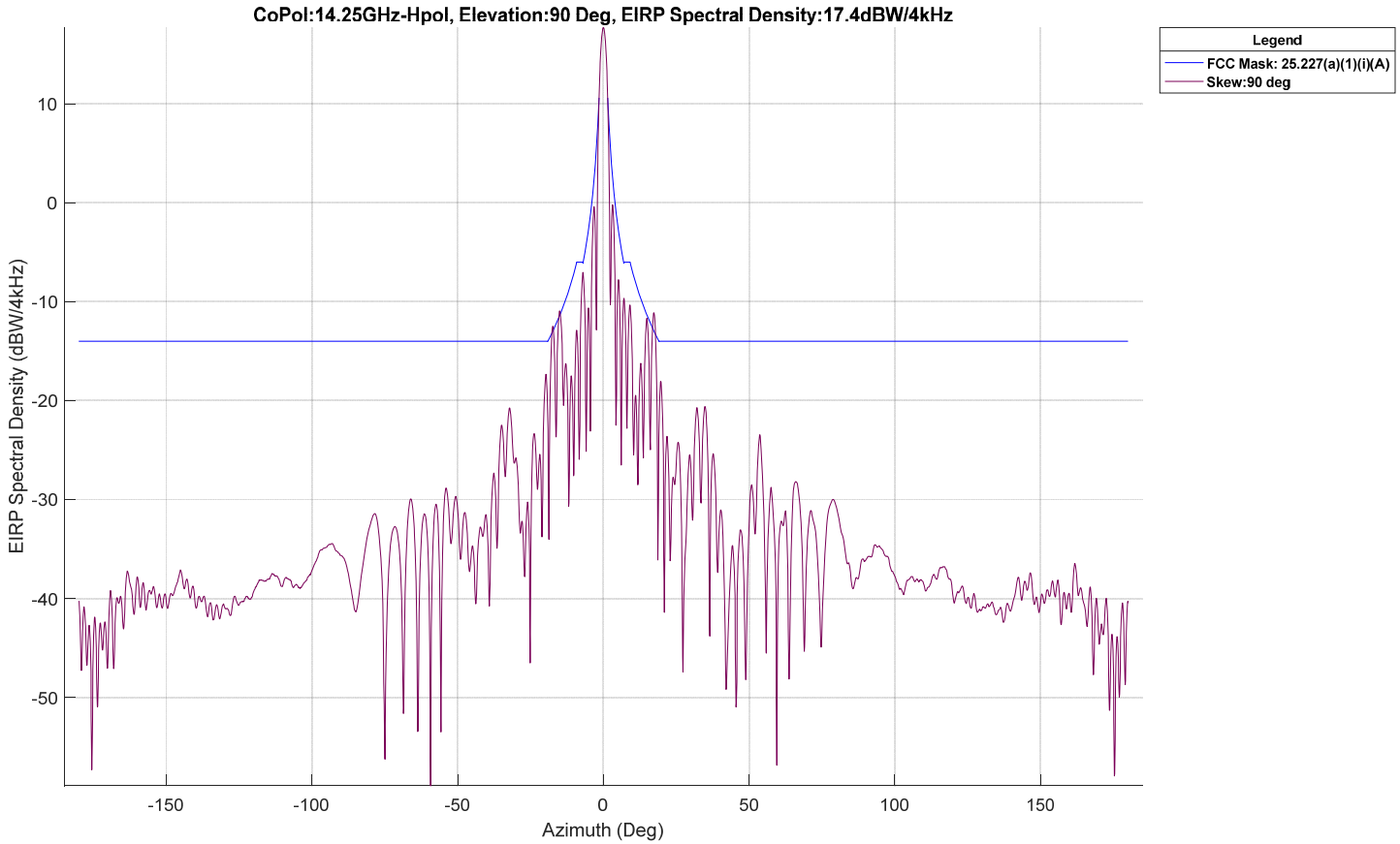
COPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



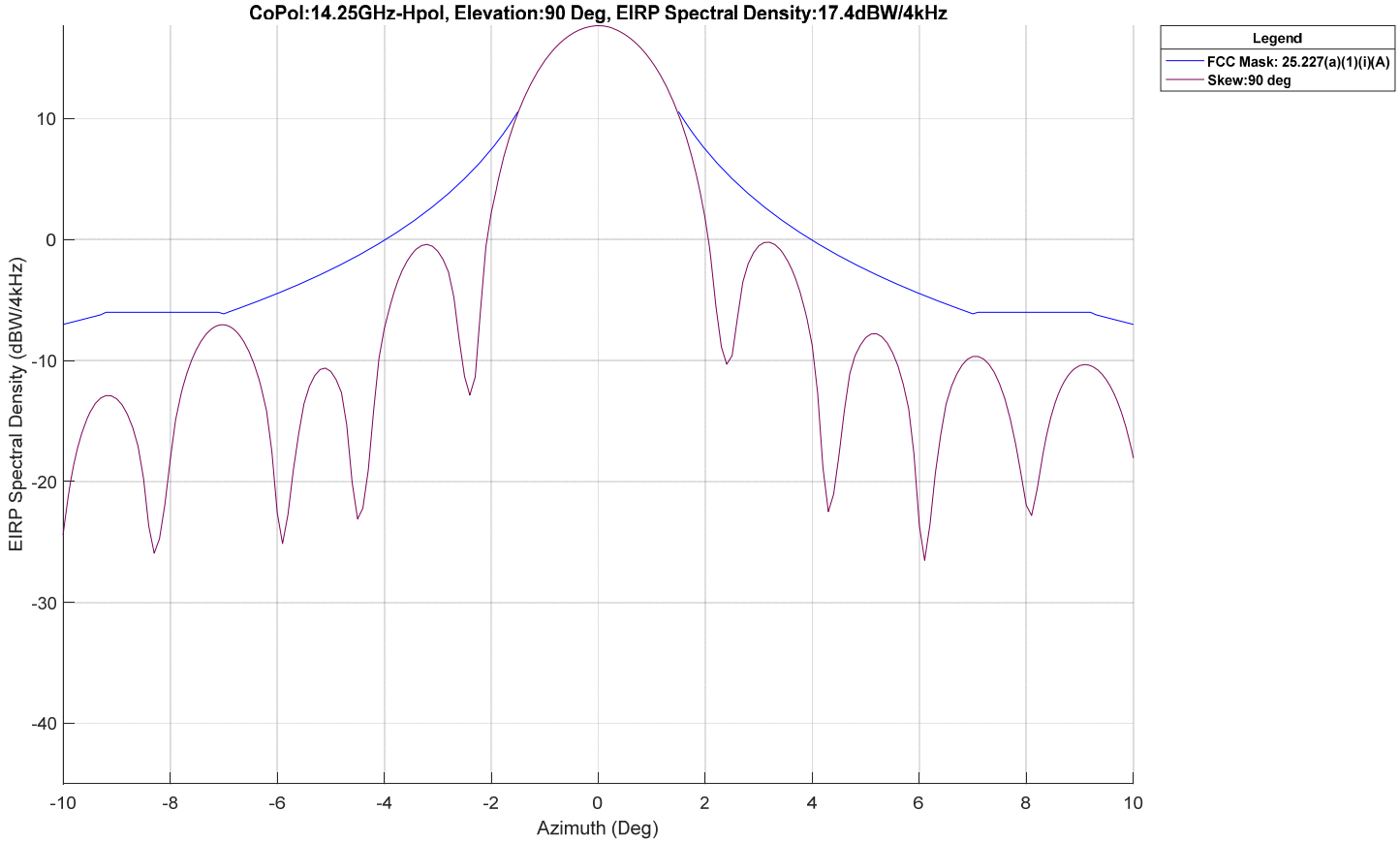
COPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



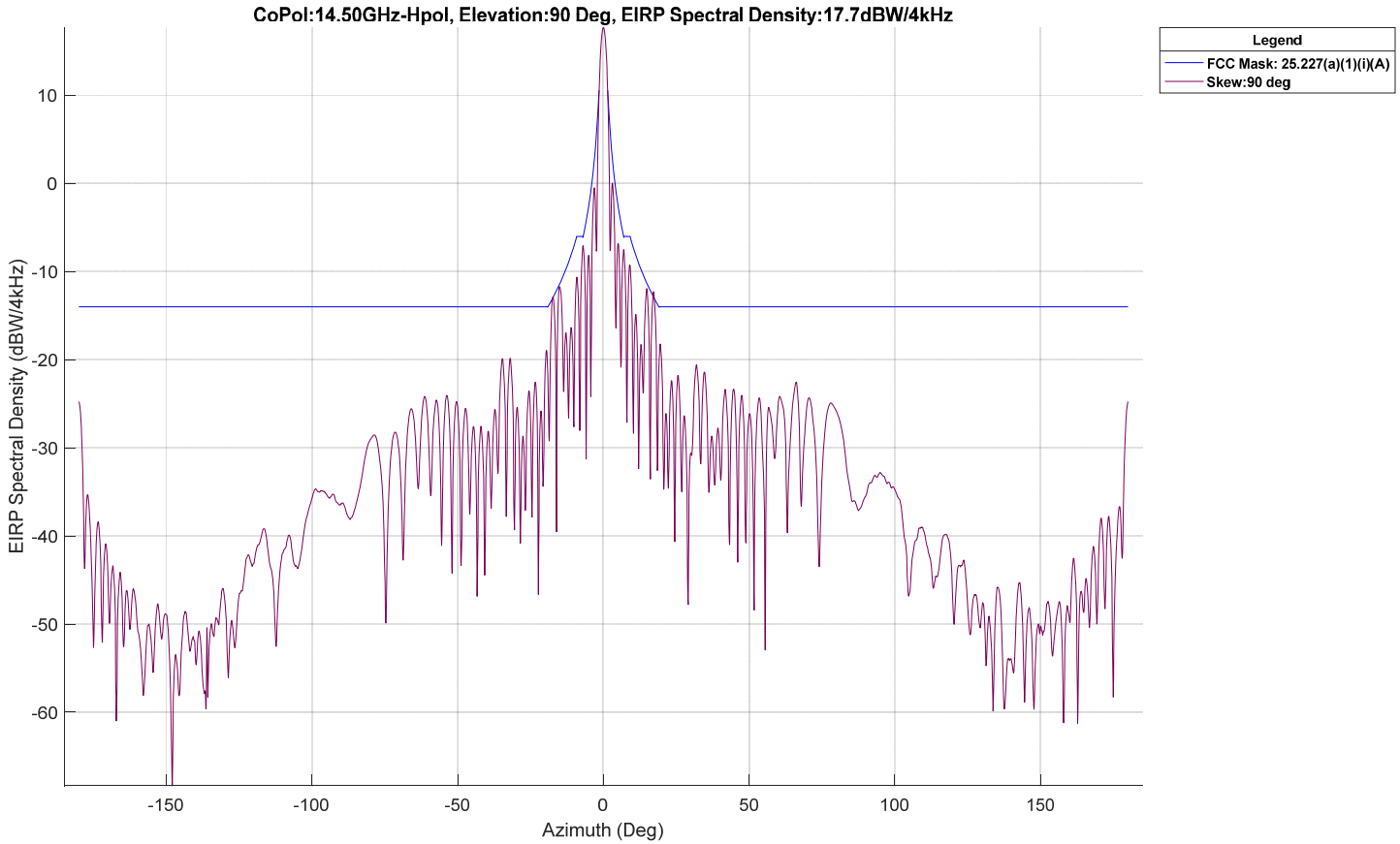
COPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



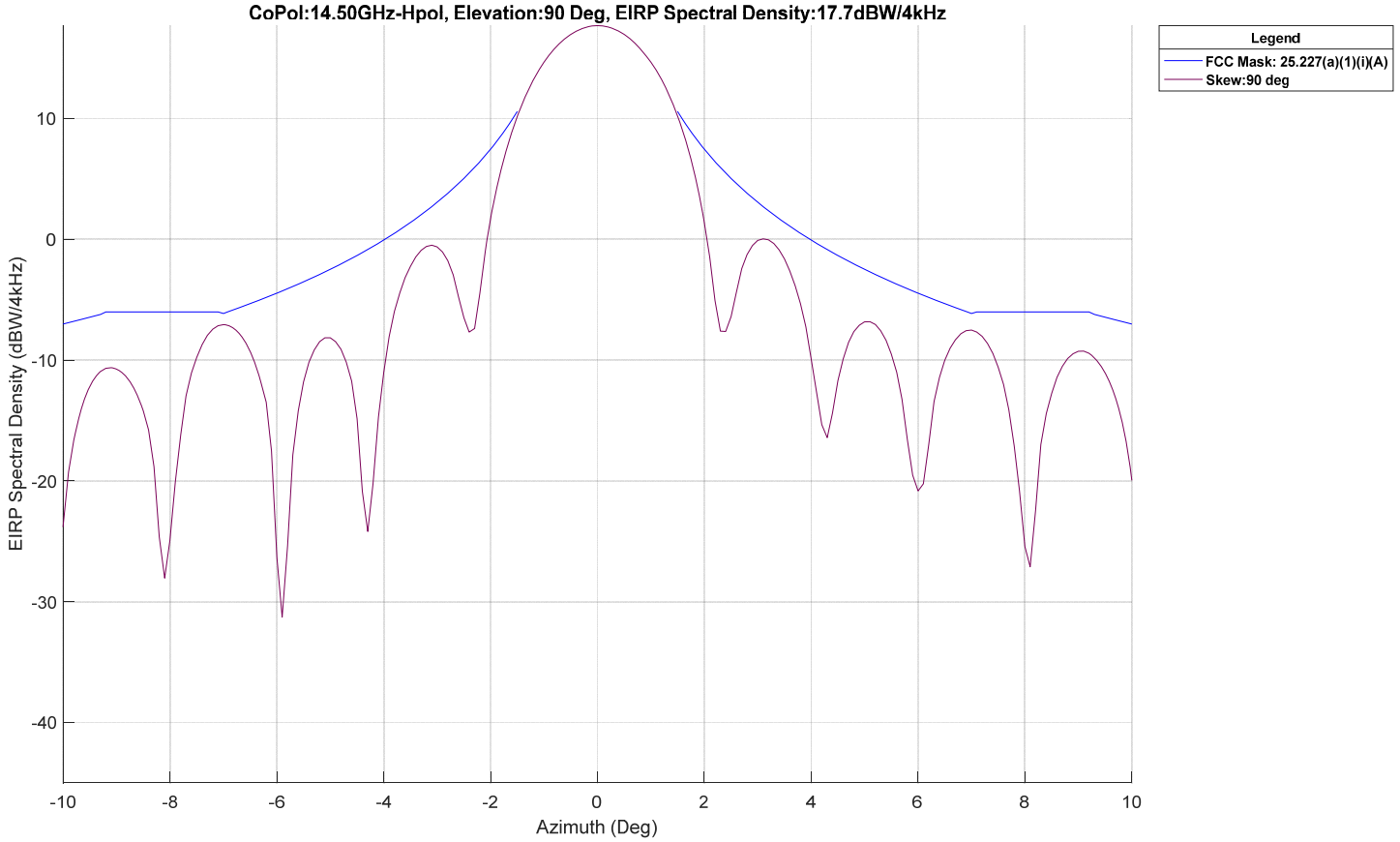
COPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



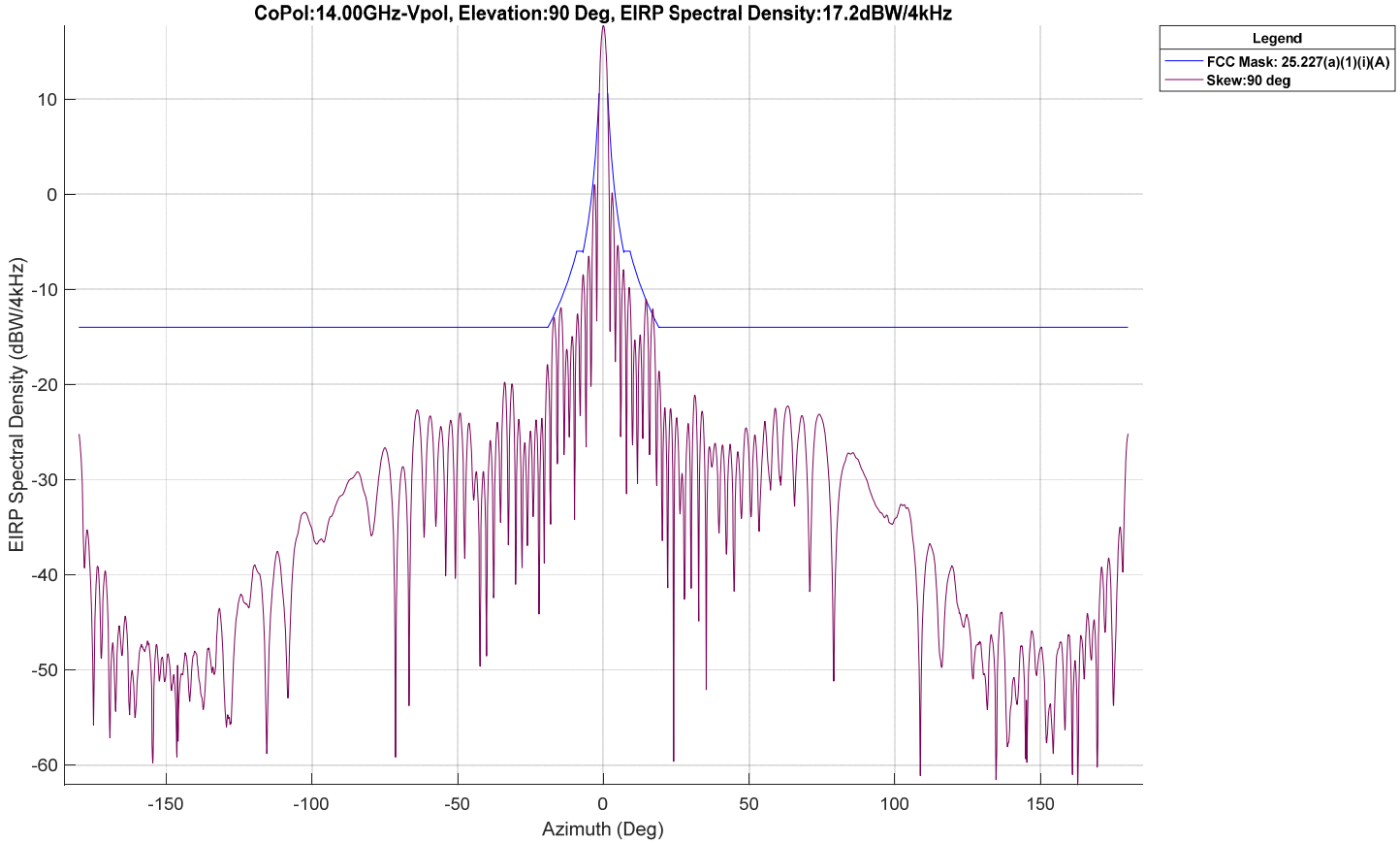
COPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



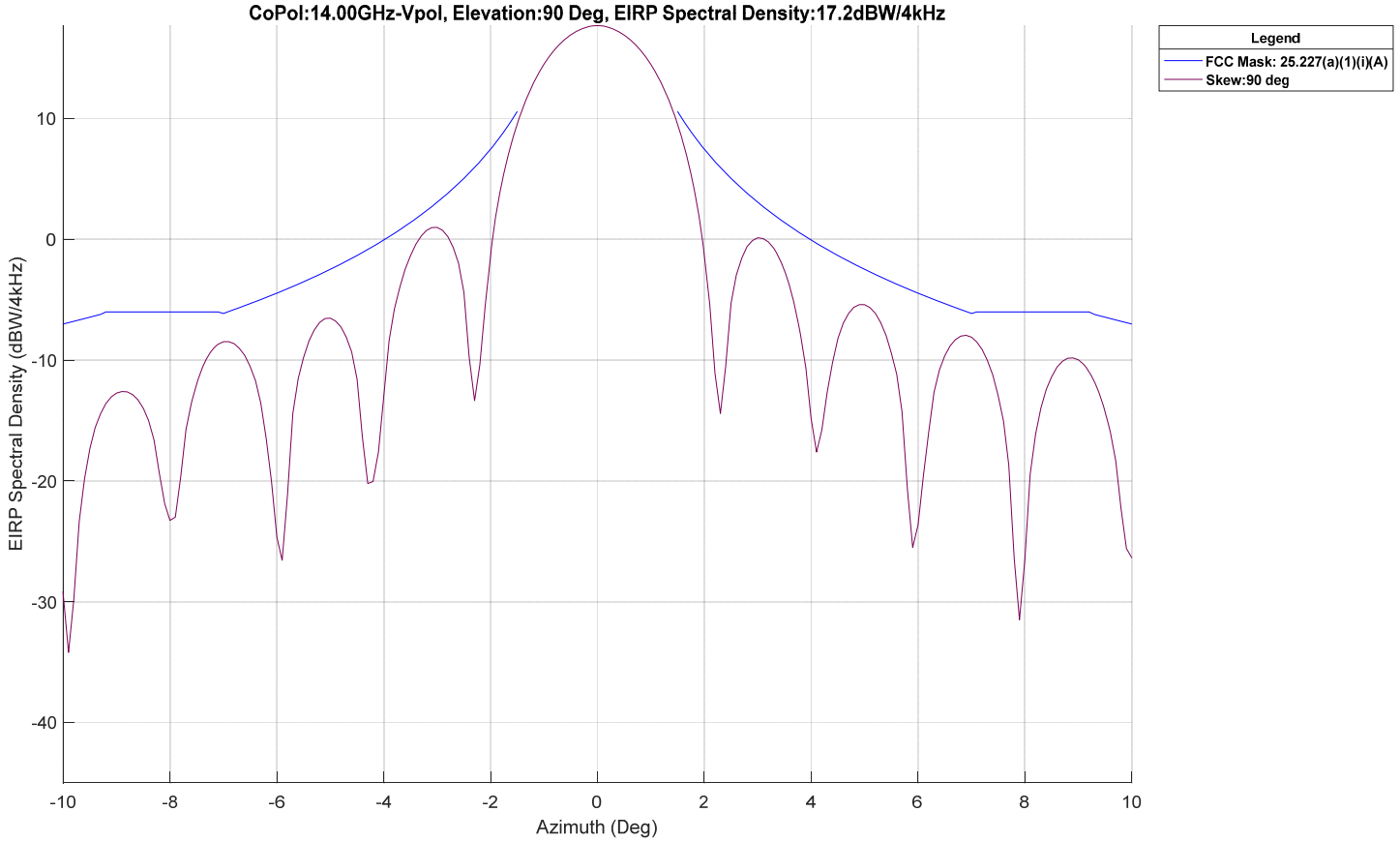
COPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



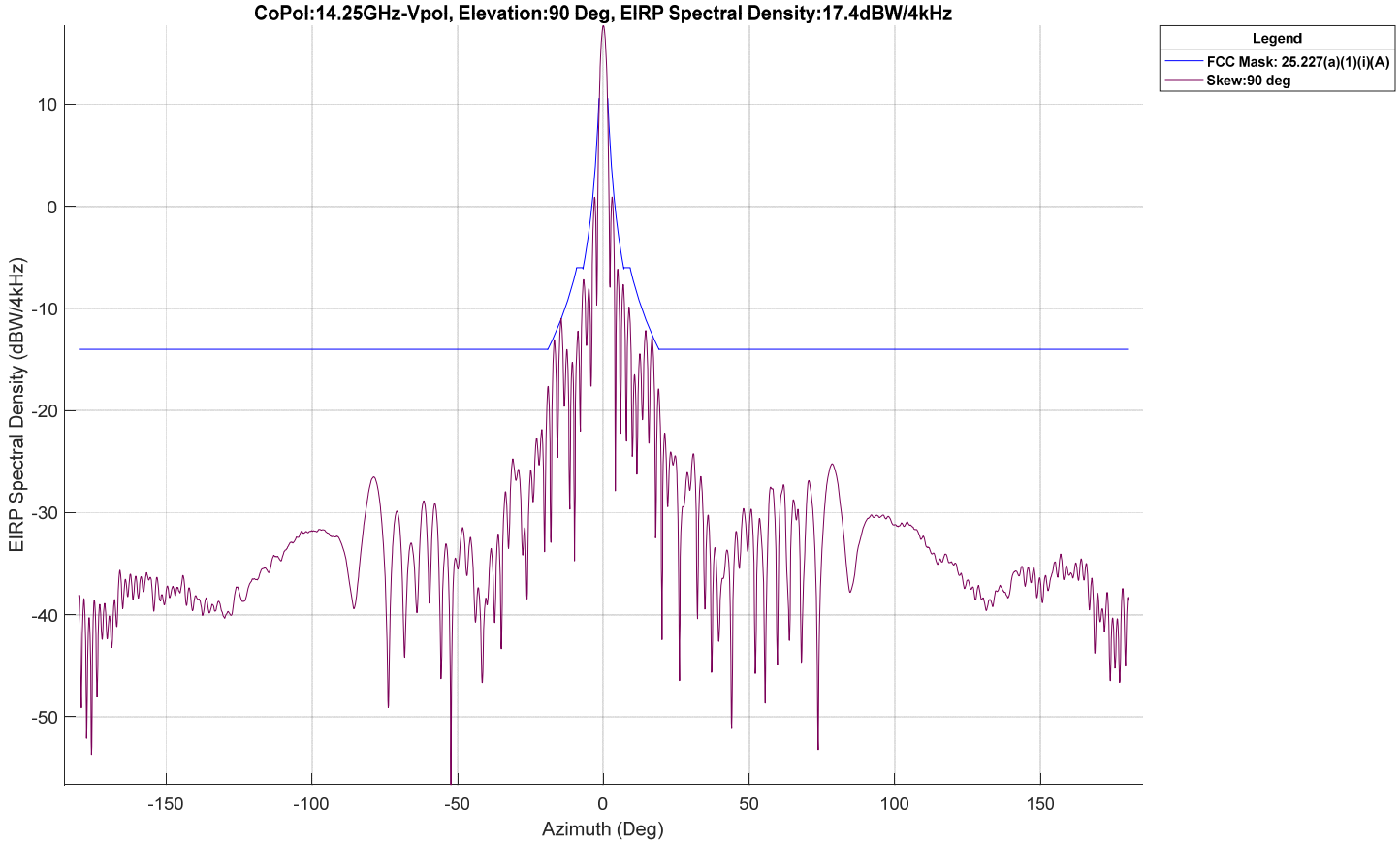
COPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



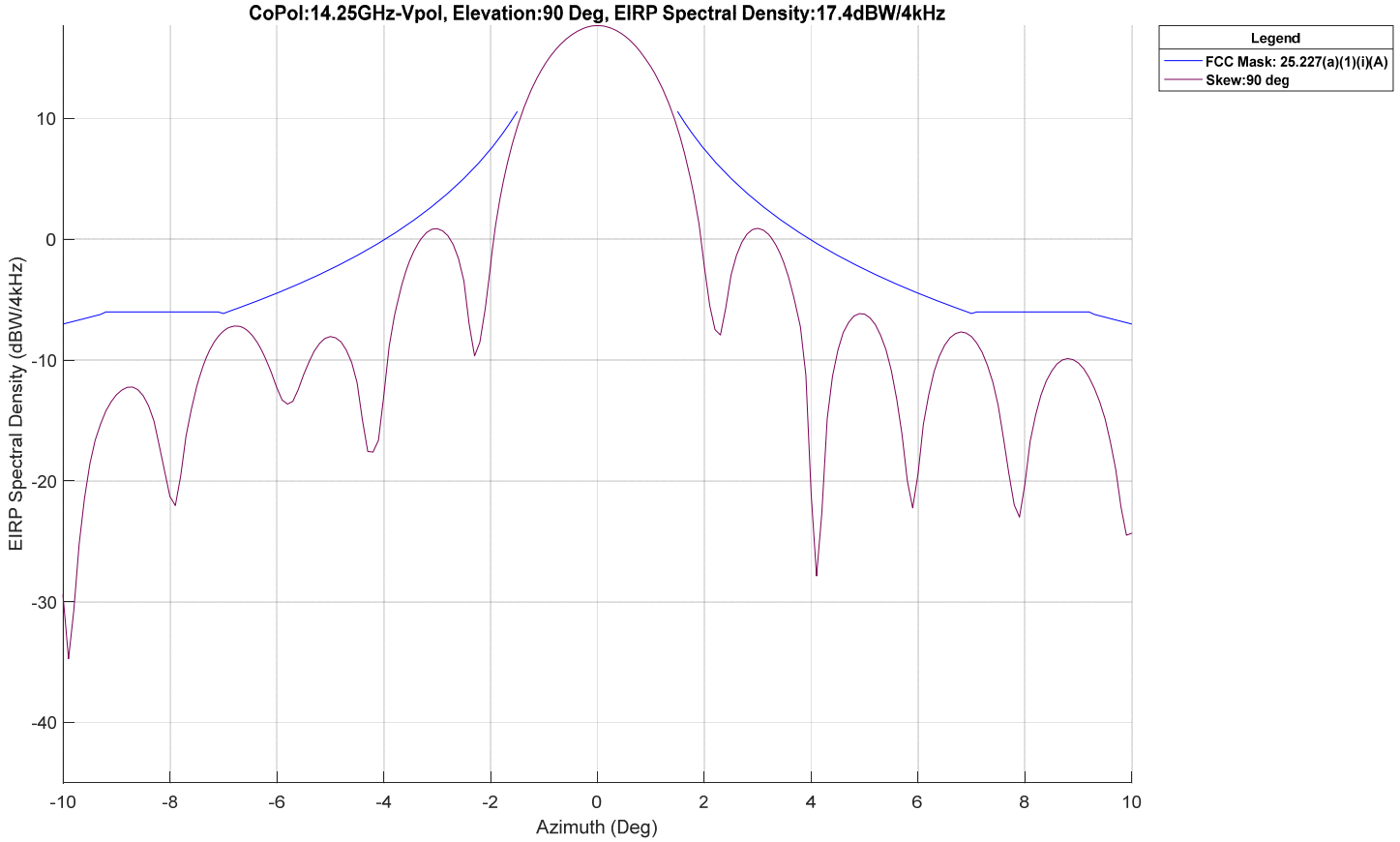
COPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



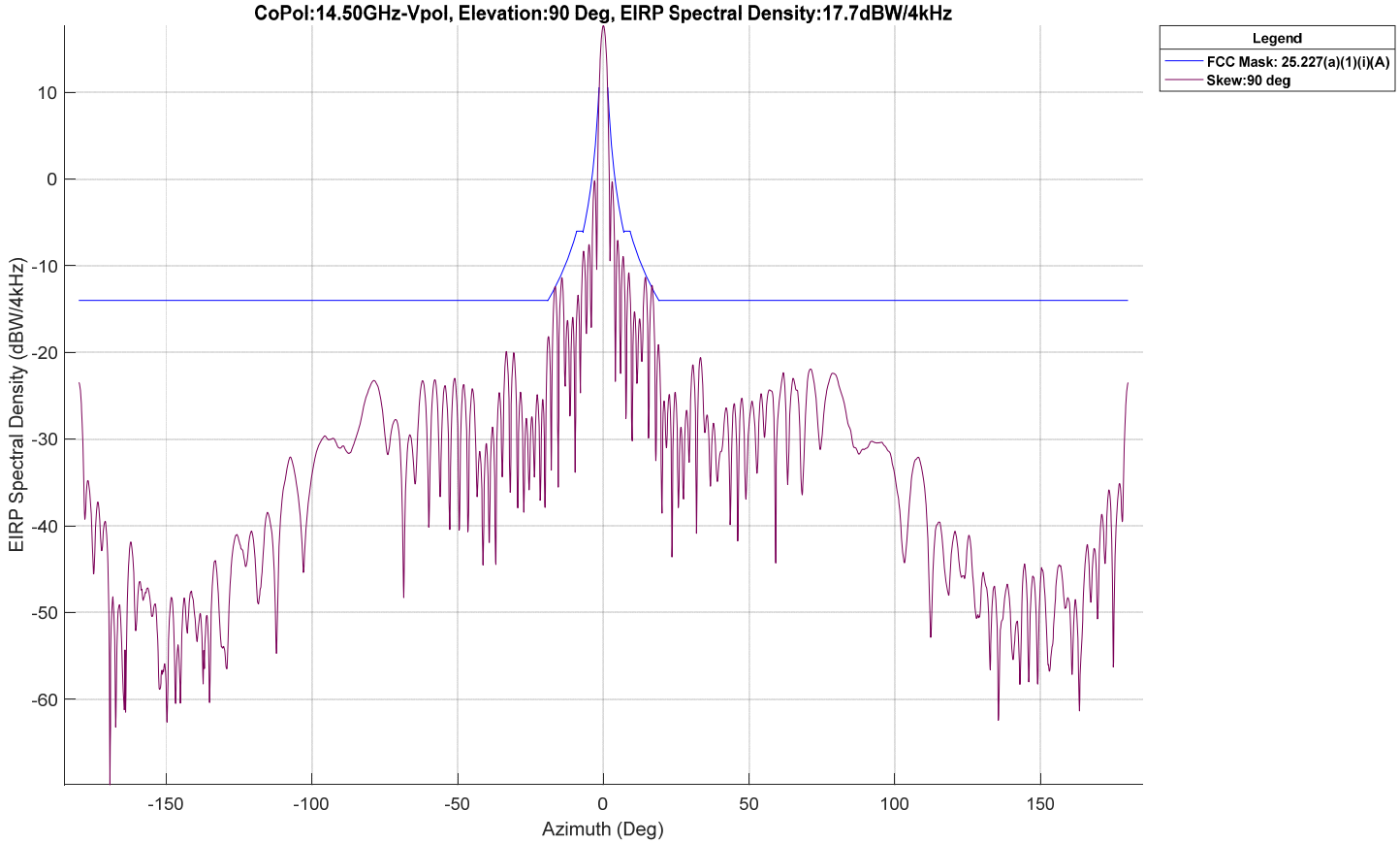
COPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



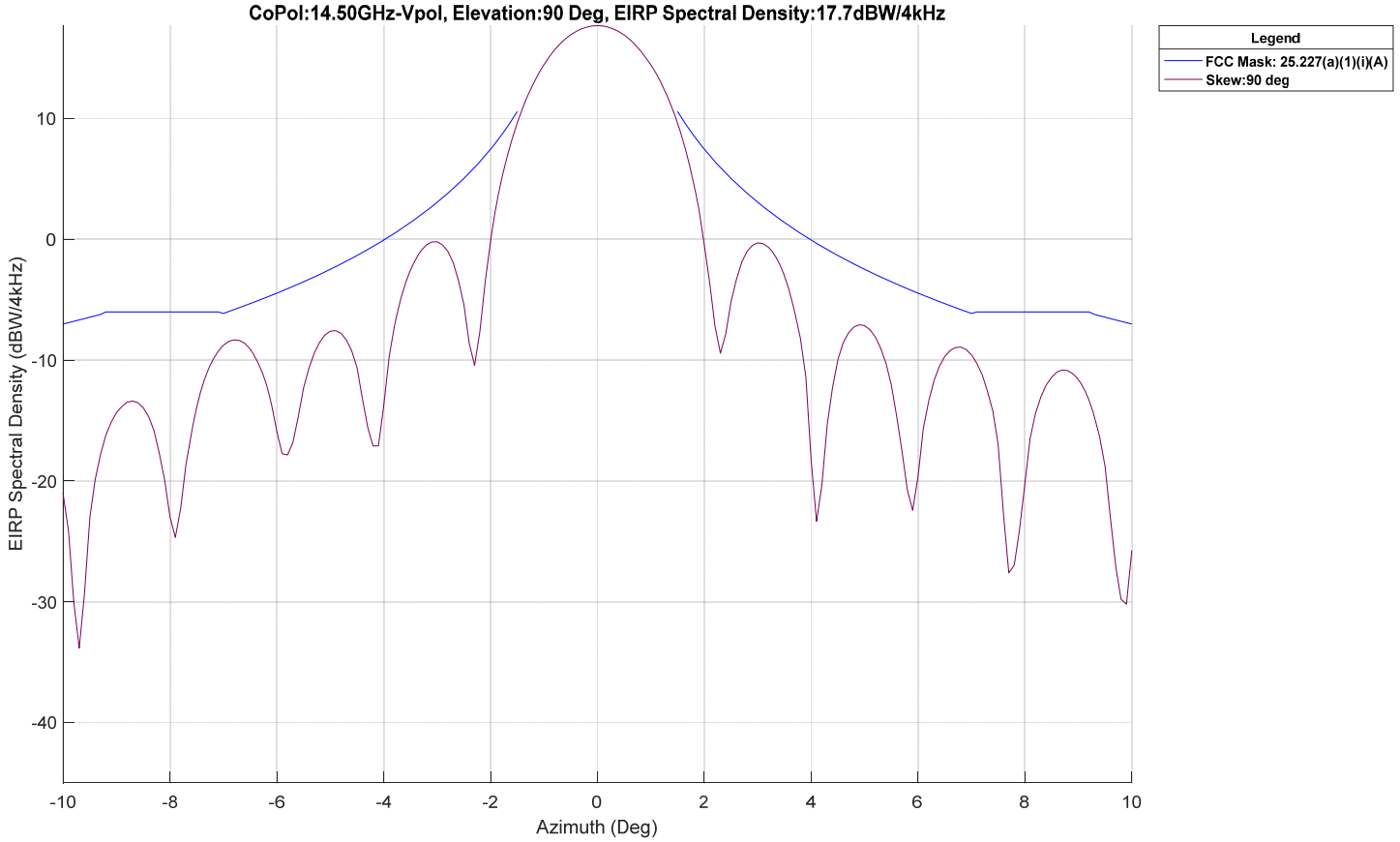
COPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.4DBW/4KHZ



COPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



COPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.7DBW/4KHZ



GSAA EIRP SPECTRAL DENSITY PLOTS – PERPENDICULAR PLANE TO GSO CO POL WITH 25.227(A)(1)(I)(B) MASK

DESCRIPTION

- EIRP Spectral Density plots are at 14.00 GHz, 14.25 GHz and 14.50 GHz for both vertical and horizontal polarization for the following Skew and Perpendicular Plane to GSO Angles as it is mapped to the maximum EIRP spectral density in dBW/4kHz in a 1.024 MHz Bandwidth (in **BOLD**):

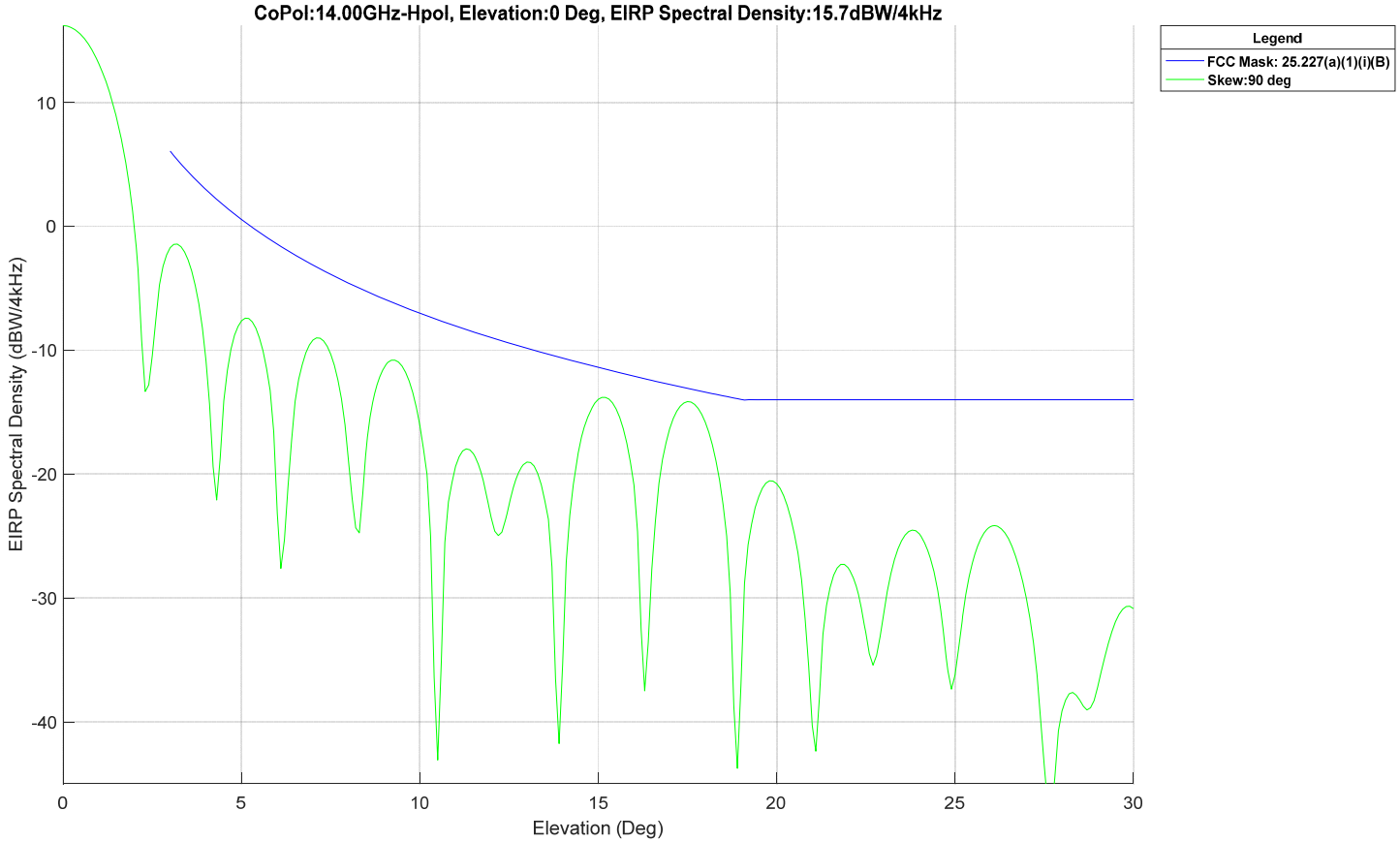
DESCRIPTION

Perpendicular Plane to GSO Co Pol ESD Plots as they comply to FCC mask 25.227(a)(1)(i)(B)

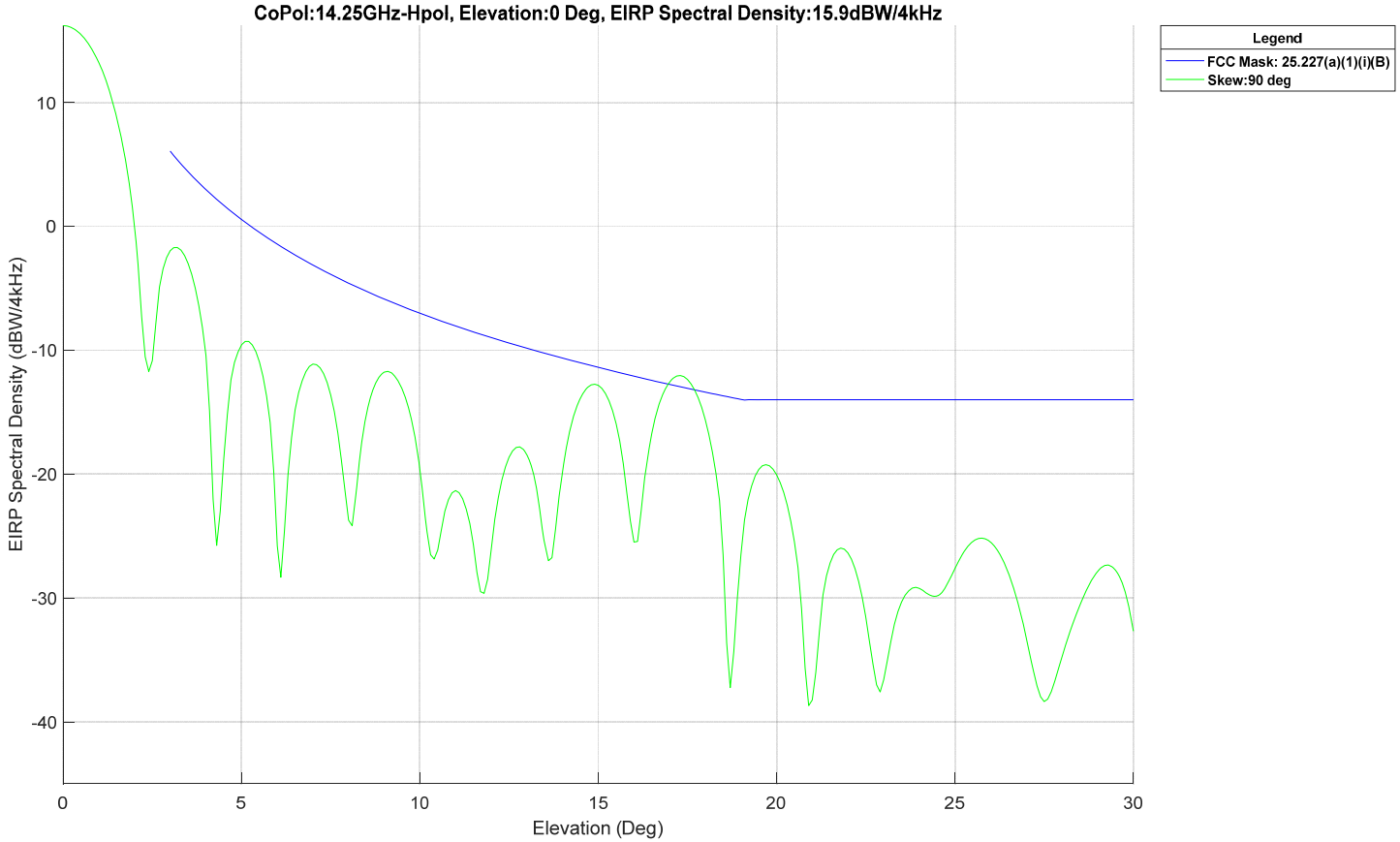
GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0
0	**16.20**	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20	9.20	8.20	**7.20**
5	16.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20	9.20	8.20	7.20
10	16.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20	9.20	8.20	7.20
15	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20	16.20	13.20	11.20	10.20	8.20	7.20
20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20	16.20	13.20	11.20	10.20	8.20	7.20
25	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20	9.20	8.20
30	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20	9.20	8.20
35	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20	16.20	13.20	11.20	10.20	8.20
40	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20	16.20	13.20	11.20	10.20	8.20
45	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	**19.20**	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20	9.20
50	17.20	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20	16.20	13.20	11.20	10.20
55	17.20	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	12.20	10.20
60	17.20	17.20	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20	16.20	13.20	11.20
65	17.20	17.20	17.20	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	16.20	14.20	
70	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	18.20	17.20	17.20	17.20
75	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20
80	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20
85	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20
90	**17.20**	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	**17.20**

*Note: Includes Radome and Cable losses

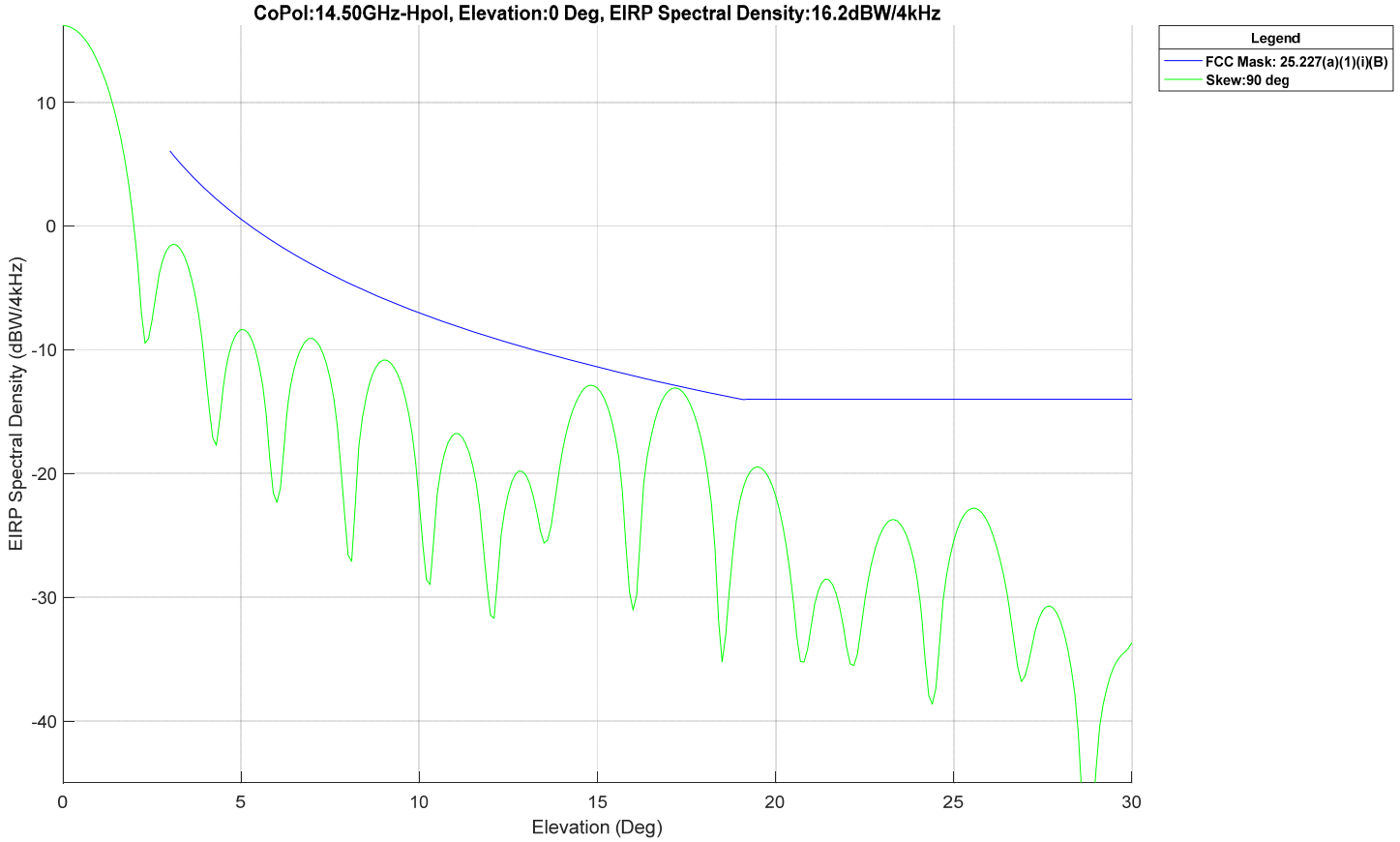
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:15.7DBW/4KHZ



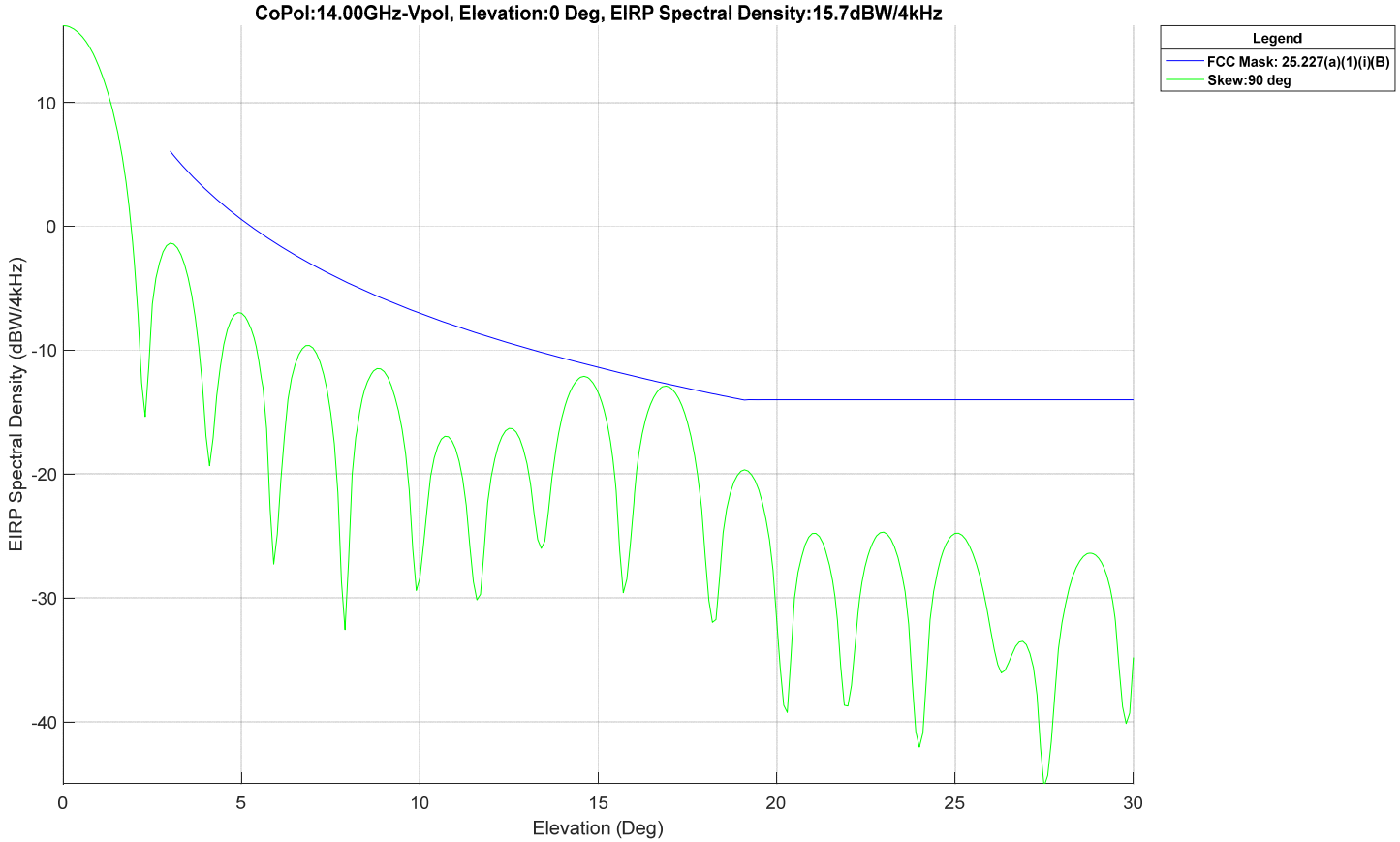
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:15.9DBW/4KHZ



COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:16.2DBW/4KHZ



COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:15.7DBW/4KHZ



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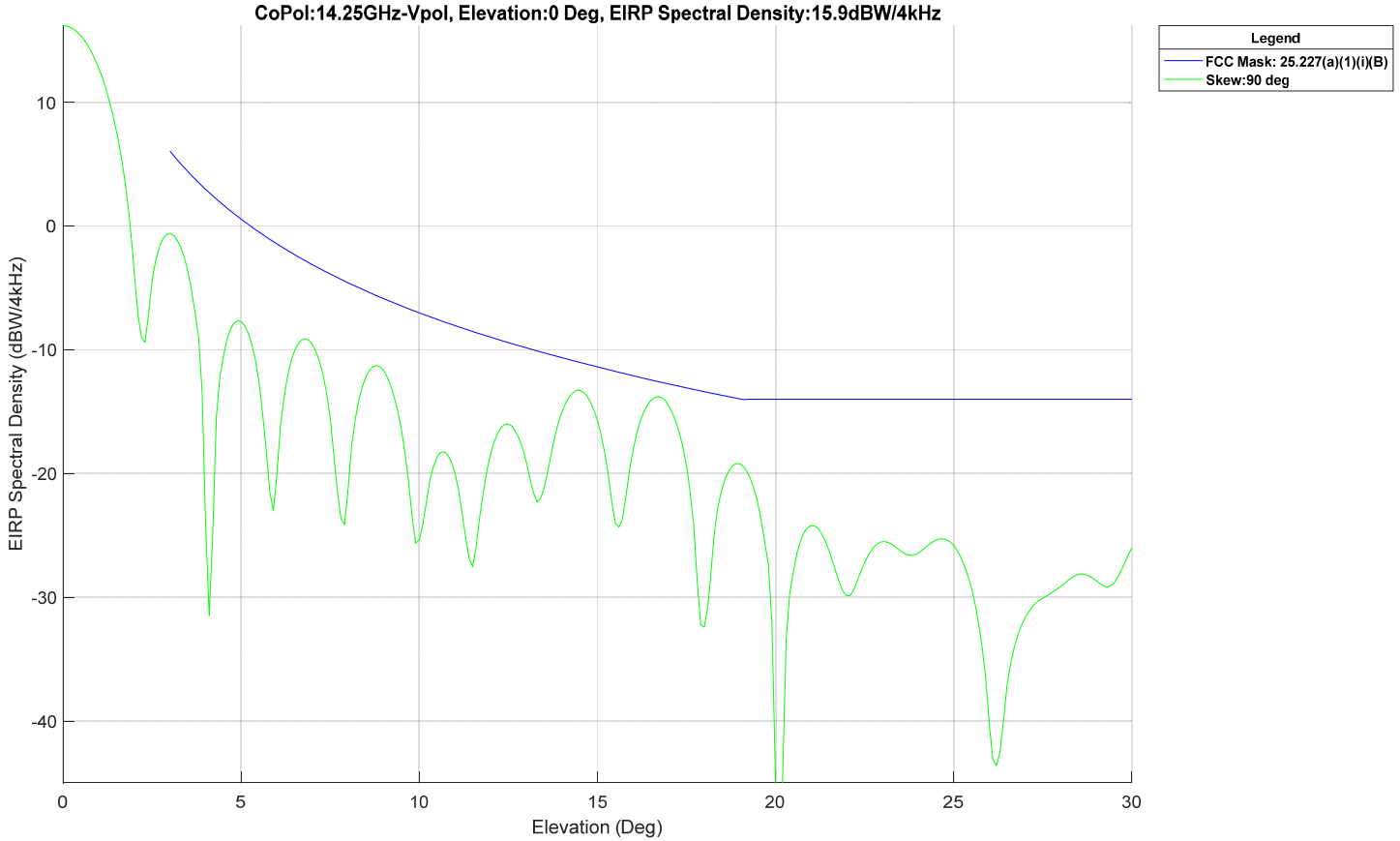
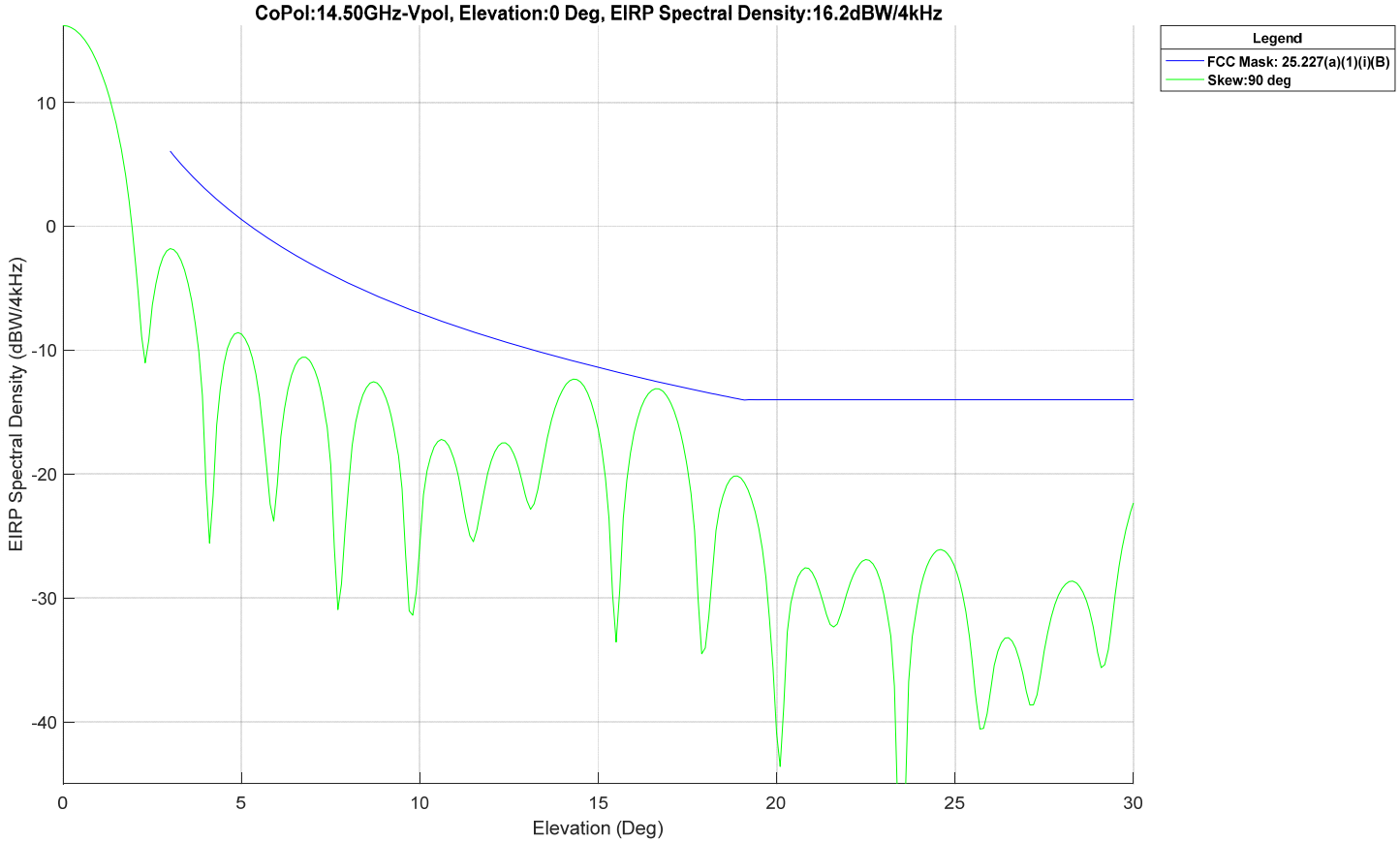
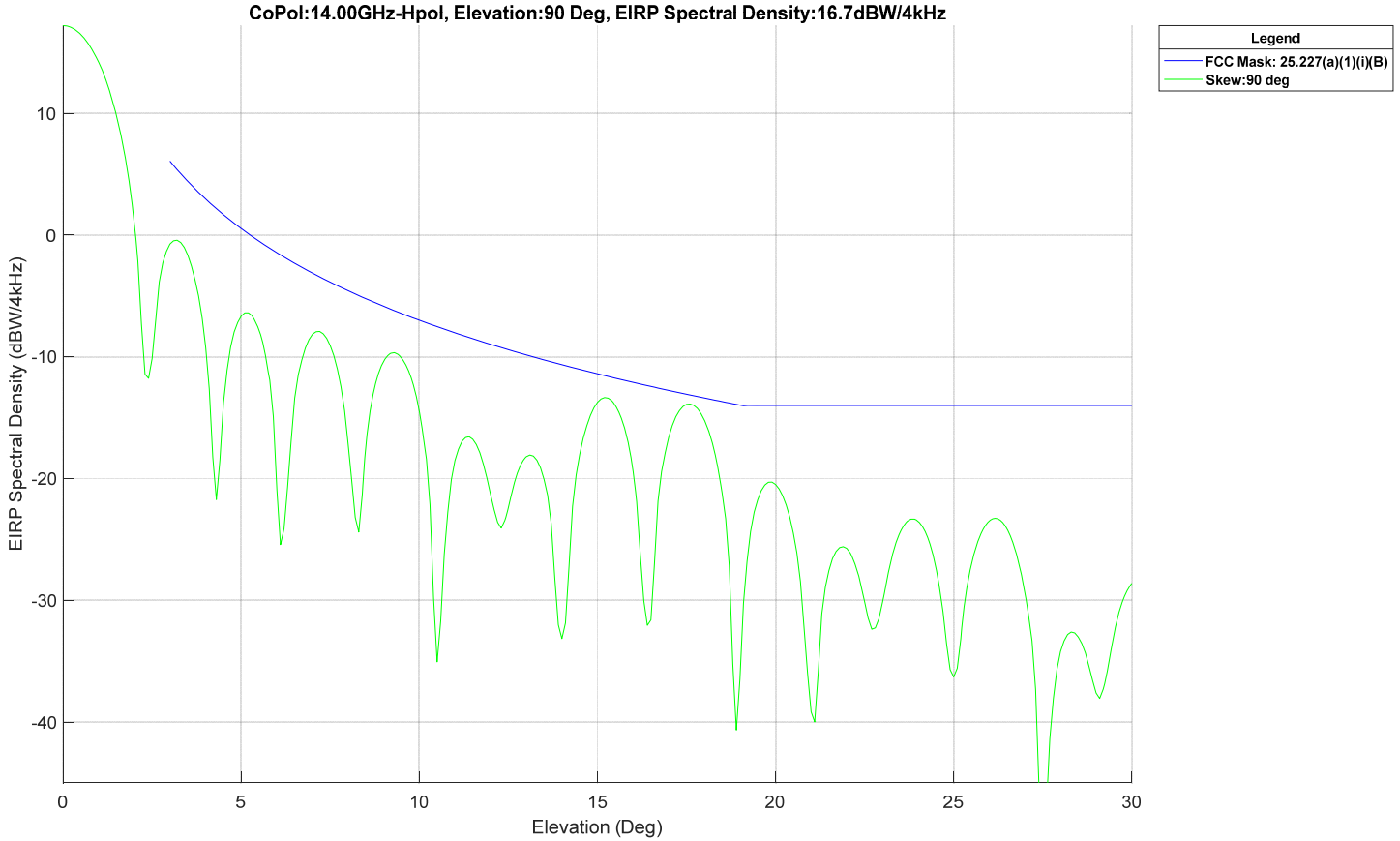


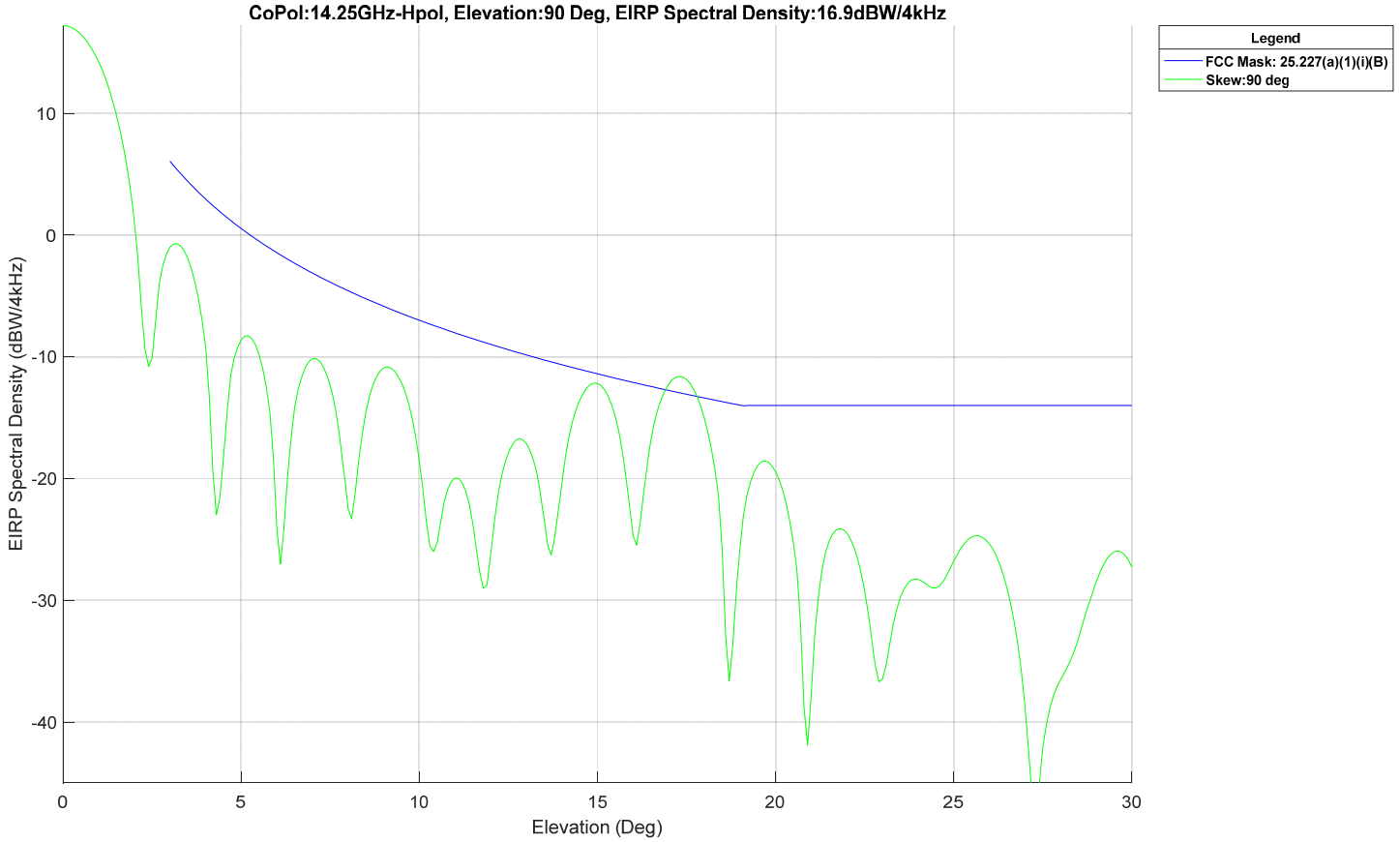
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:16.2DBW/4KHZ



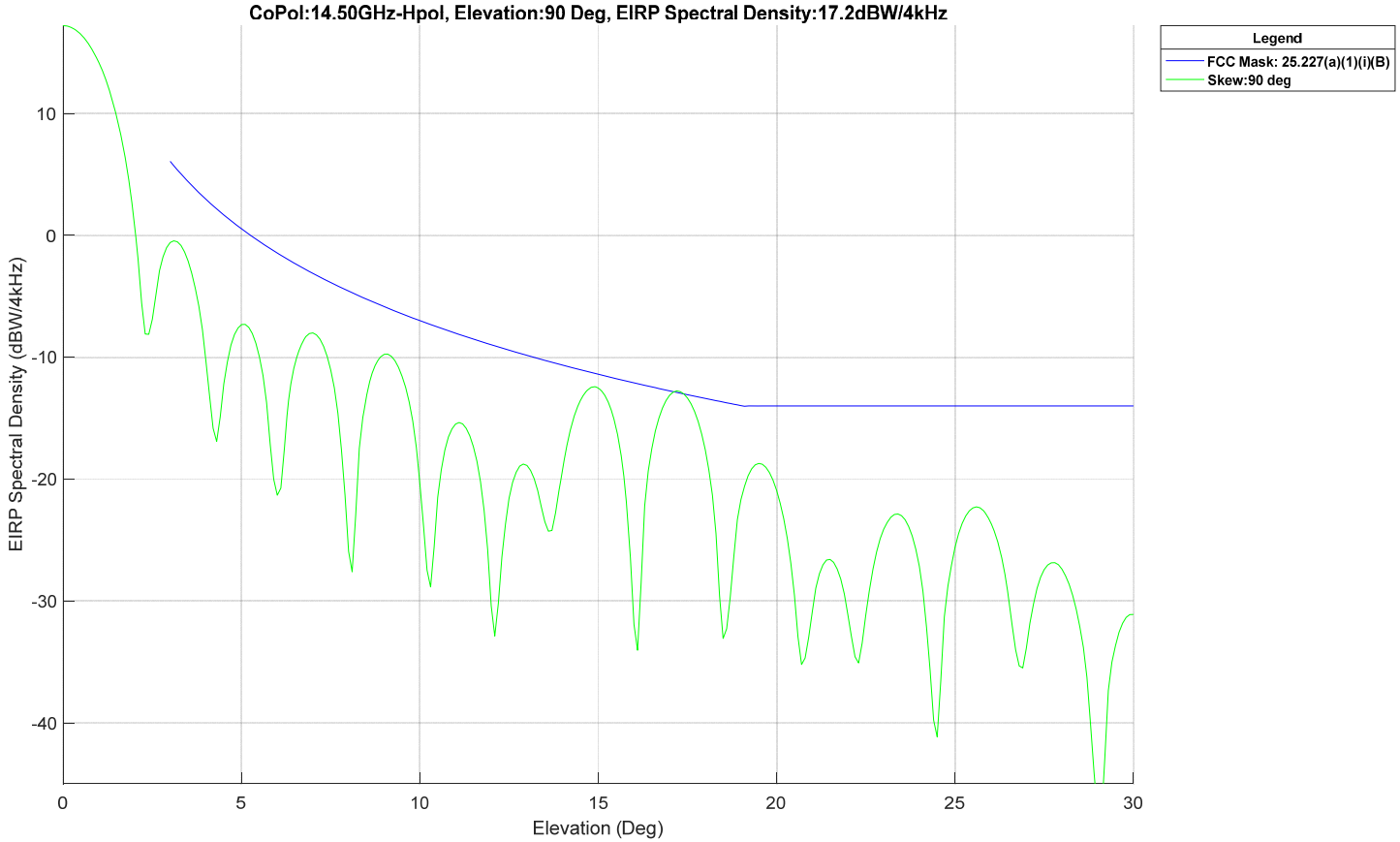
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.7DBW/4KHZ



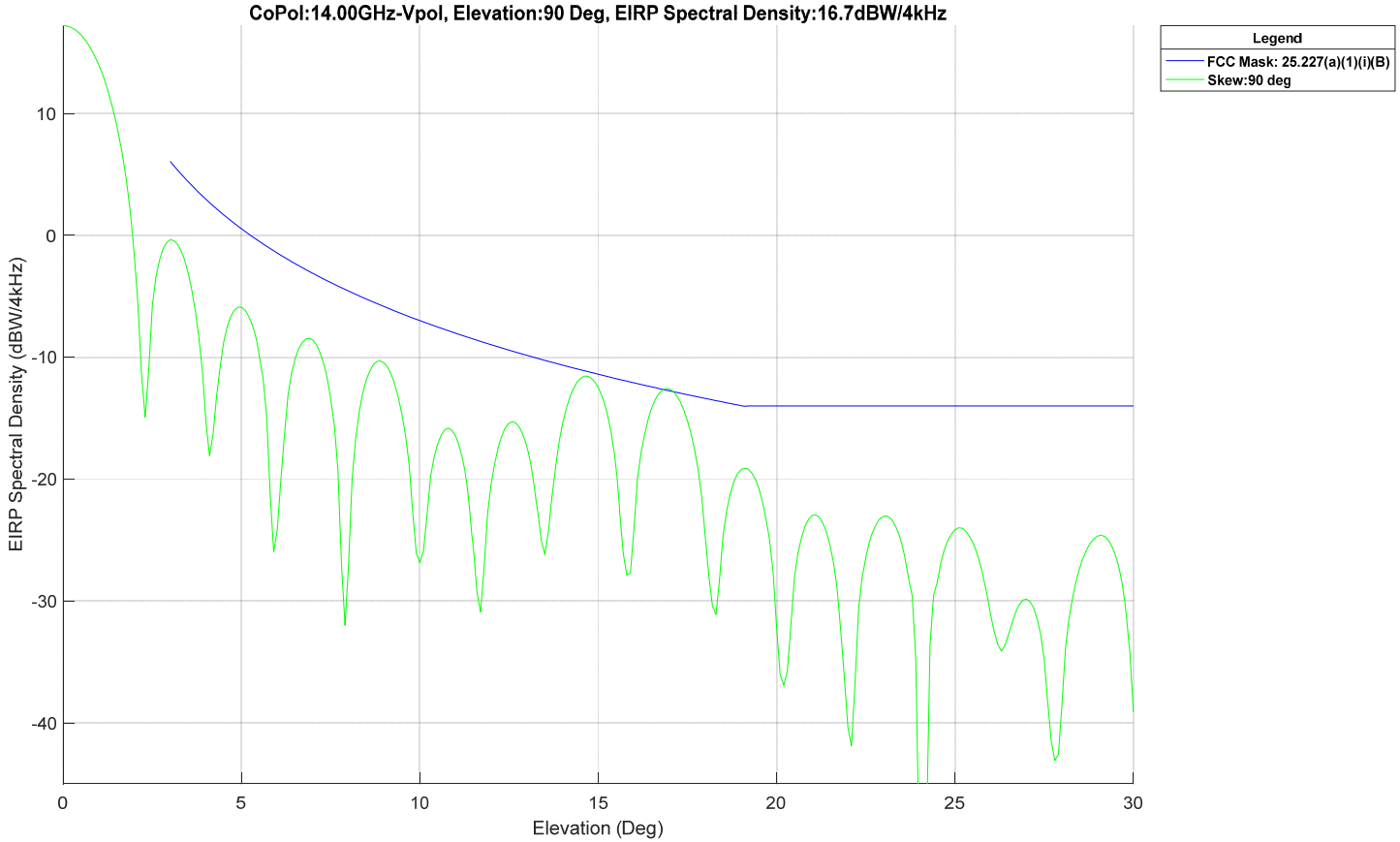
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.9DBW/4KHZ



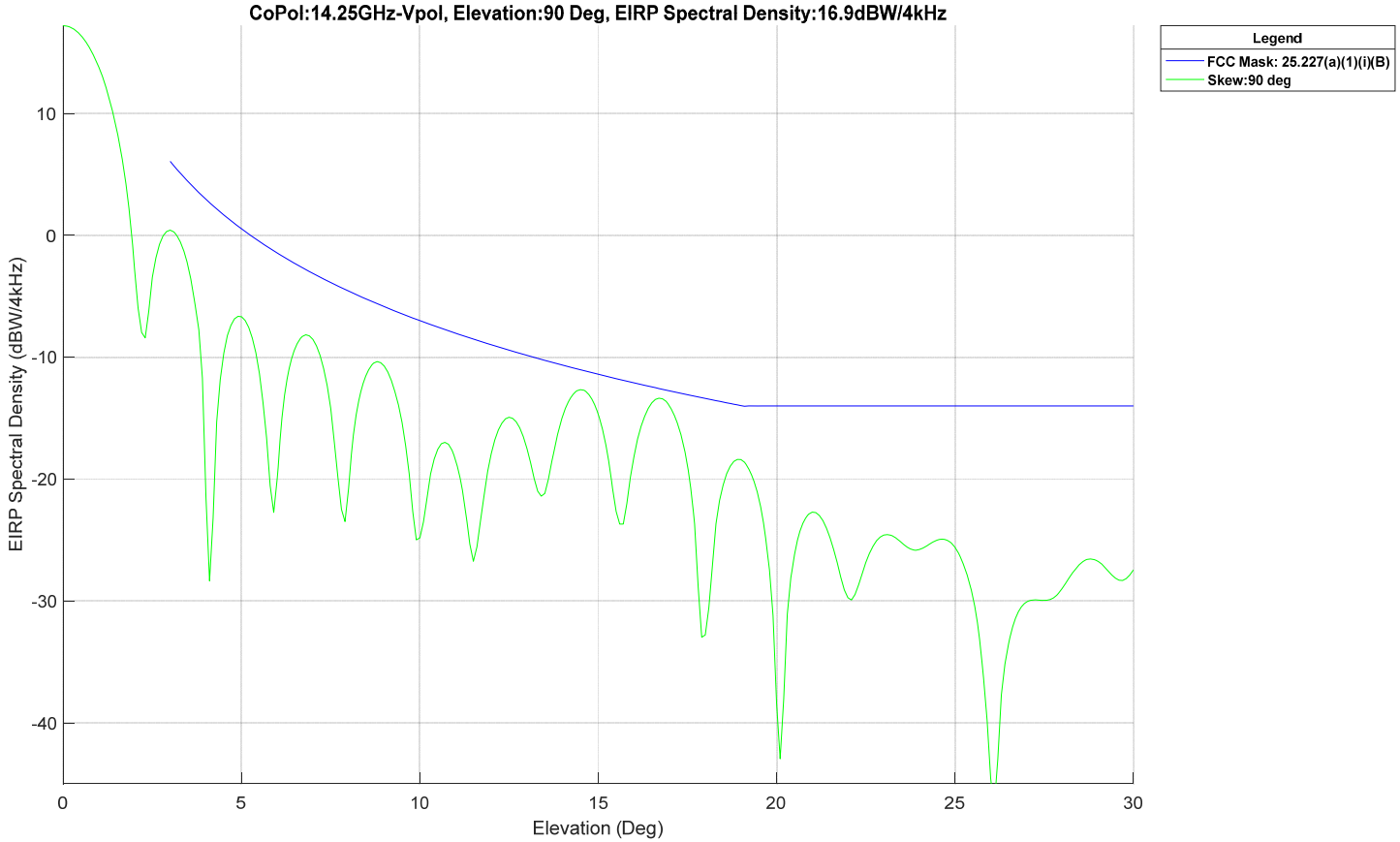
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



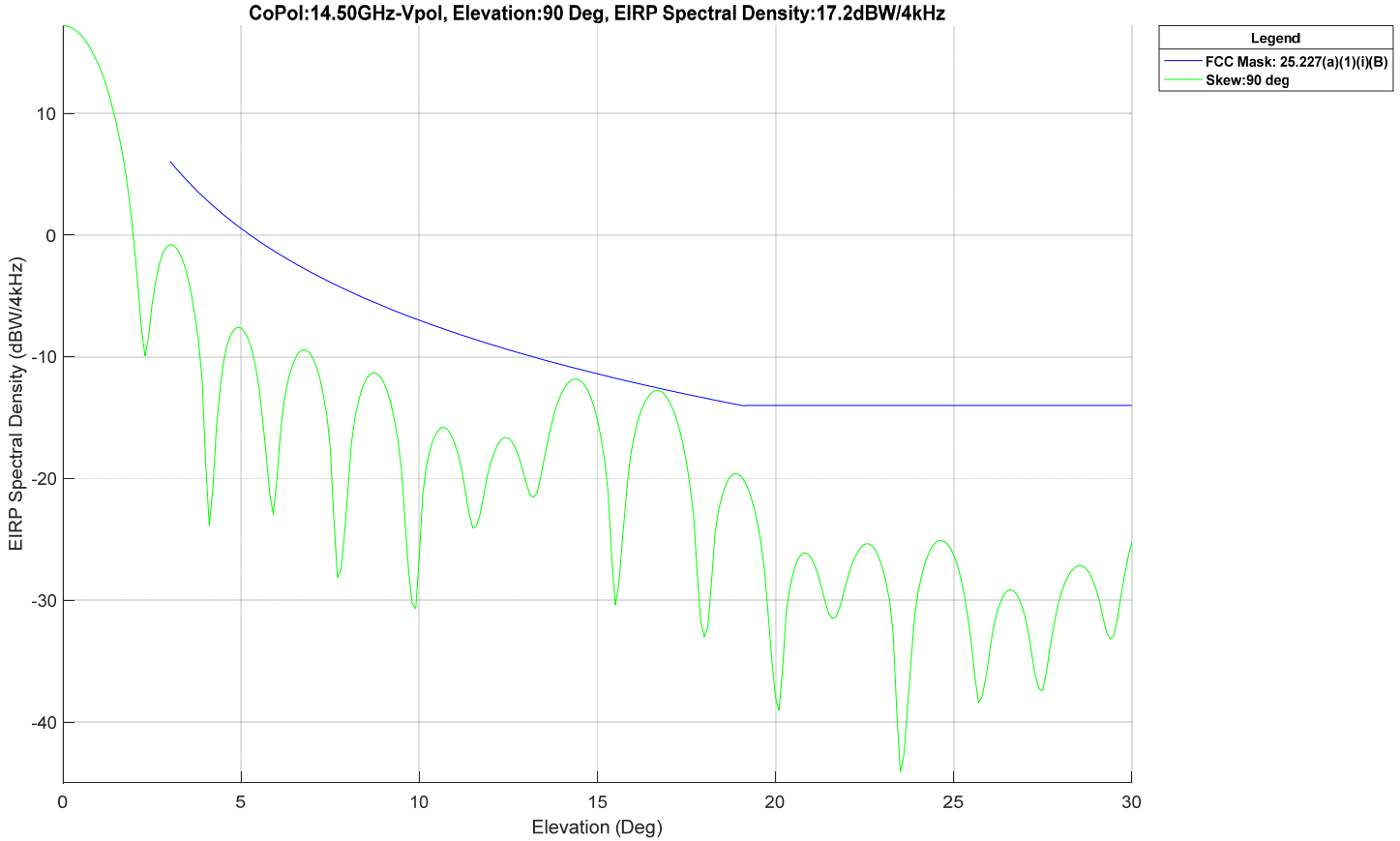
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.7DBW/4KHZ



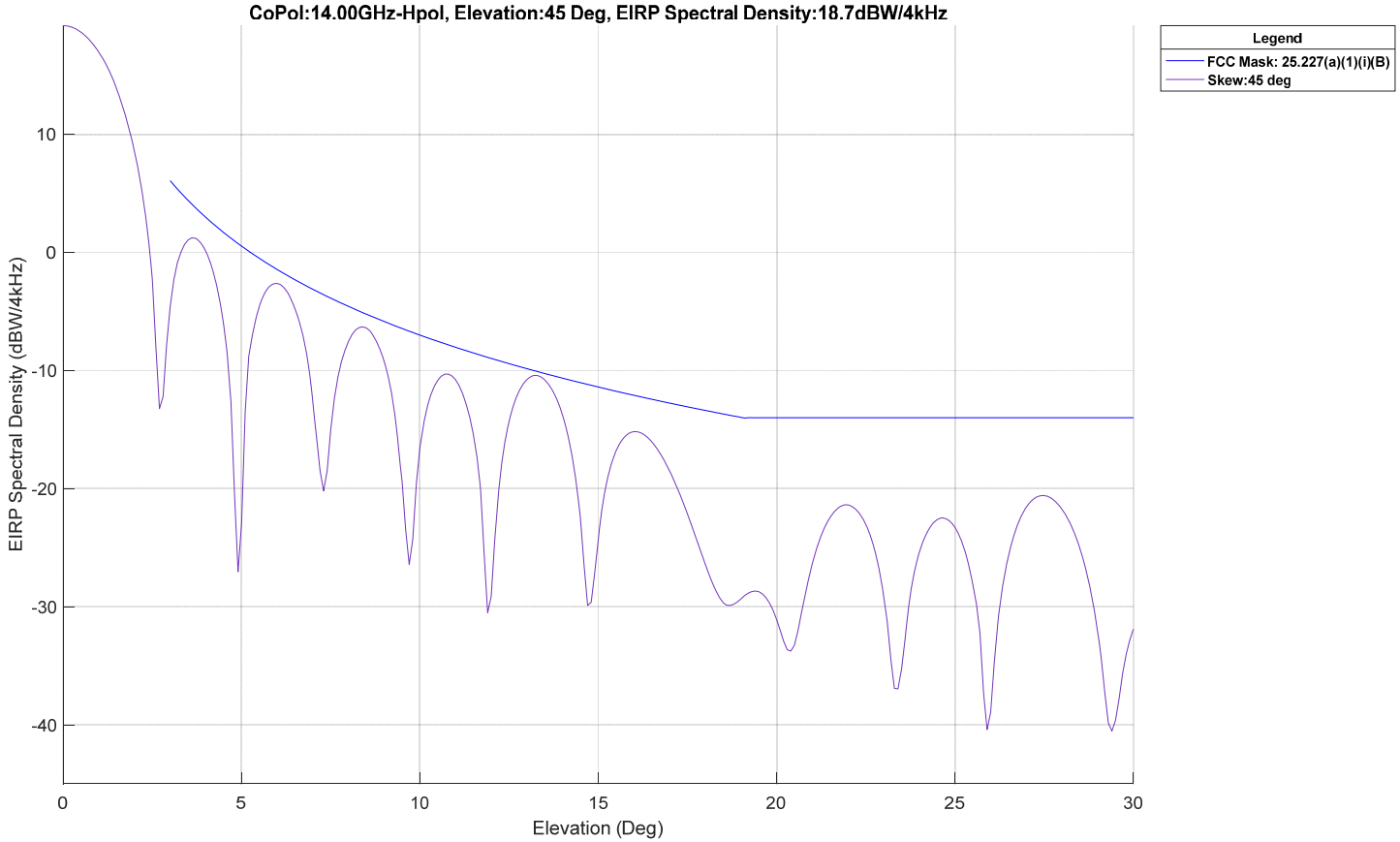
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.9DBW/4KHZ



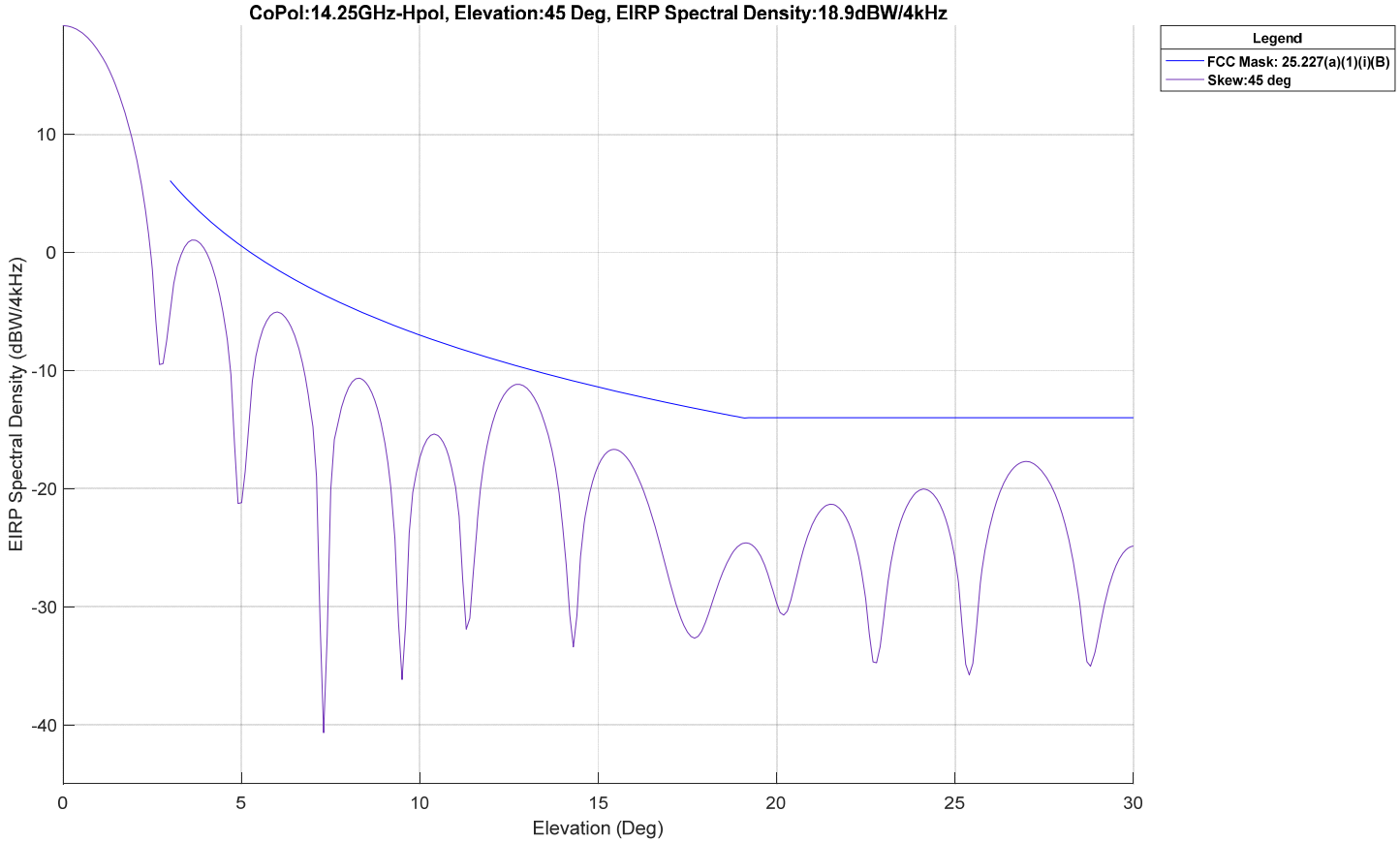
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



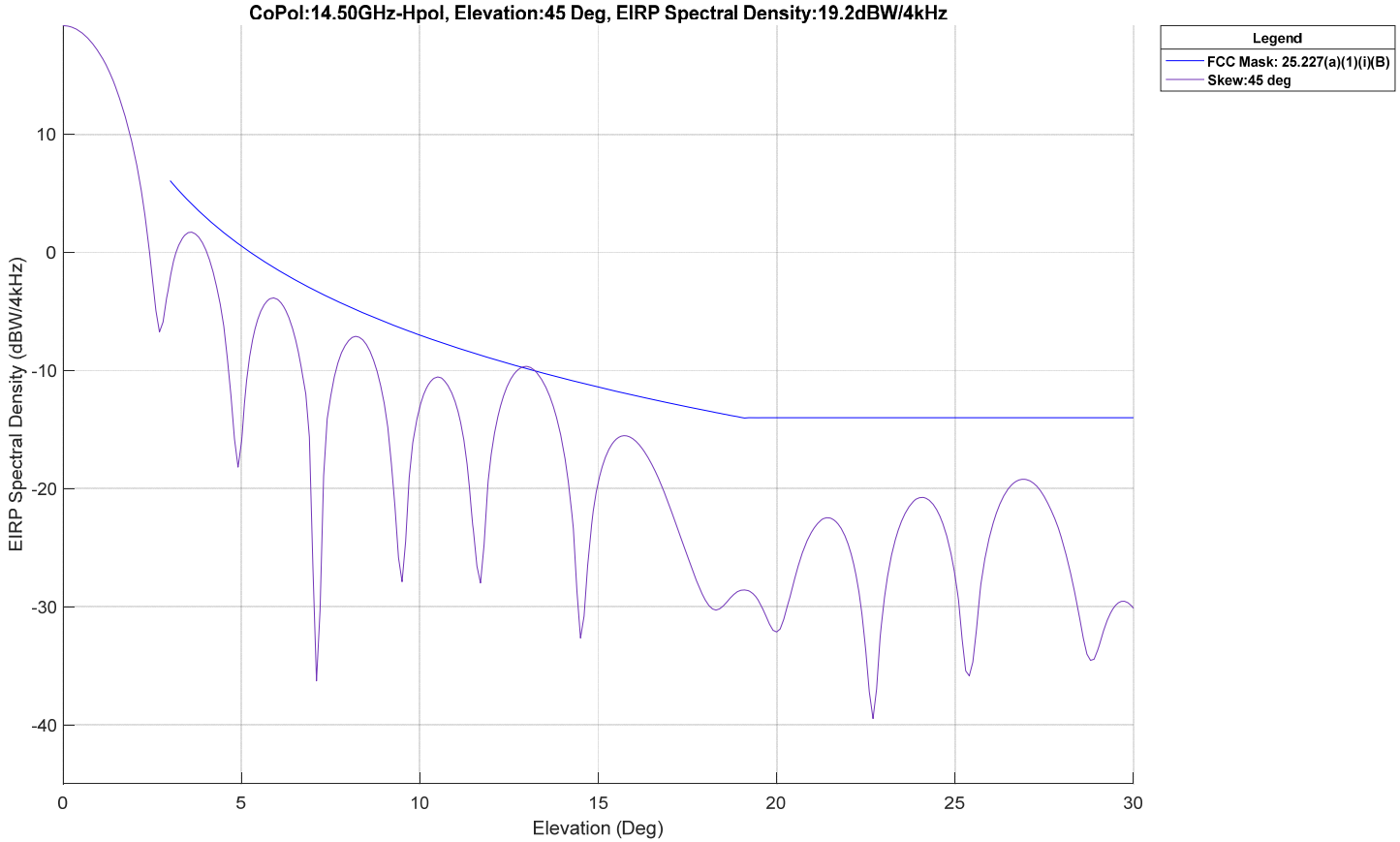
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:45 DEG, EIRP SPECTRAL DENSITY:18.7DBW/4KHZ



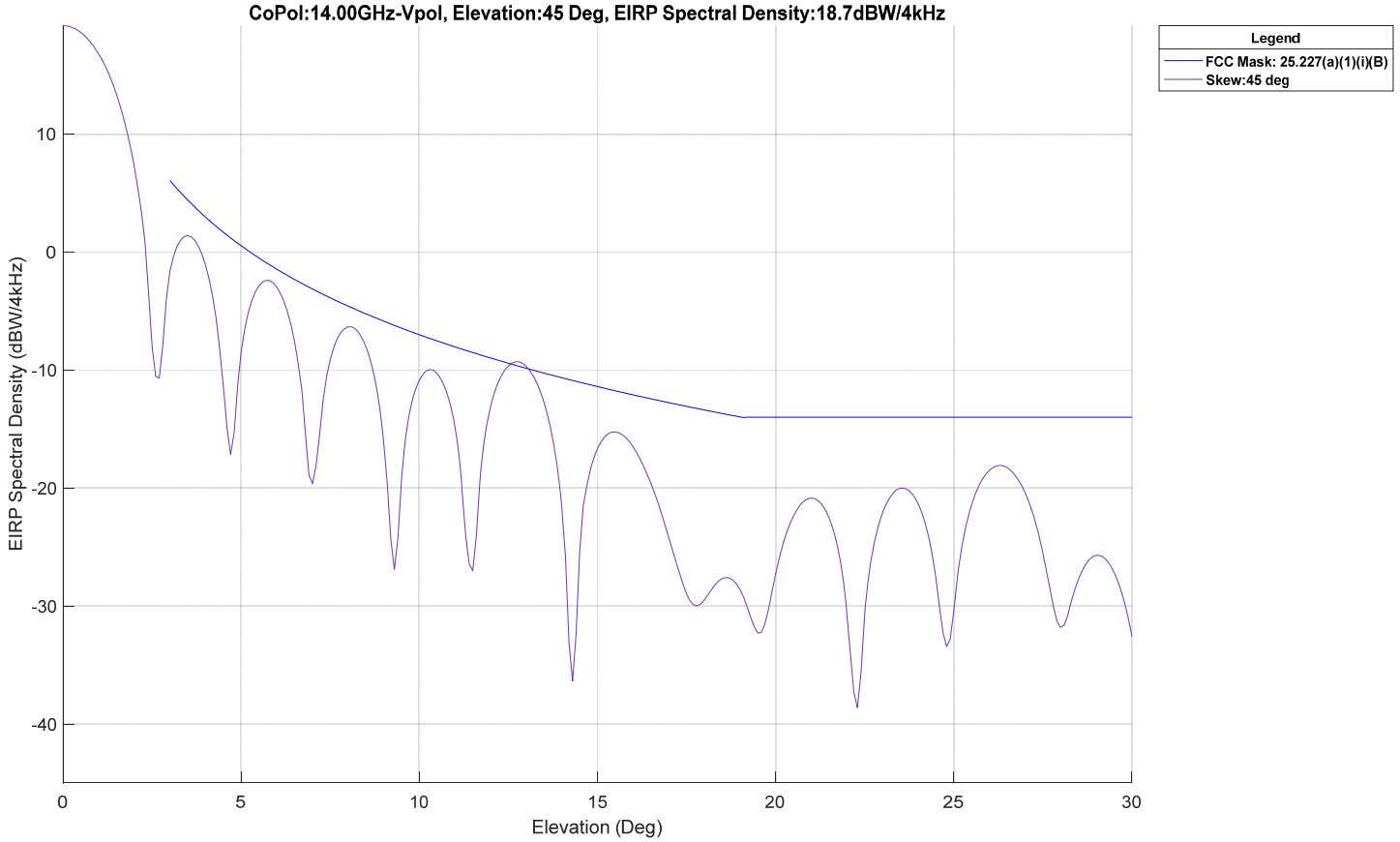
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:45 DEG, EIRP SPECTRAL DENSITY:18.9DBW/4KHZ



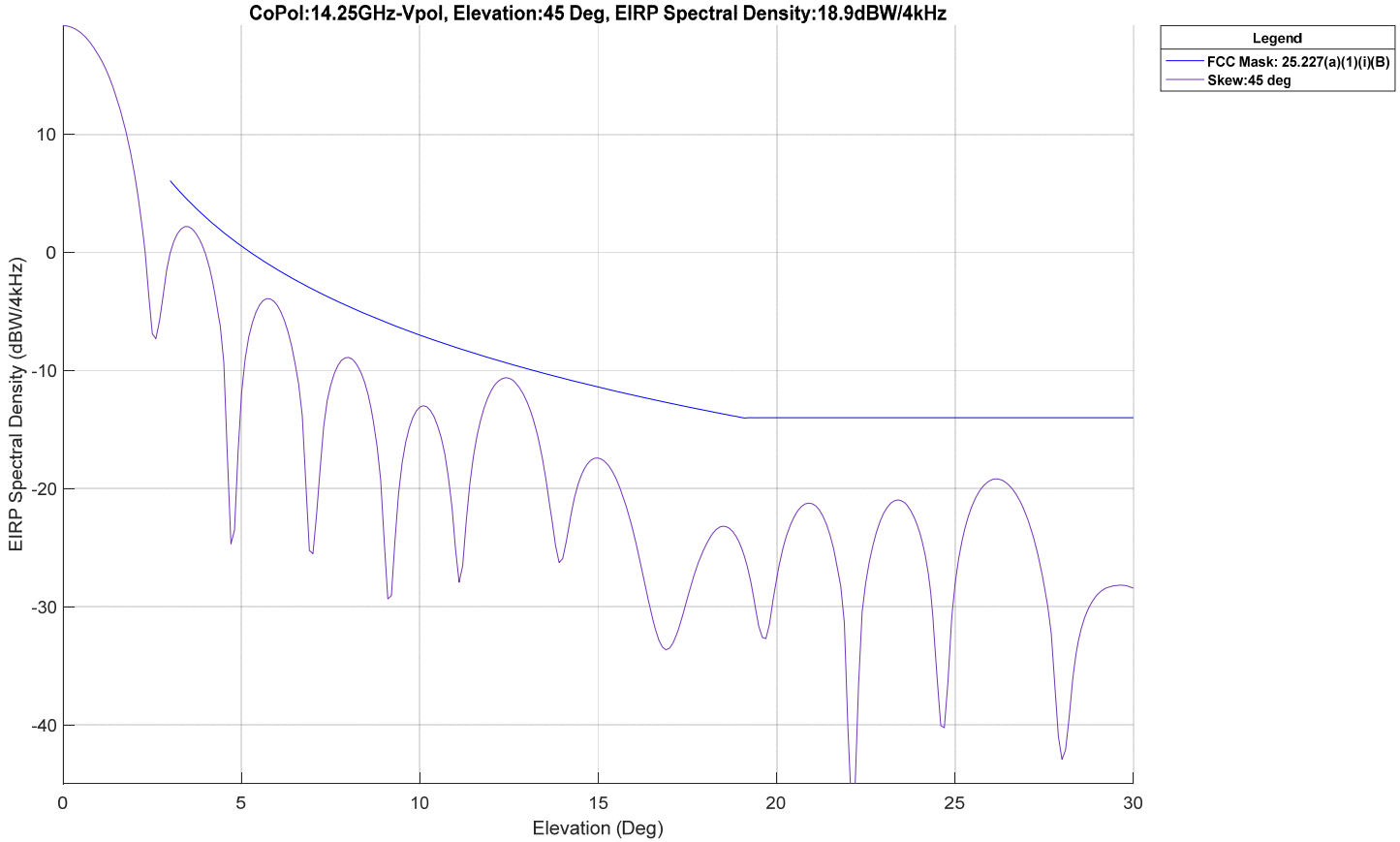
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:45 DEG, EIRP SPECTRAL DENSITY:19.2DBW/4KHZ



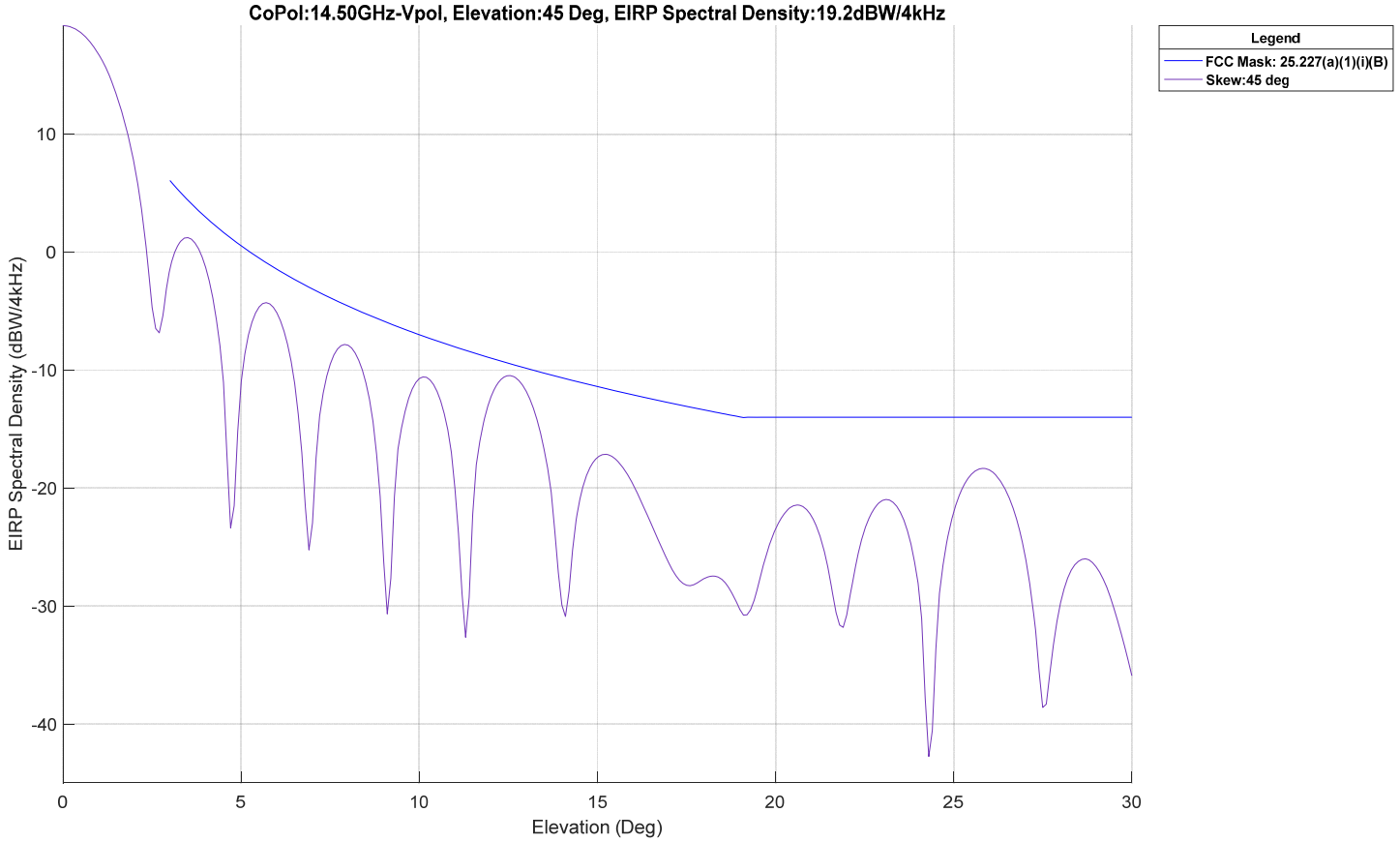
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:45 DEG, EIRP SPECTRAL DENSITY:18.7DBW/4KHZ



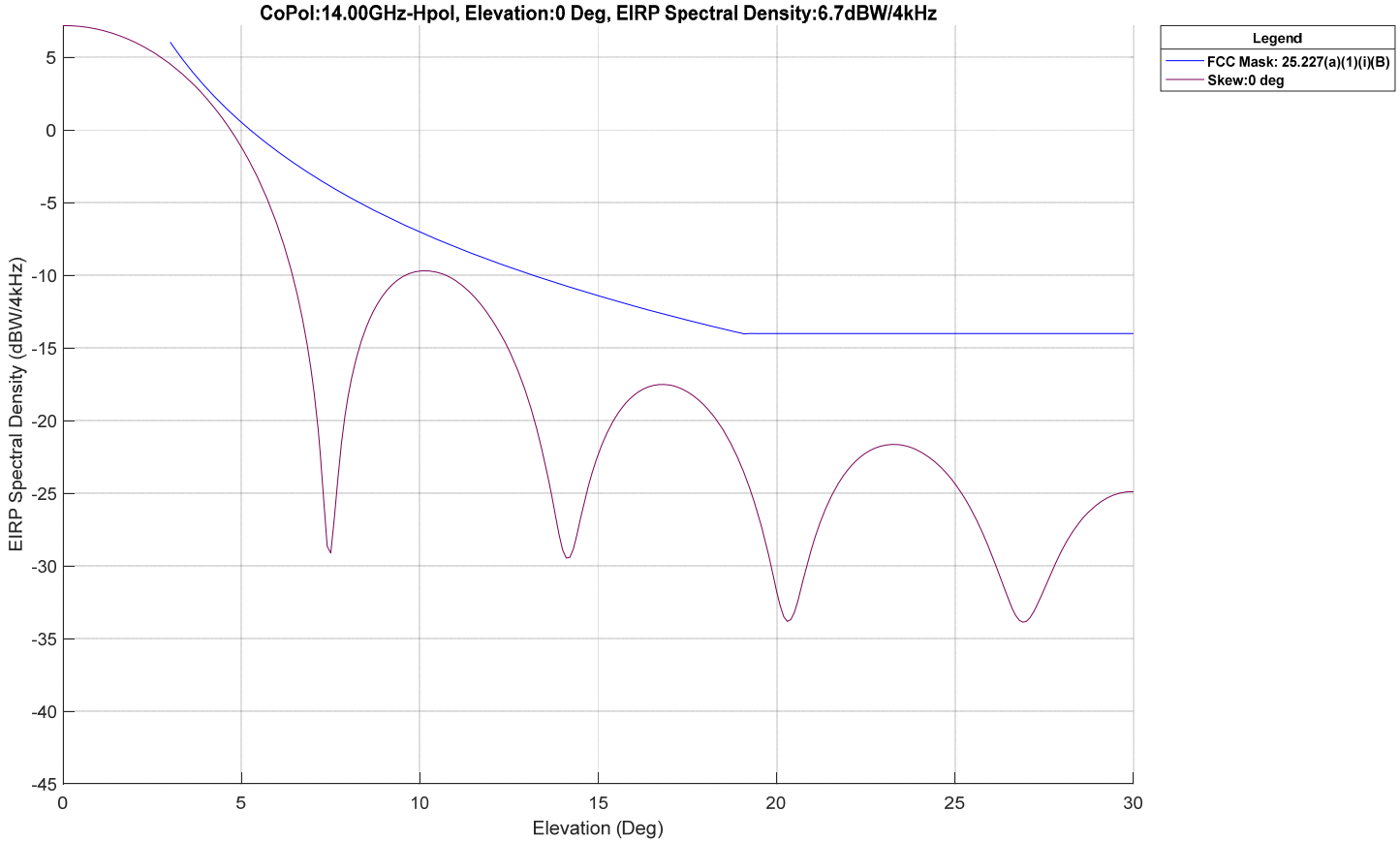
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:45 DEG, EIRP SPECTRAL DENSITY:18.9DBW/4KHZ



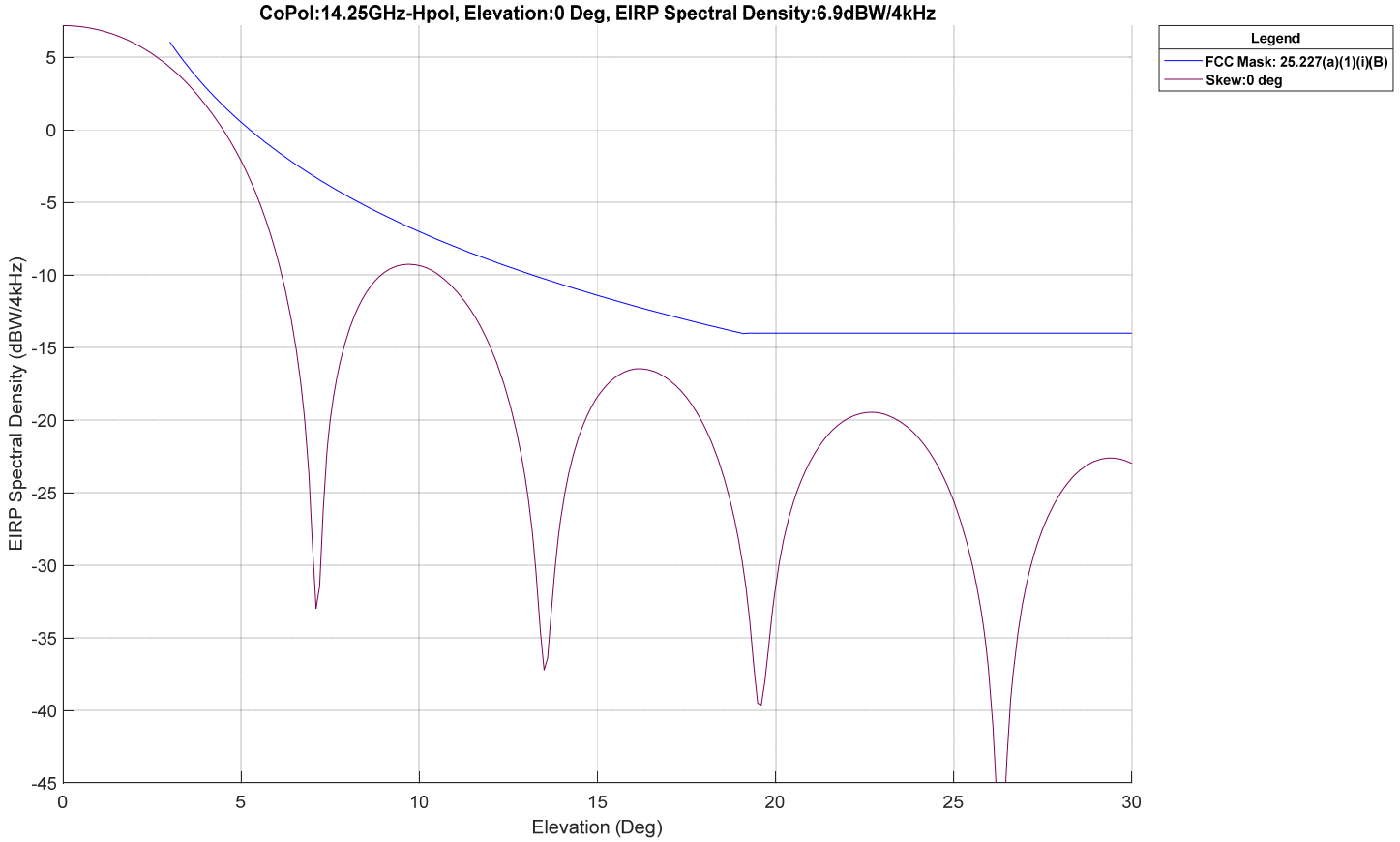
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:45 DEG, EIRP SPECTRAL DENSITY:19.2DBW/4KHZ



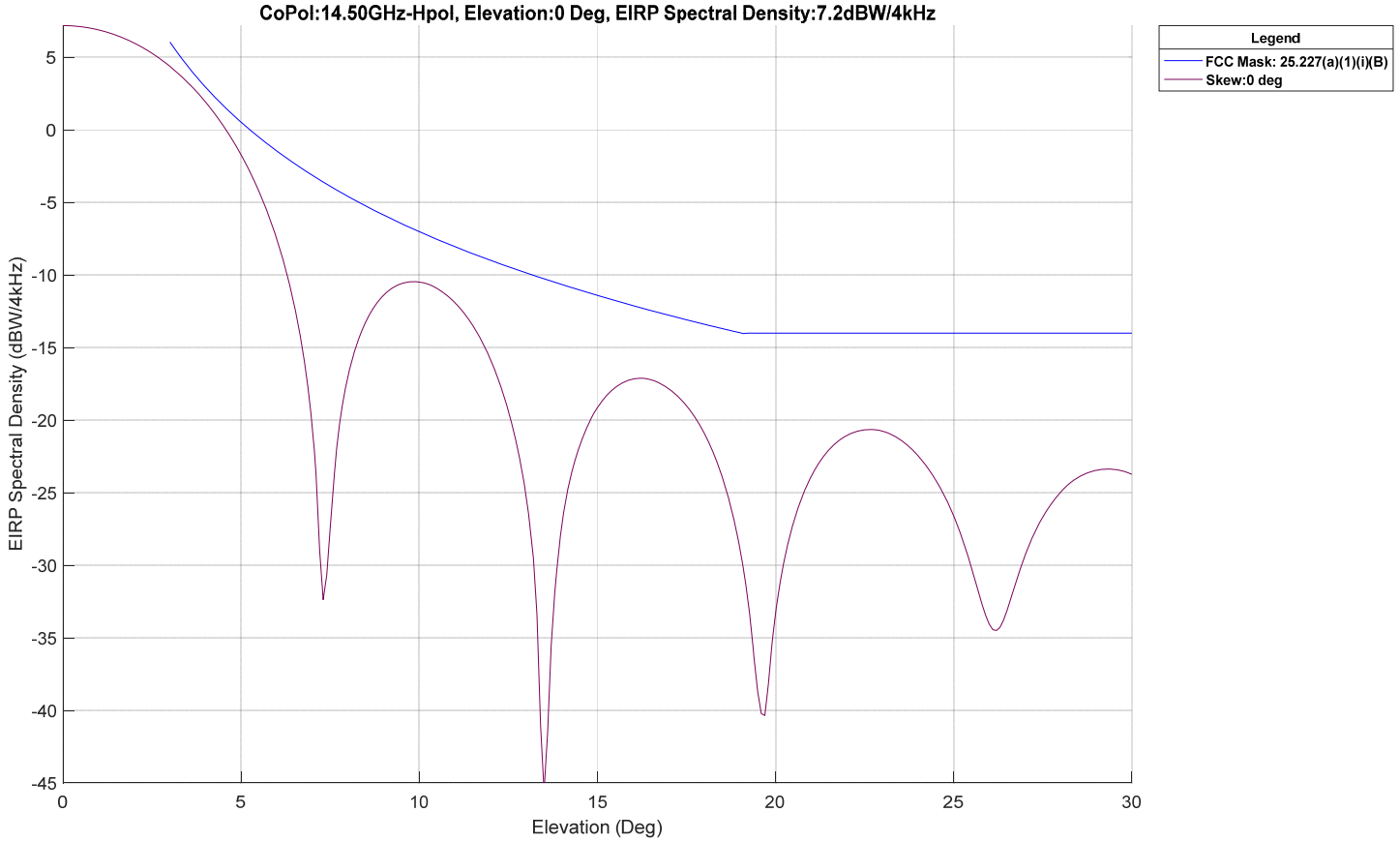
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:6.7DBW/4KHZ



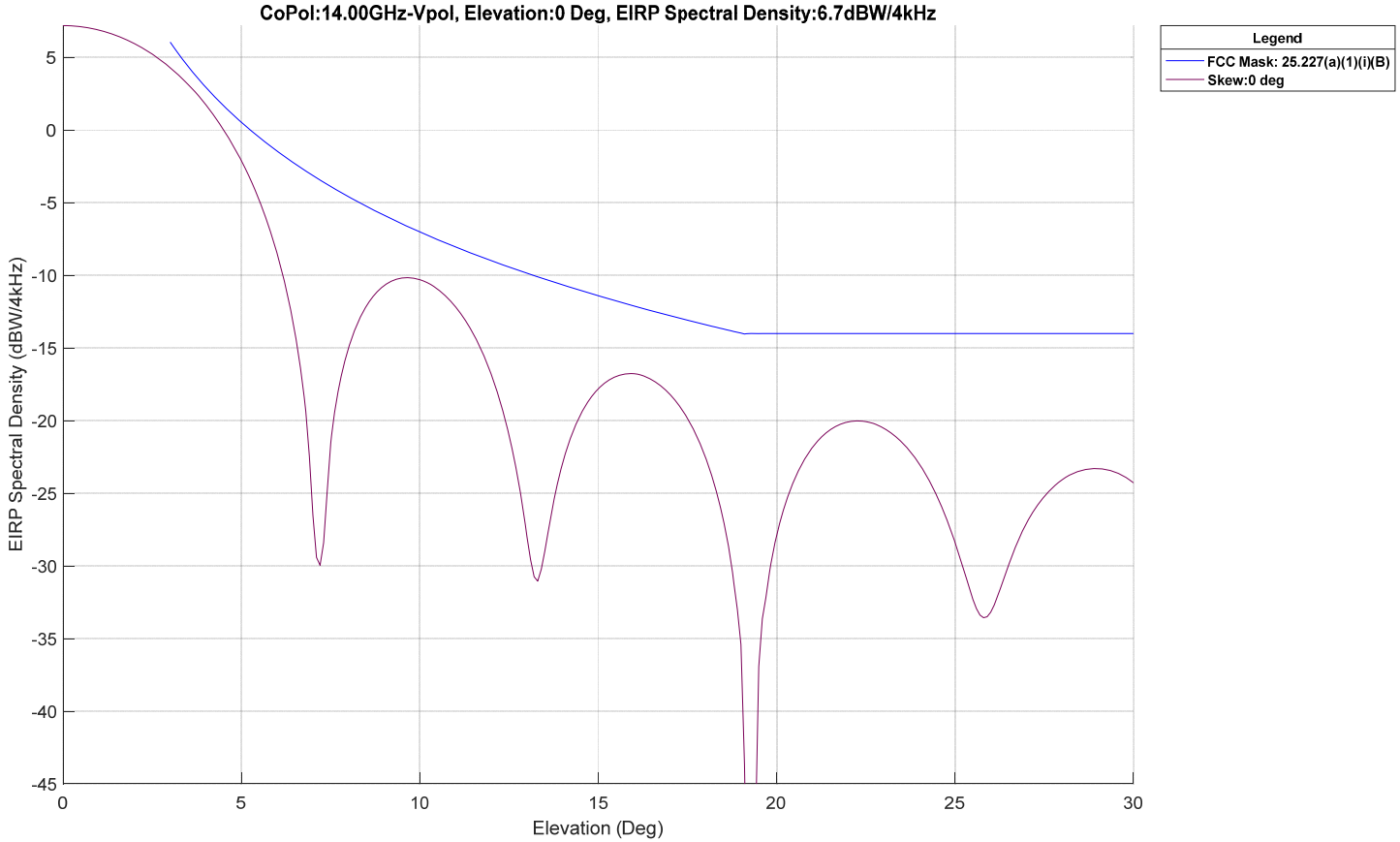
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:6.9DBW/4KHZ



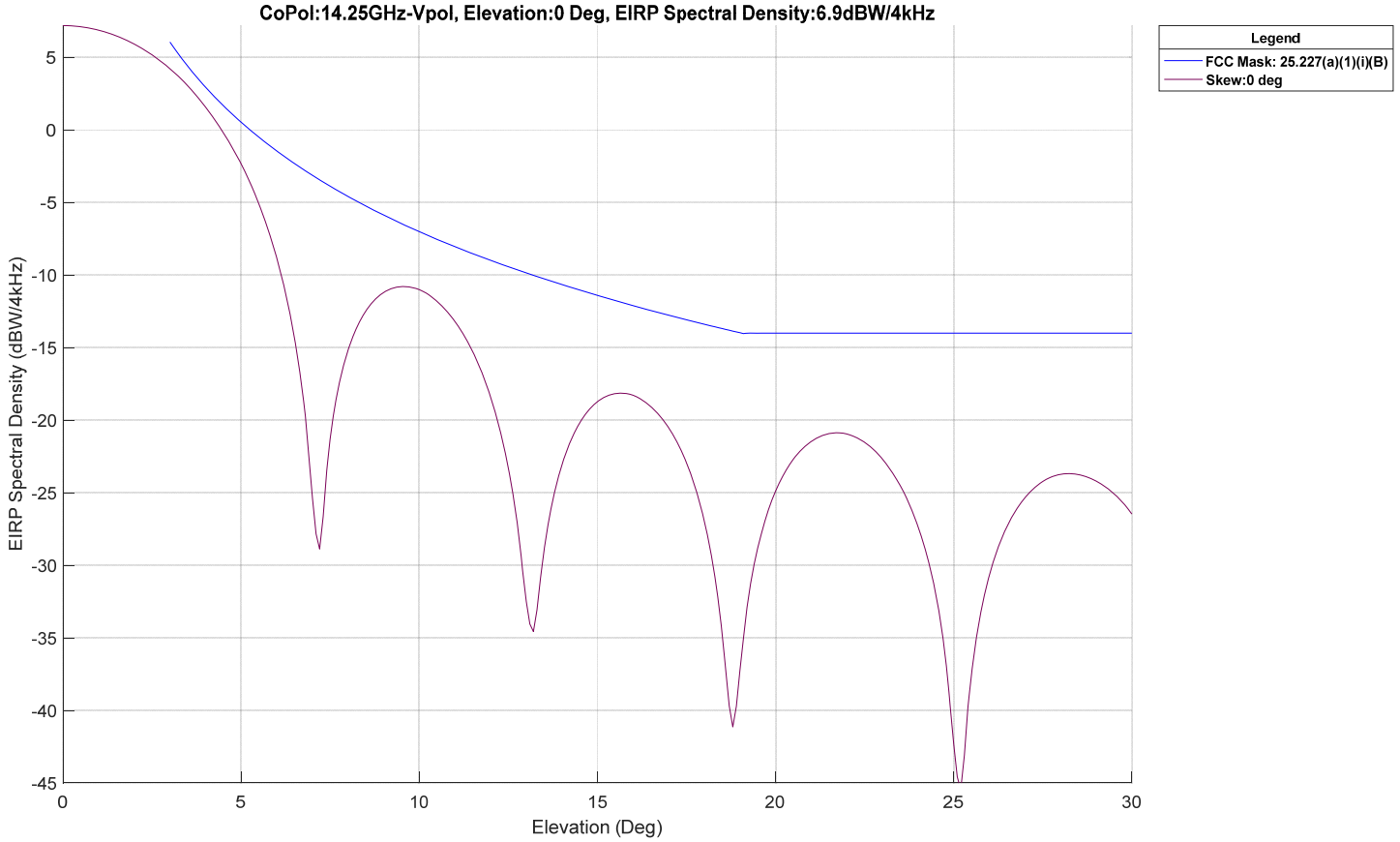
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:7.2DBW/4KHZ



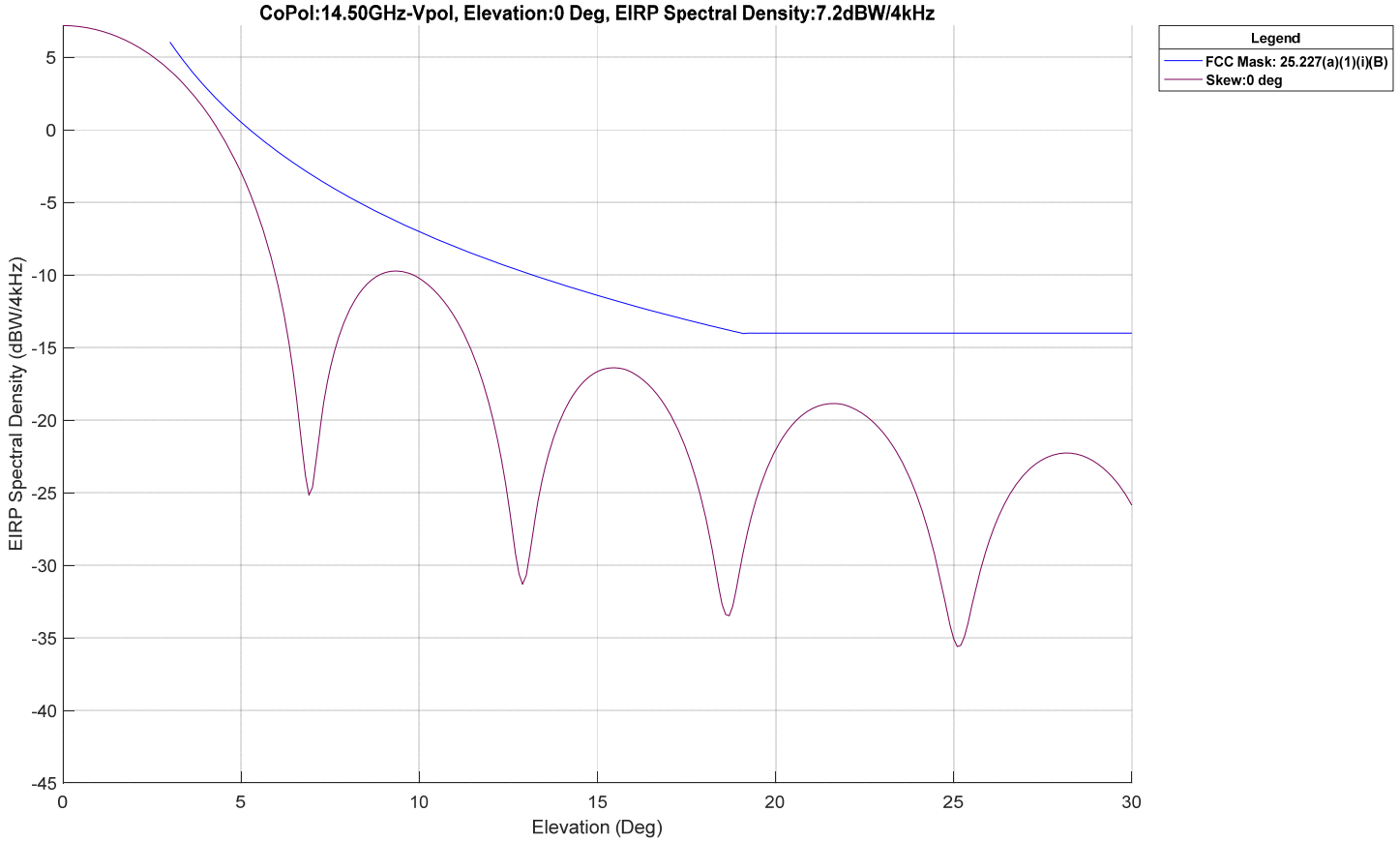
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:6.7DBW/4KHZ



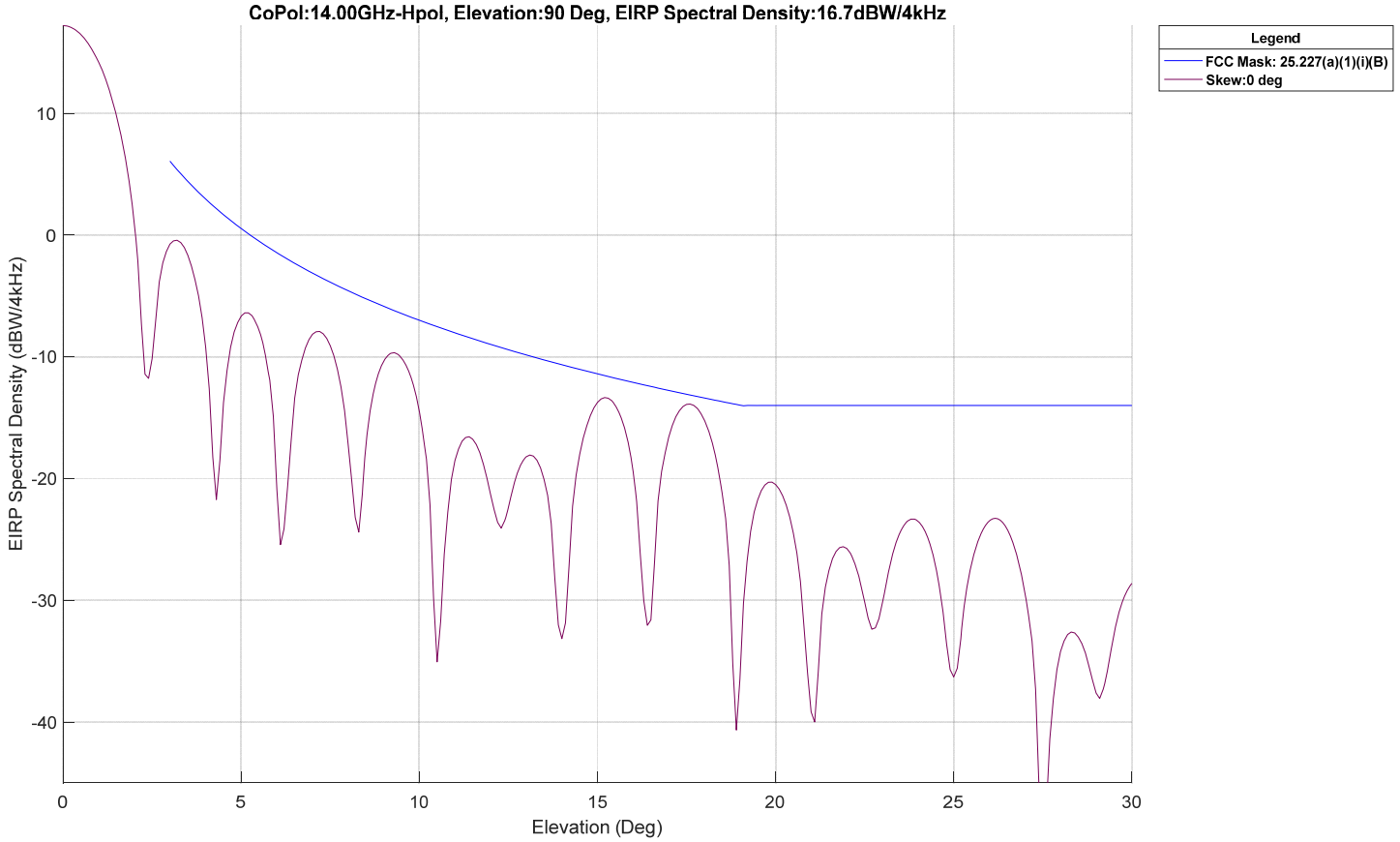
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:6.9DBW/4KHZ



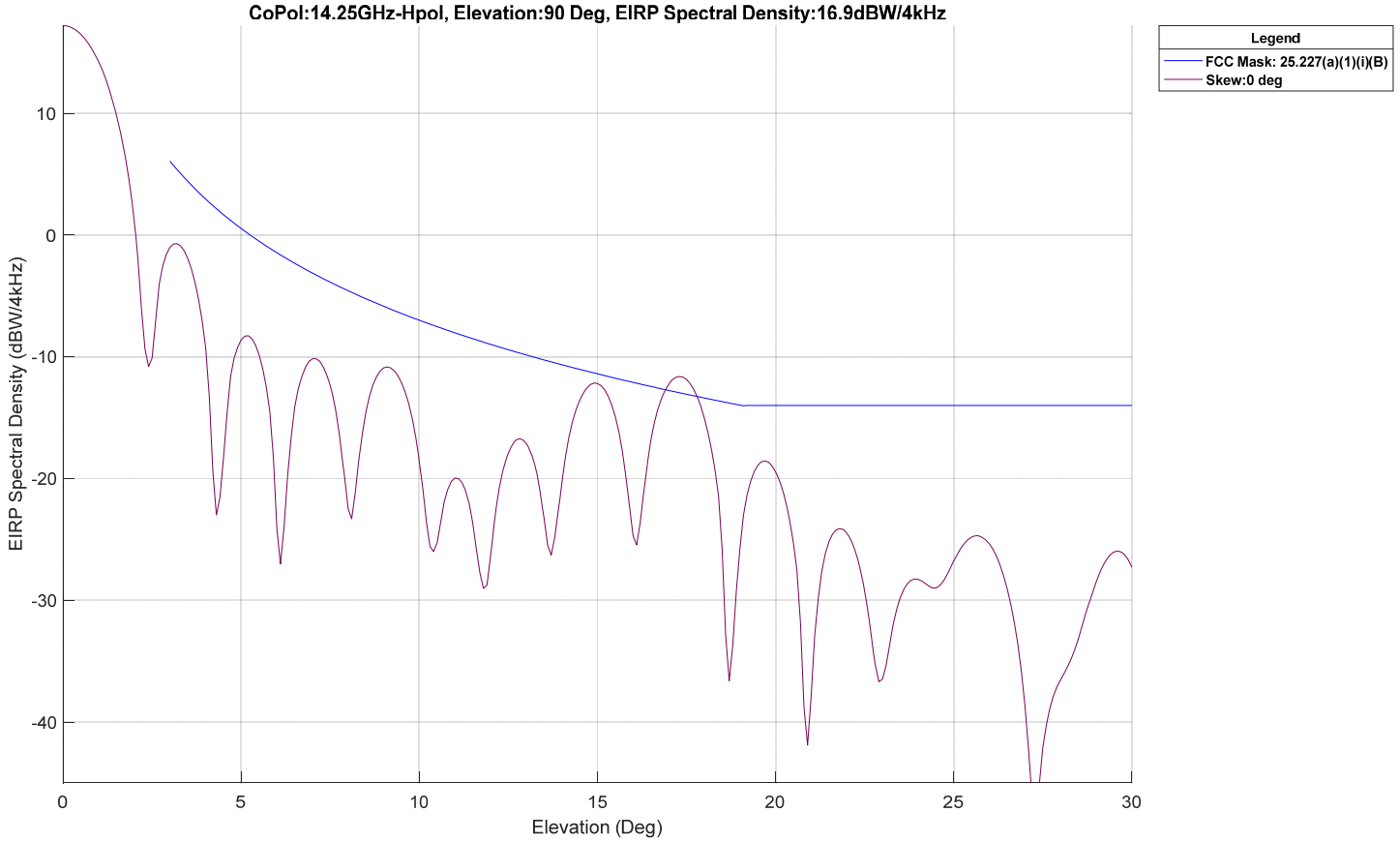
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:7.2DBW/4KHZ



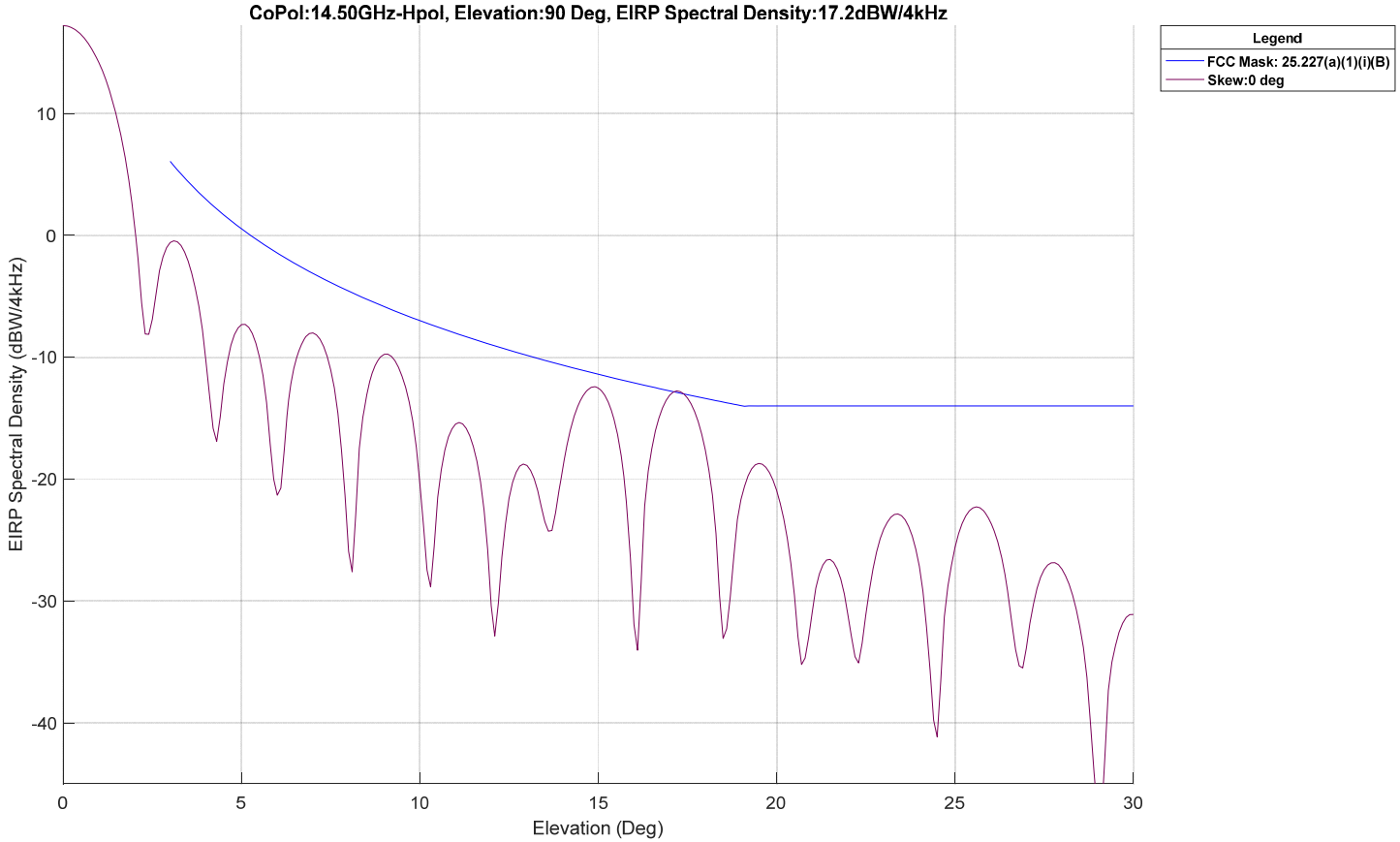
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.7DBW/4KHZ



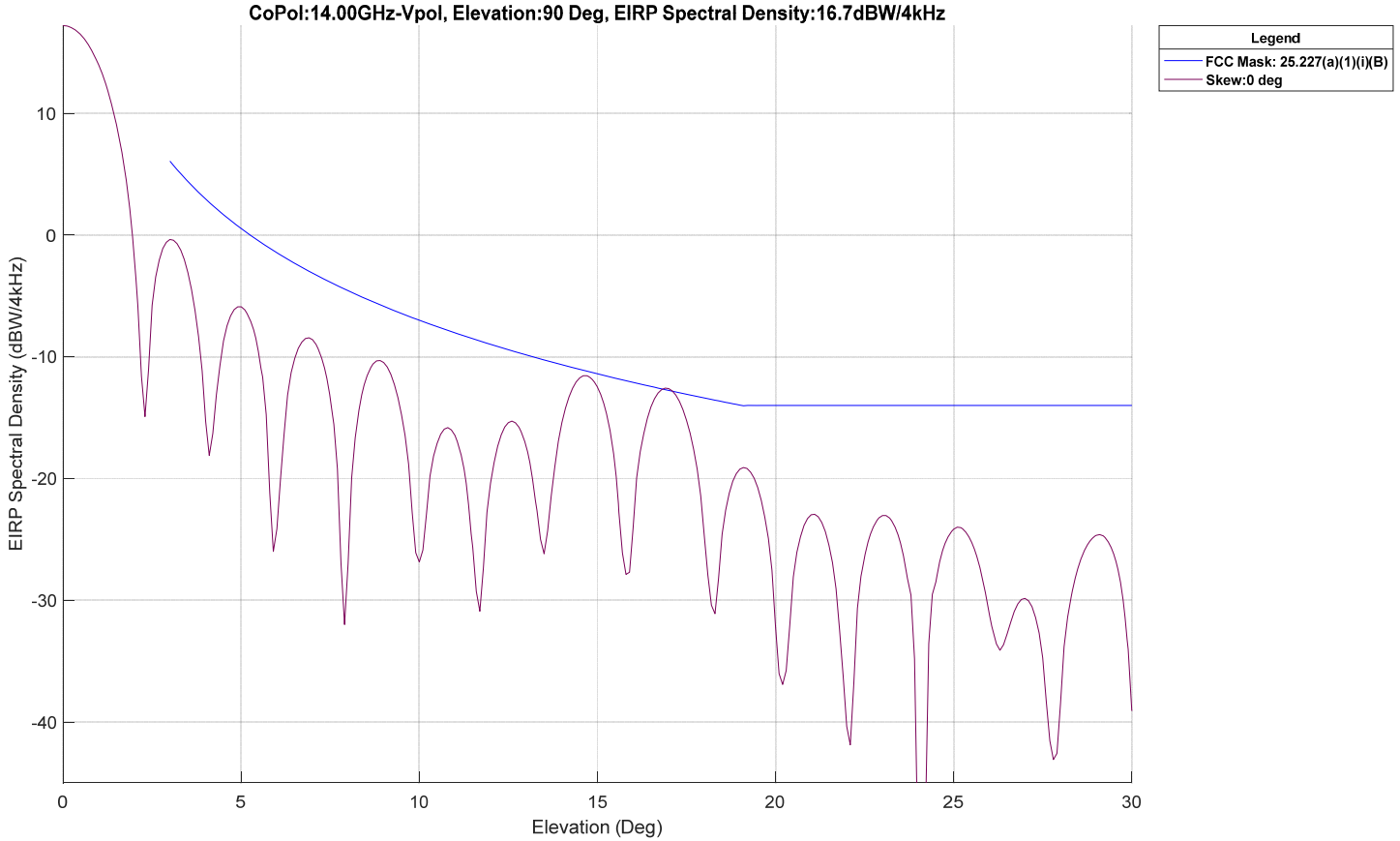
COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.9DBW/4KHZ



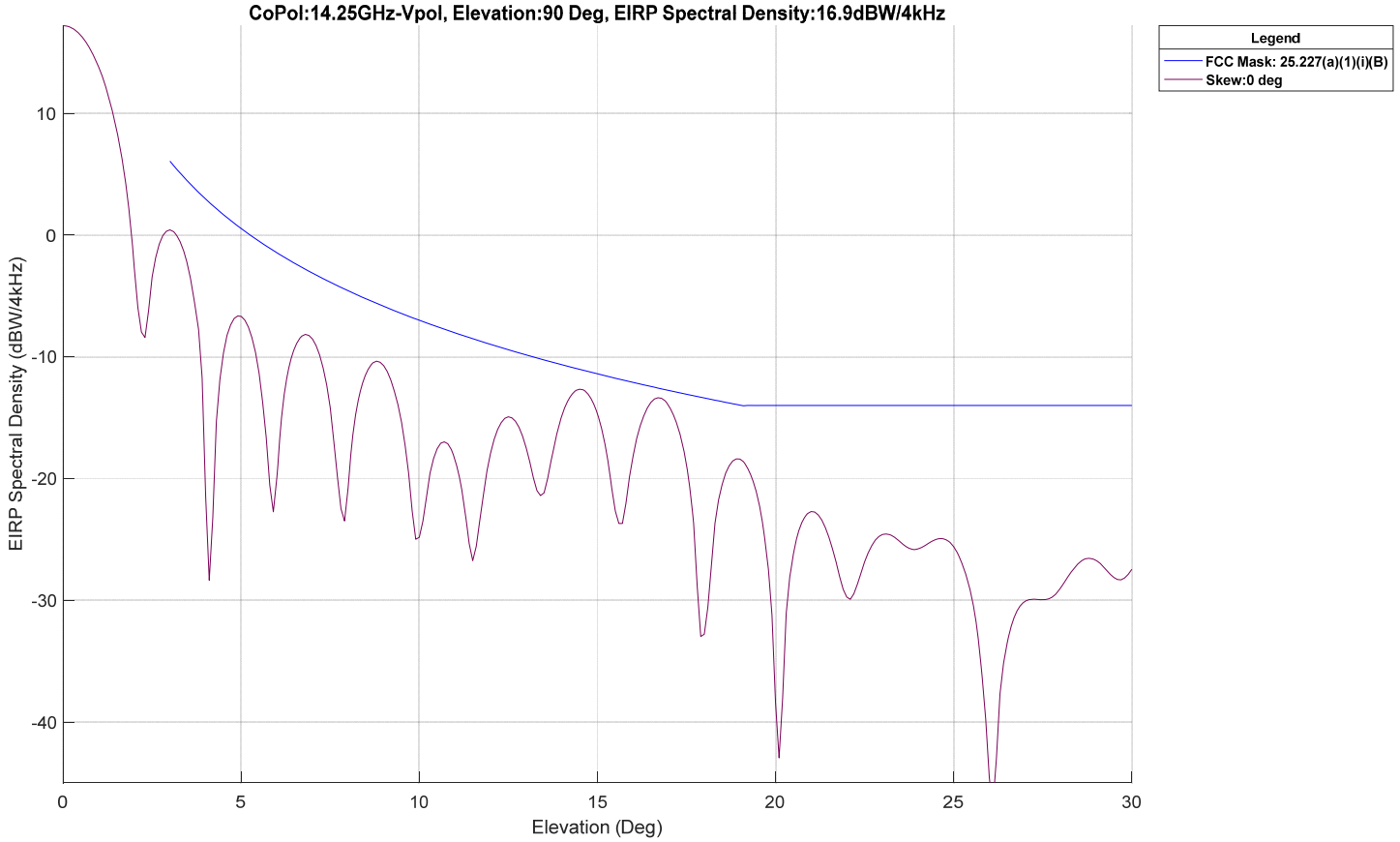
COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



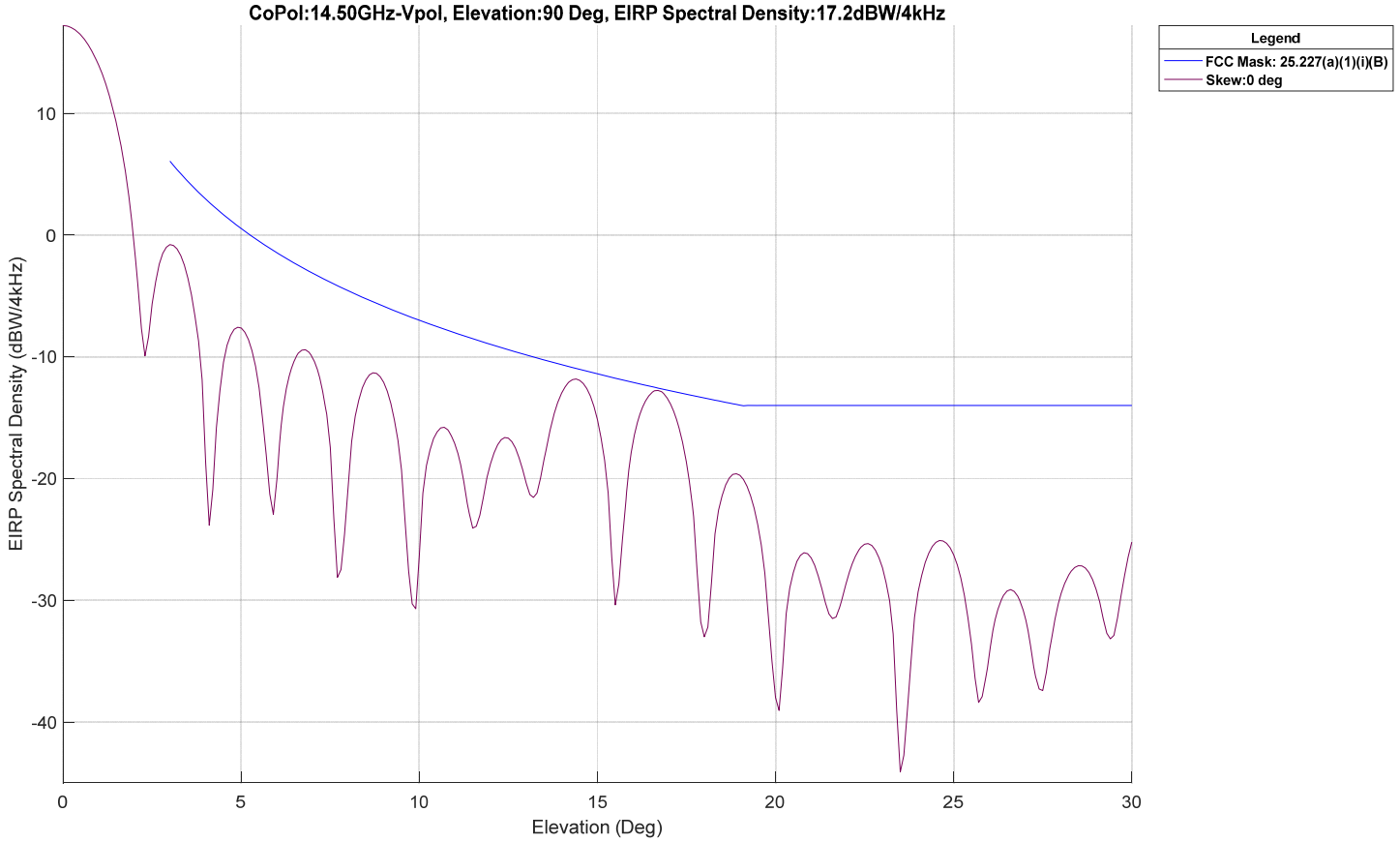
COPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.7DBW/4KHZ



COPOL-PERPENDICULAR TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:16.9DBW/4KHZ



COPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:90 DEG, EIRP SPECTRAL DENSITY:17.2DBW/4KHZ



GSAA EIRP SPECTRAL DENSITY PLOTS – TANGENT PLANE TO GSO CROSS POL WITH 25.227(A)(1)(I)(C) MASK

DESCRIPTION

- EIRP Spectral Density plots are at 14.00 GHz, 14.25 GHz and 14.50 GHz for both vertical and horizontal polarization for the following Skew and Elevation Angles as it is mapped to the maximum EIRP spectral density in dBW/4kHz in a 1.024 MHz Bandwidth (in **BOLD**):

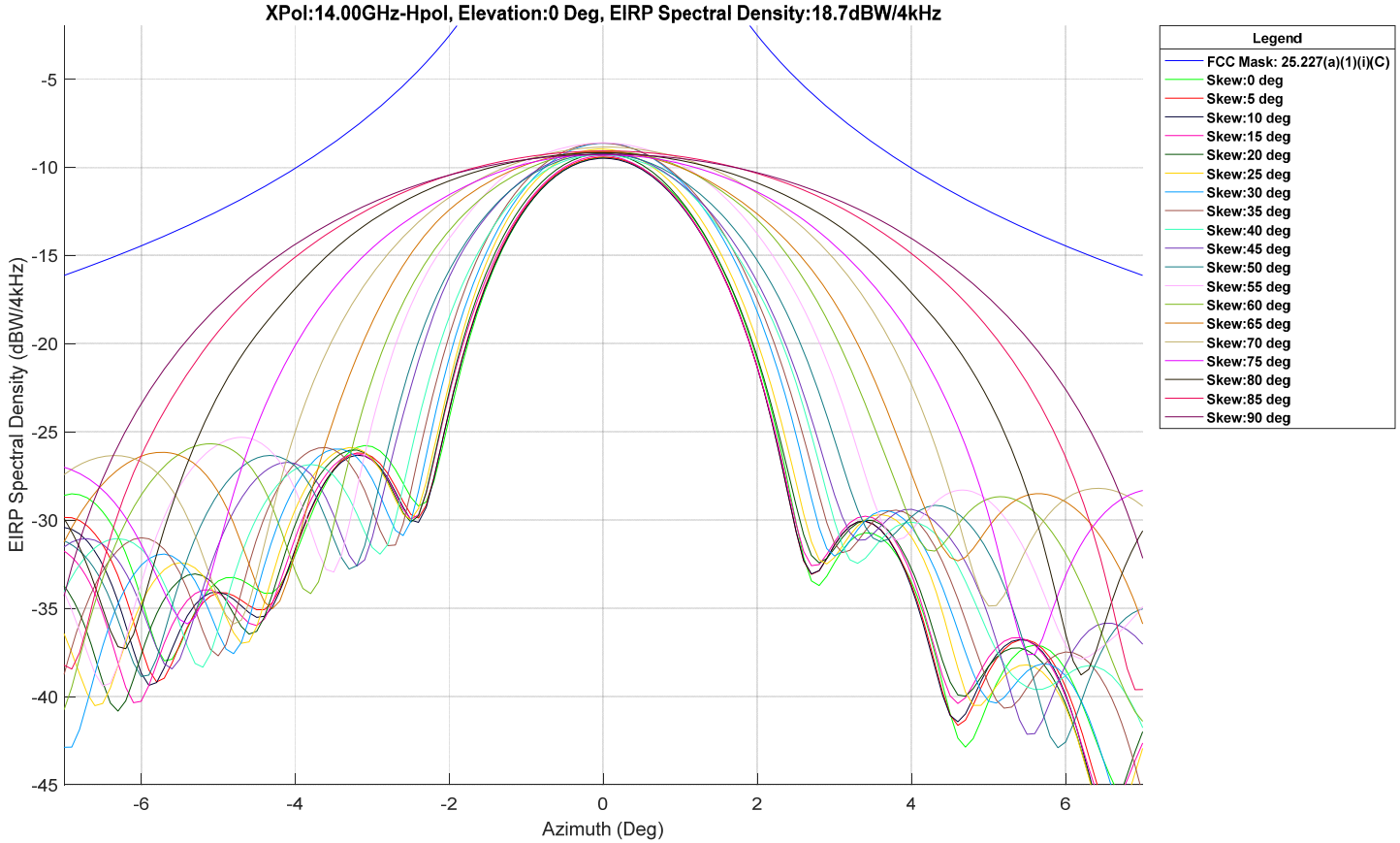
DESCRIPTION

Tangent Plane to GSO Cross Pol ESD Plots as they comply to FCC mask 25.227(a)(1)(i)(C)

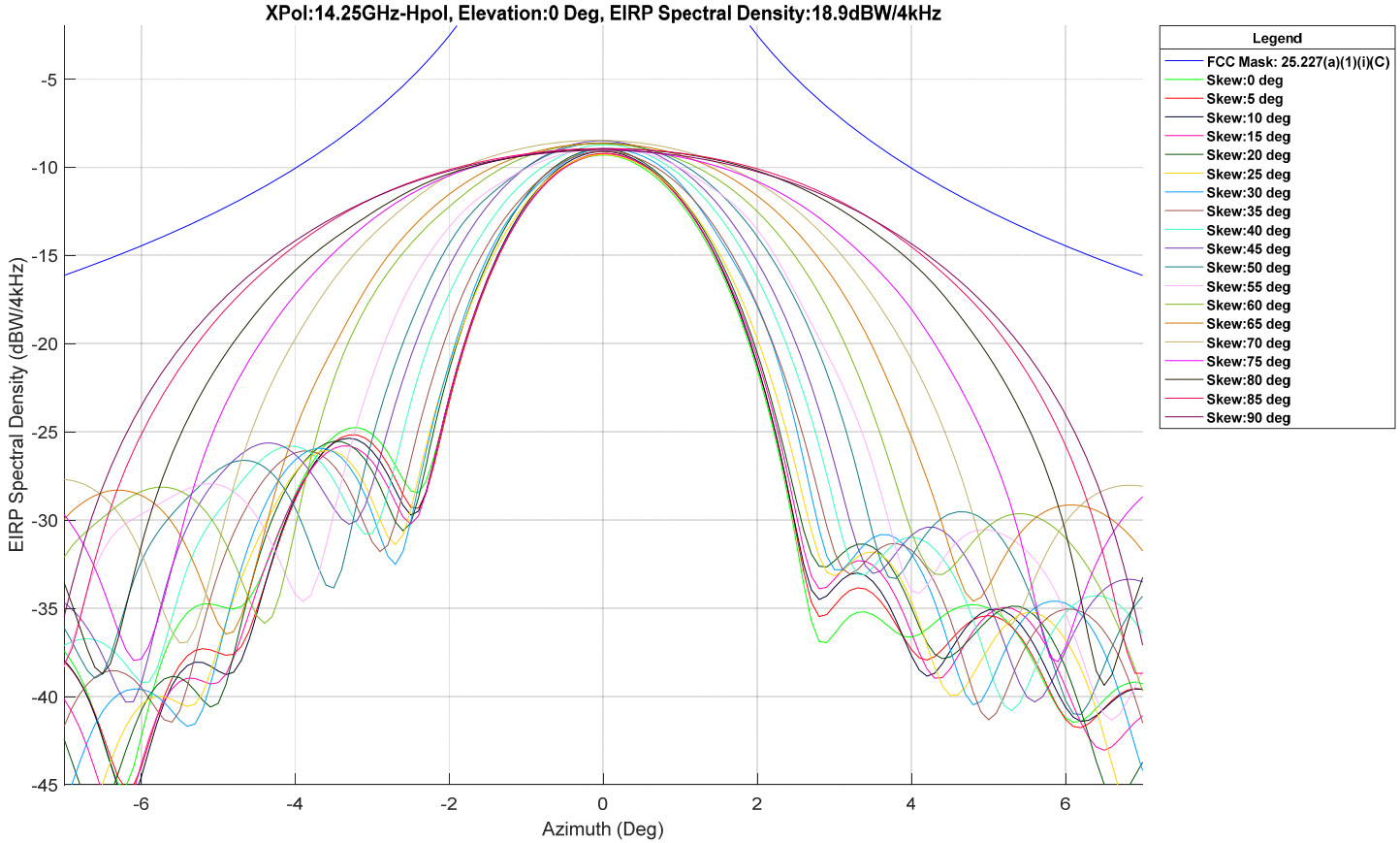
GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**
5	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
10	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
15	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
20	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
25	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
30	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
35	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
40	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
45	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
50	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
55	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
60	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
65	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
70	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
75	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
80	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
85	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2

*Note: Includes Radome and Cable losses

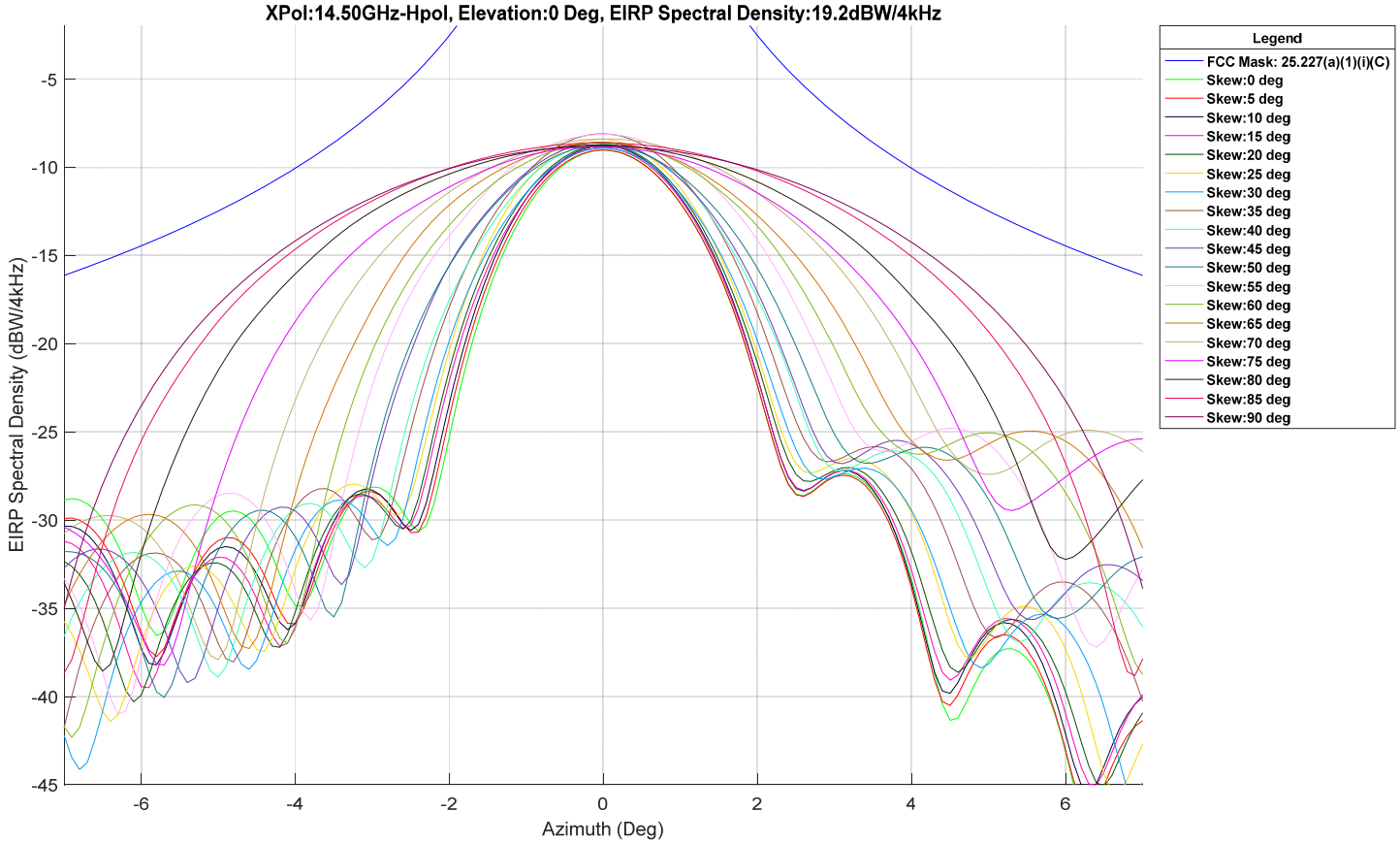
XPOL-TANGENT TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:18.7 DBW/4KHZ



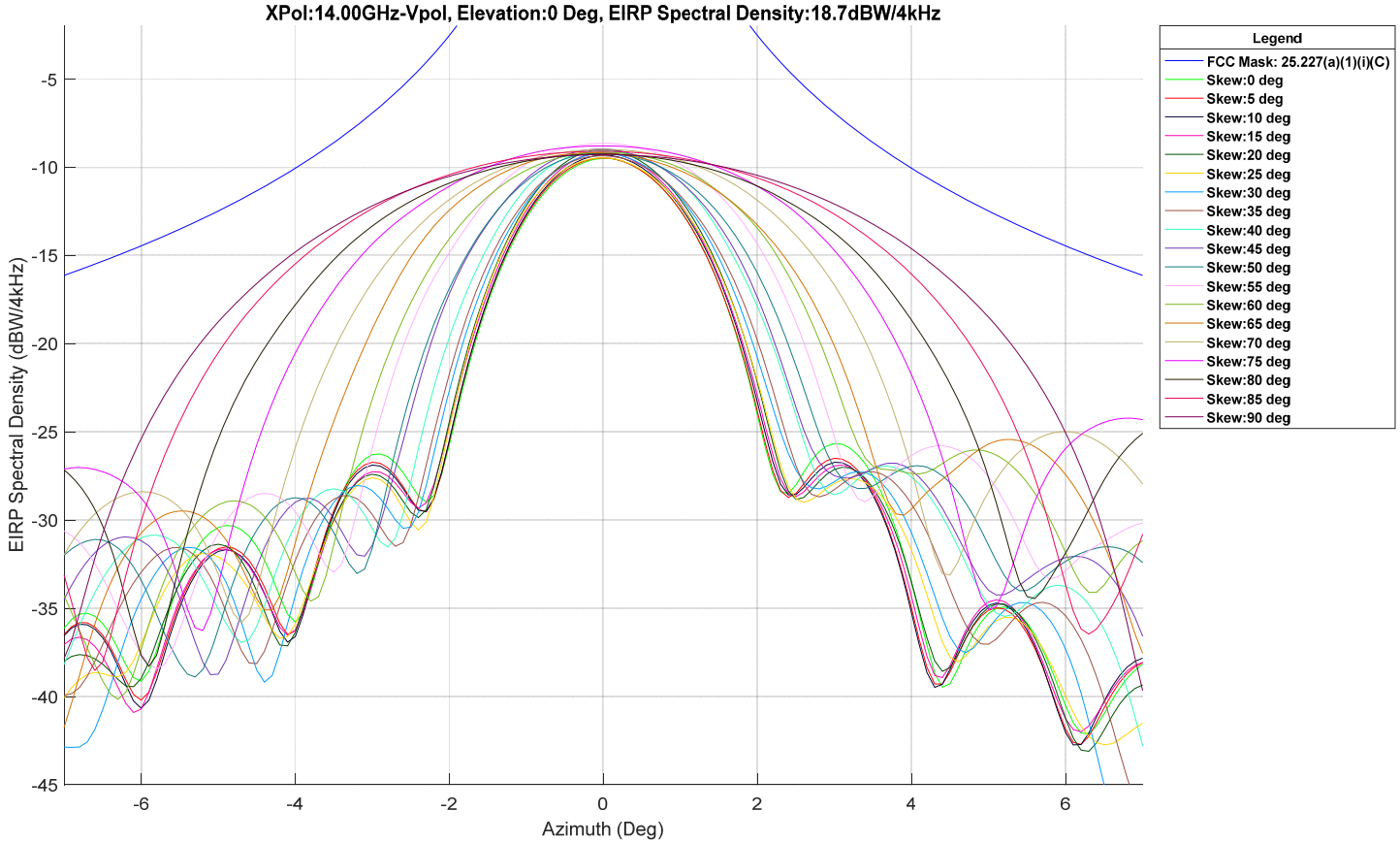
XPOL-TANGENT TO GSO PLANE:14.25GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:18.9 DBW/4KHZ



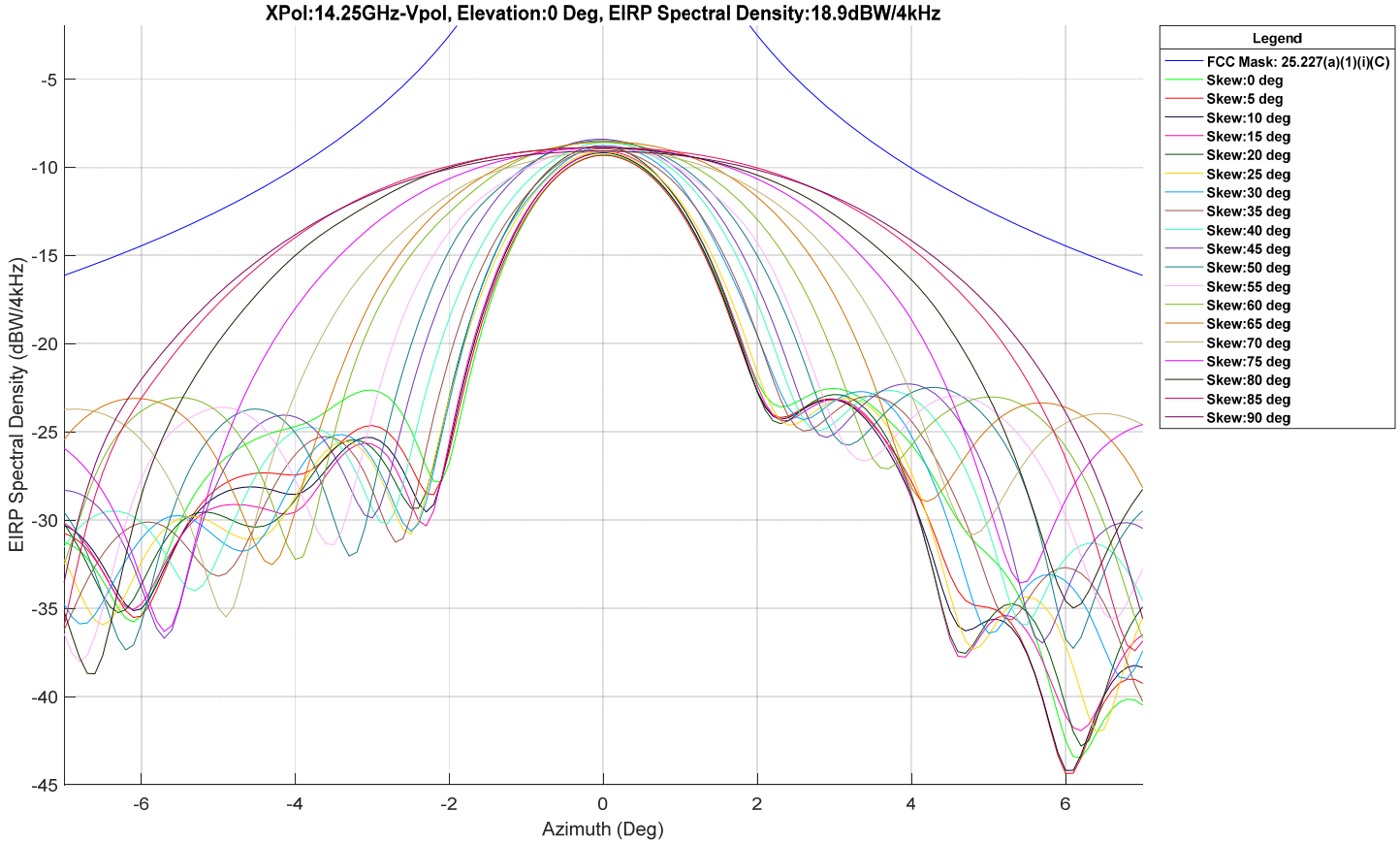
XPOL-TANGENT TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:19.2 DBW/4KHZ



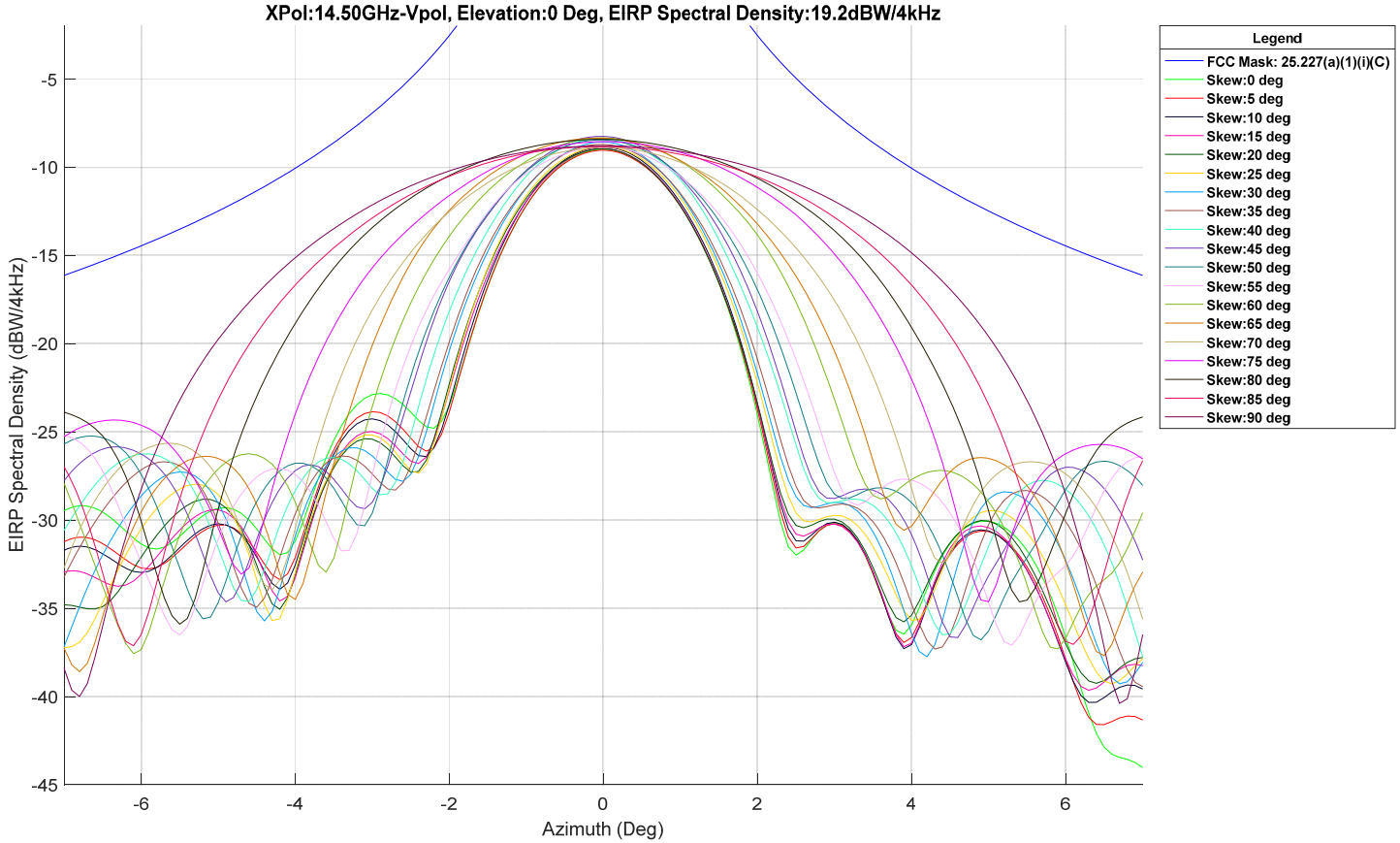
XPOL-TANGENT TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:18.7 DBW/4KHZ



XPOL-TANGENT TO GSO PLANE:14.25GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:18.9 DBW/4KHZ



XPOL-TANGENT TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:19.2 DBW/4KHZ



GSAA EIRP SPECTRAL DENSITY PLOTS – PERPENDICULAR PLANE TO GSO CROSS POL WITH 25.227(A)(1)(I)(C) MASK

DESCRIPTION

- EIRP Spectral Density plots are at 14.00 GHz, 14.25 GHz and 14.50 GHz for both vertical and horizontal polarization for the following Skew and Elevation Angles as it is mapped to the maximum EIRP spectral density in dBW/4kHz in a 1.024 MHz Bandwidth (in **BOLD**):

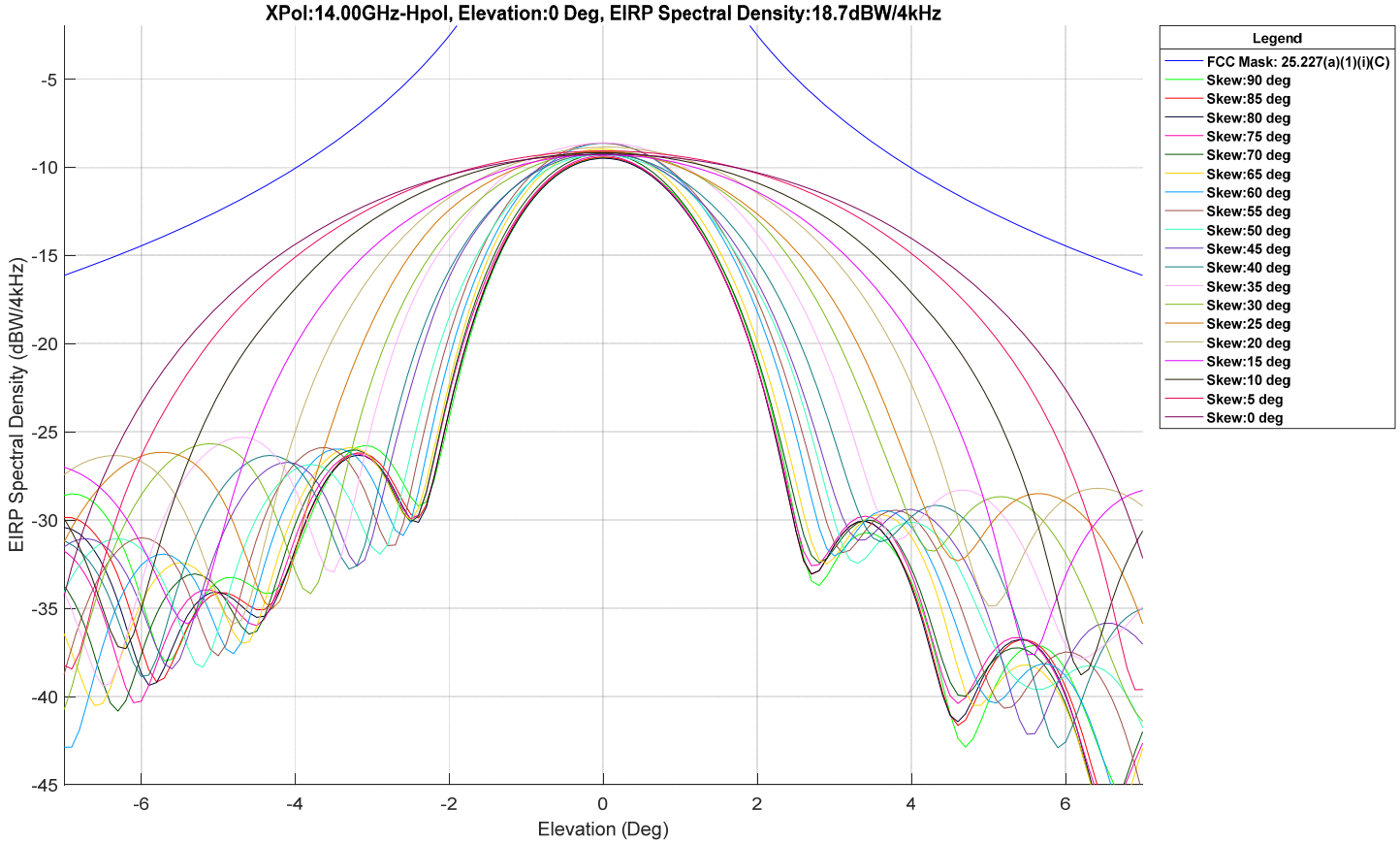
DESCRIPTION

Perpendicular Plane to GSO Cross Pol ESD Plots as they comply to FCC mask 25.227(a)(1)(i)(C)

GSAA MAXIMUM EIRP SPECTRAL DENSITY (dBW/4kHz) in a 1.024 MHz Bandwidth																			
Elevation[deg]\Skew[deg]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**
5	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
10	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
15	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
20	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
25	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
30	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
35	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
40	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
45	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
50	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
55	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
60	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
65	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
70	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
75	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
80	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
85	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2

*Note: Includes Radome and Cable losses

XPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:18.7 DBW/4KHZ



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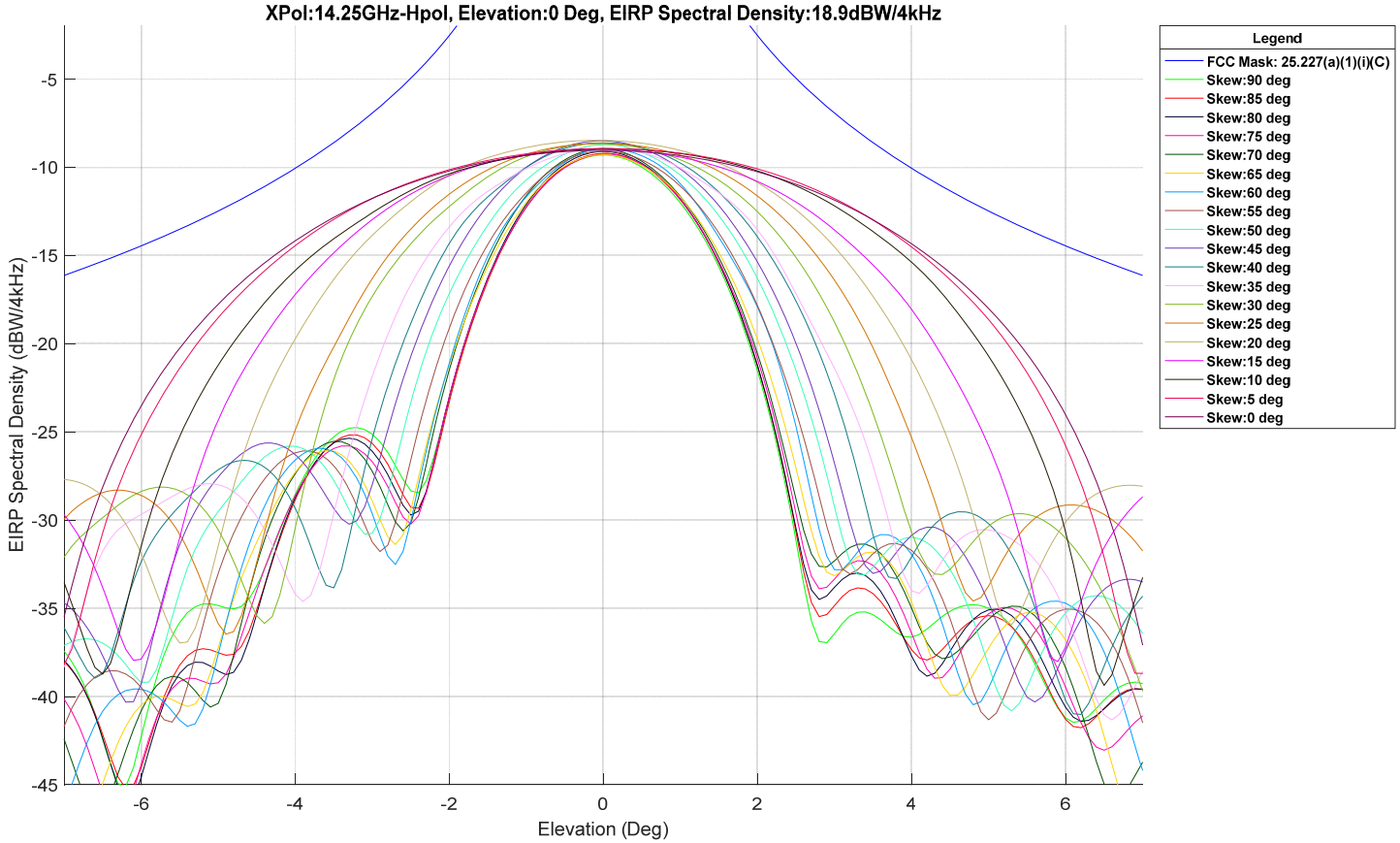
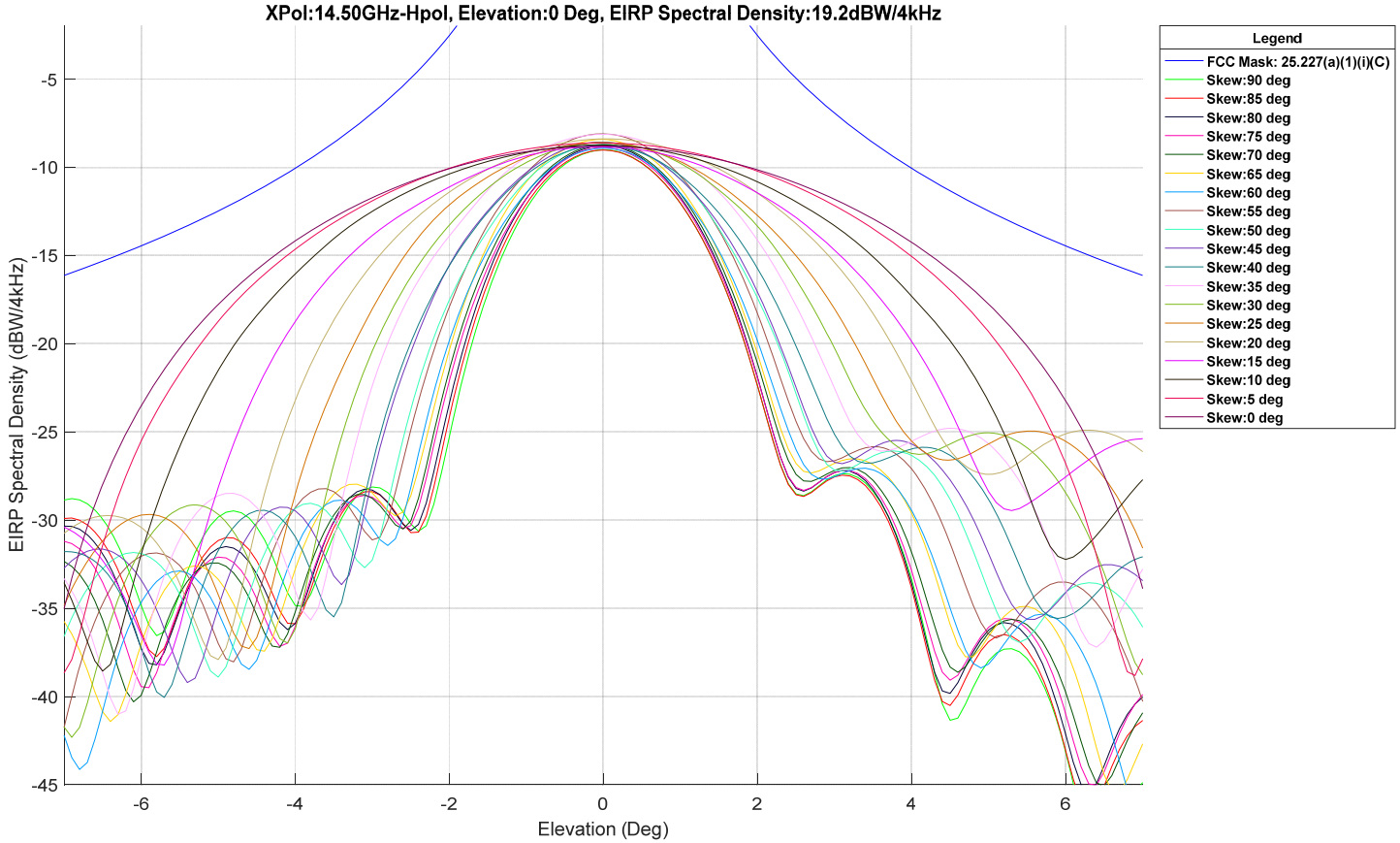
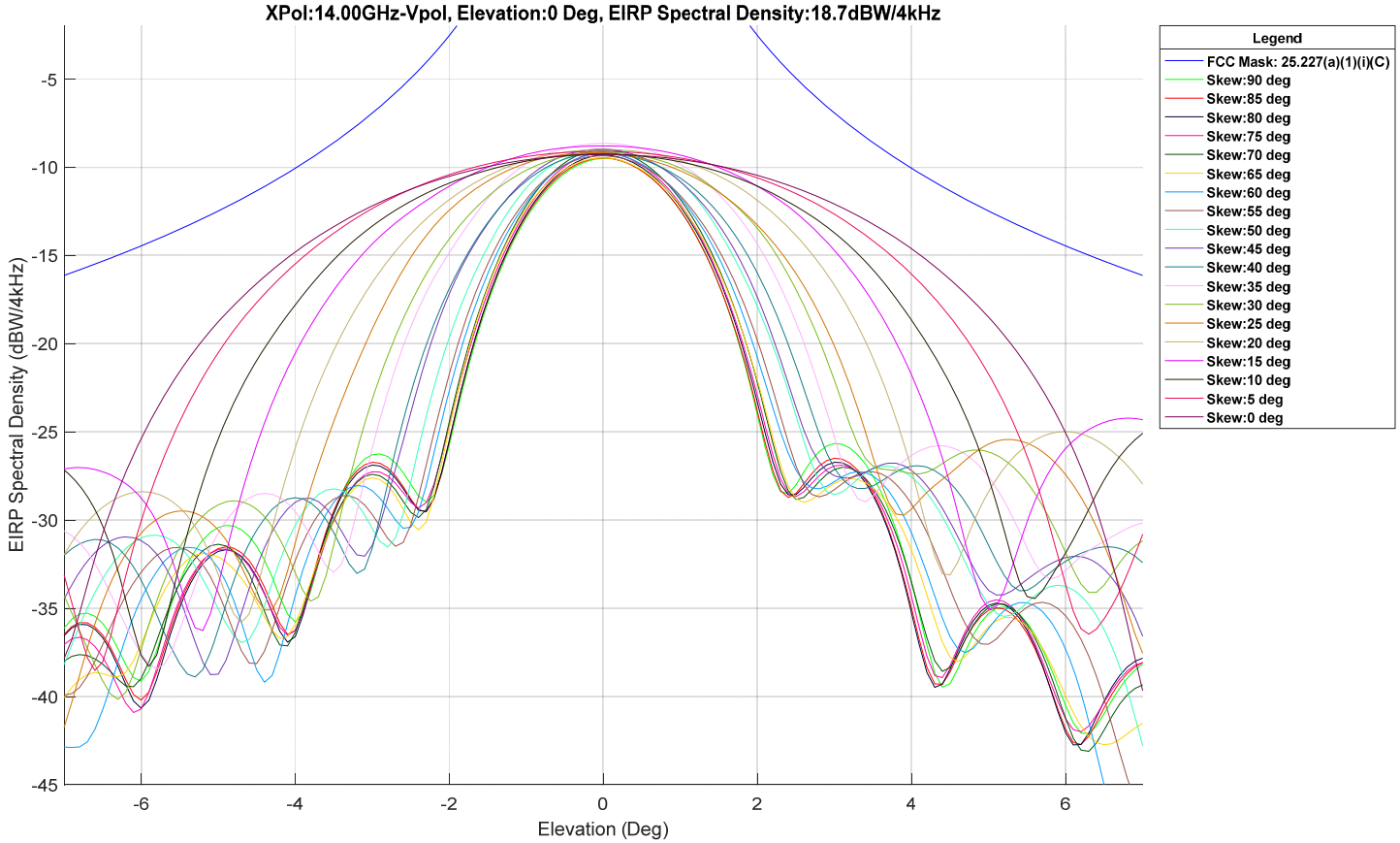


XPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-HPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:19.2 DBW/4KHZ



XPOL-PERPENDICULAR TO GSO PLANE:14.00GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:18.7 DBW/4KHZ



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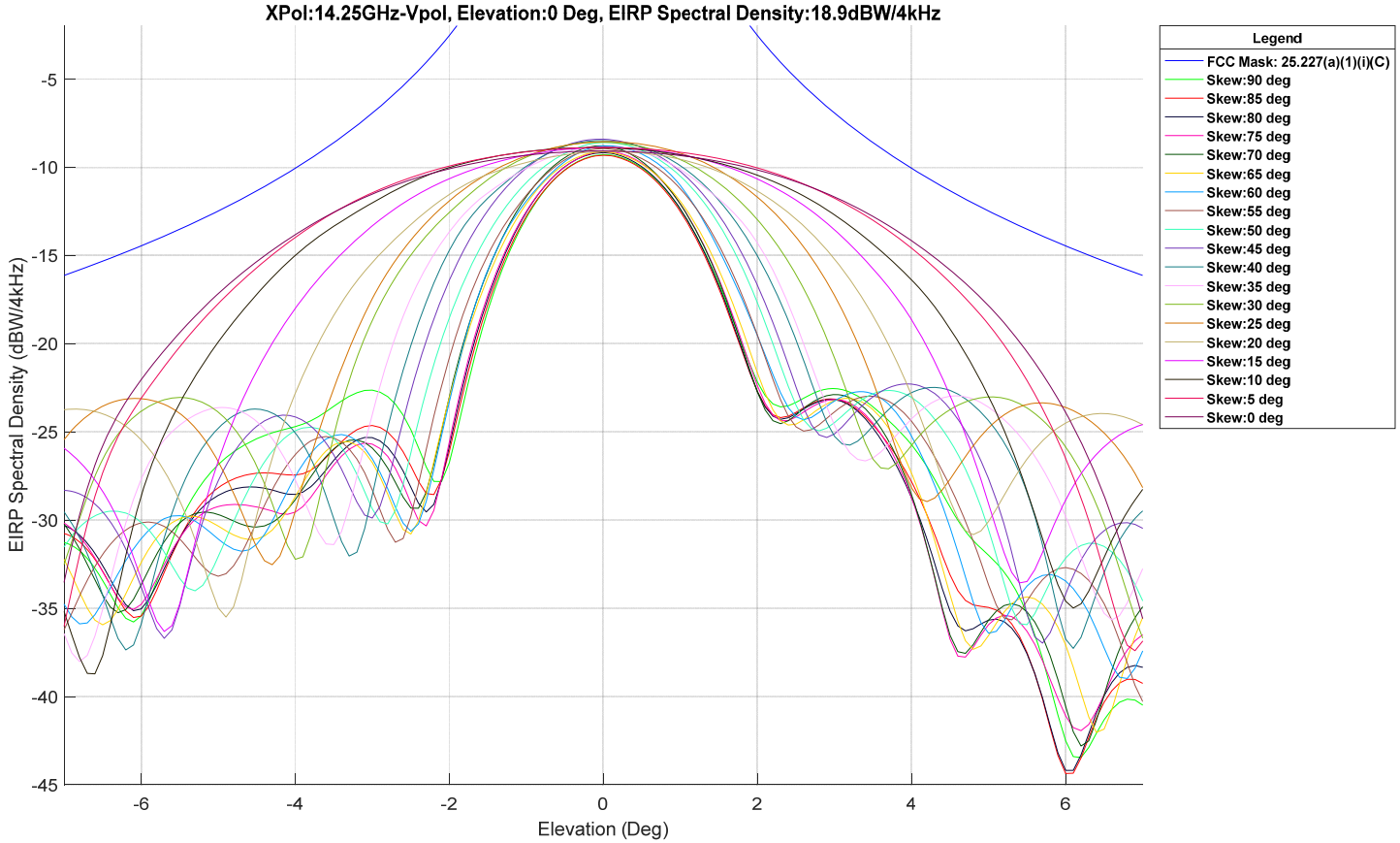
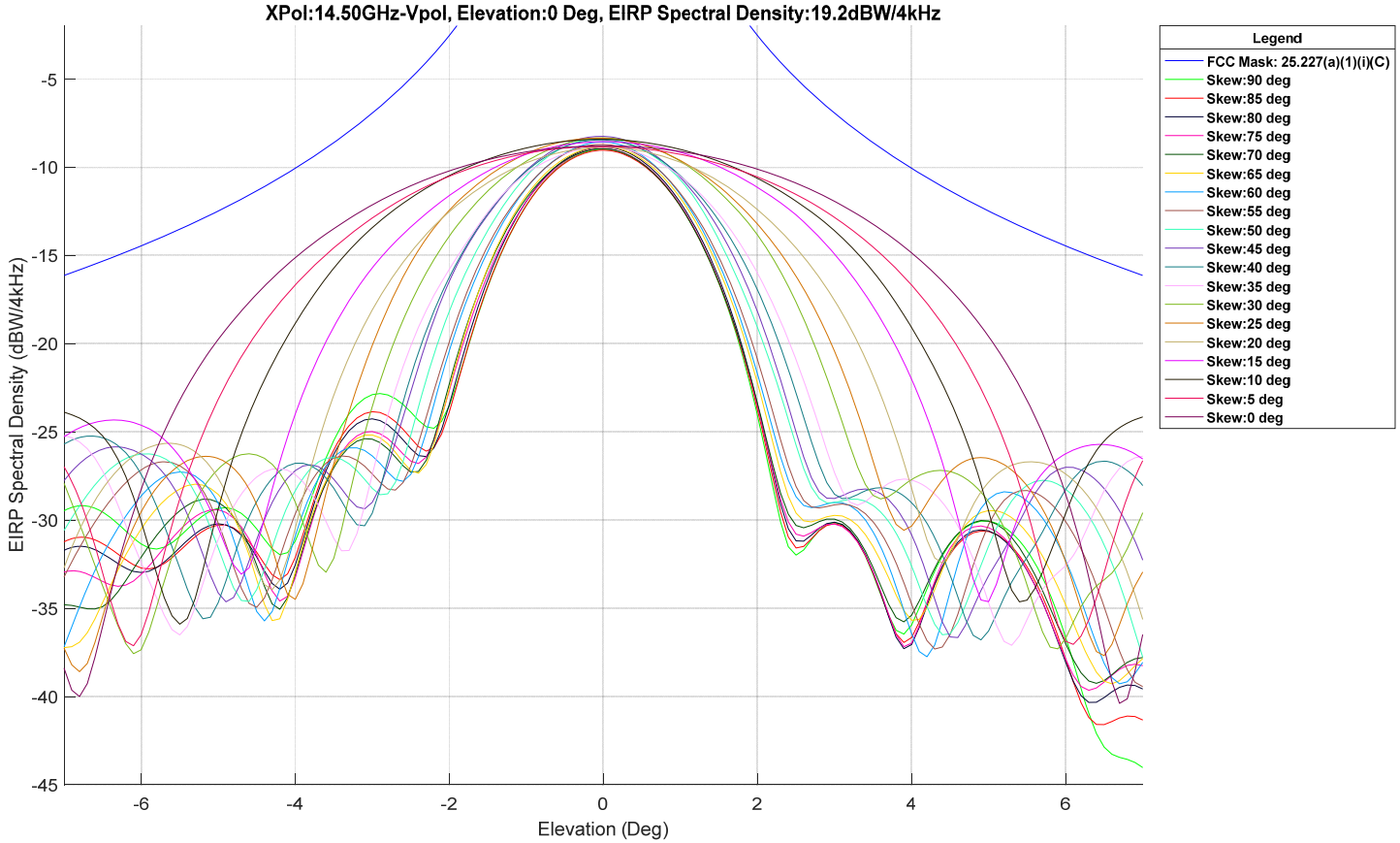


XPOL-PERPENDICULAR TO GSO PLANE:14.50GHZ-VPOL, ELEVATION:0 DEG, EIRP SPECTRAL DENSITY:19.2 DBW/4KHZ



APPENDIX B. Coordination Letters

Coordination Letters

SES

Kimberly M. Baum
Vice President Spectrum Management & Development, Americas

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

30 September 2016

Subject: Engineering Certification of SES Americom, Inc. for the AMC-1 Satellite

To whom it may concern,

This letter confirms that SES is aware that Global Eagle Entertainment, Inc. ("GEE"), licensed by the Federal Communications Commission ("FCC") as Row 44, Inc., is seeking FCC authority to operate an additional transmit/receive remote terminal in conjunction with its blanket authorization to operate technically identical Ku-band Earth Stations Aboard Aircraft ("ESAA") pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules (Call Sign E080100). Row 44 seeks authority for GEE's new ESAA terminals to communicate with the AMC-1 satellite at 129.15° W.L., under the current ESAA rules, including Section 25.227.

Based upon the contents of the applications (we understand that Row 44 will seek both an experimental license and the modification of its ESAA license) and the representations made to SES by GEE concerning how it will operate on AMC-1 according to its letter dated September 28, 2016:

- SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by GEE are consistent with any existing coordination agreements to which SES is a party with adjacent satellite operators within +/- 6 degrees of orbital separation from AMC-1.

- If the FCC authorizes the operations proposed by GEE, SES will include the power density levels specified by GEE in all future satellite network coordination with other operators of satellites adjacent to AMC-1.

Yours Sincerely,

Kimberly M. Baum

SES Americom, Inc.
4 Research Way
Princeton, NJ 08540
USA

Tel. +1 609 987 4000
Fax +1 609 987 4517
kimberly.baum@ses.com
www.ses.com

Kimberly M. Baum
Vice President Spectrum Management & Development, Americas

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

5 October 2016

Subject: Engineering Certification of SES Americom, Inc. for the AMC-9 Satellite

To whom it may concern,

This letter confirms that SES is aware that Global Eagle Entertainment, Inc. ("GEE"), licensed by the Federal Communications Commission ("FCC") as Row 44, Inc., is seeking FCC authority to operate an additional transmit/receive remote terminal in conjunction with its blanket authorization to operate technically identical Ku-band Earth Stations Aboard Aircraft ("ESAA") pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules (Call Sign E080100). Row 44 seeks authority for GEE's new ESAA terminals to communicate with the AMC-9 satellite at 83° W.L., under the current ESAA rules, including Section 25.227.

Based upon the contents of the applications (we understand that Row 44 will seek both an experimental license and the modification of its ESAA license) and the representations made to SES by GEE concerning how it will operate on AMC-9 according to its letter dated October 5, 2016:

- SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by GEE are consistent with any existing coordination agreements to which SES is a party with adjacent satellite operators within +/- 6 degrees of orbital separation from AMC-9.

- If the FCC authorizes the operations proposed by GEE, SES will include the power density levels specified by GEE in all future satellite network coordination with other operators of satellites adjacent to AMC-9.

SES has also reviewed the discussion in the applications regarding the off-axis EIRP density of Row 44 antennas communicating with AMC-9 in directions other than along the GSO plane. SES is of the view that the non-compliant emissions would not create interference to Ku-band geostationary satellites.

Yours Sincerely,

Kimberly M. Baum

SES Americom, Inc.
4 Research Way
Princeton, NJ 08540
USA

Tel. +1 609 987 4000
Fax +1 609 987 4517
Enter sender e-mail
www.ses.com

Kimberly M. Baum
Vice President Spectrum Management & Development, Americas

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

30 September 2016

Subject: Engineering Certification of SES Americom, Inc. for the SES-1 Satellite

To whom it may concern,

This letter confirms that SES is aware that Global Eagle Entertainment, Inc. ("GEE"), licensed by the Federal Communications Commission ("FCC") as Row 44, Inc., is seeking FCC authority to operate an additional transmit/receive remote terminal in conjunction with its blanket authorization to operate technically identical Ku-band Earth Stations Aboard Aircraft ("ESAA") pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules (Call Sign E080100). Row 44 seeks authority for GEE's new ESAA terminals to communicate with the SES-1 satellite at 101° W.L., under the current ESAA rules, including Section 25.227.

Based upon the contents of the applications (we understand that Row 44 will seek both an experimental license and the modification of its ESAA license) and the representations made to SES by GEE concerning how it will operate on SES-1 according to its letter dated September 28, 2016:

- SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by GEE are consistent with any existing coordination agreements to which SES is a party with adjacent satellite operators within +/- 6 degrees of orbital separation from SES-1.

- If the FCC authorizes the operations proposed by GEE, SES will include the power density levels specified by GEE in all future satellite network coordination with other operators of satellites adjacent to SES-1.

Yours Sincerely,

Kimberly M. Baum

SES Americom, Inc.
4 Research Way
Princeton, NJ 08540
USA

Tel. +1 609 987 4000
Fax +1 609 987 4517
kimberly.baum@ses.com
www.ses.com

A Coordination Agreement Between the National Aeronautics and Space Administration (hereinafter "NASA") and Row 44, Incorporated (hereinafter "Row 44") for Operation of the Row AMSS in the 14.05 – 14.47 GHz-Band

Row 44 seeks to license and operate aeronautical mobile-satellite stations (AMSS) over the Continental United States (CONUS) on a secondary basis in the 14.05 to 14.47 GHz FSS band. The AMSS terminals are part of the Row 44 communications system aboard general aviation and commercial aircraft using transponders in the Geostationary Satellite Orbit (GSO) arc. This Coordination Agreement has been prepared in compliance with the rules of the Federal Communications Commission (FCC) and the recommendations of the member states of the International Telecommunication Union (ITU) following the World Radio Communication Conference WRC-03.

1. Overview

The 14.0 – 14.5 GHz-band has been allocated to the mobile-satellite service, now including aeronautical mobile-satellite service, on a secondary basis, provided that Airborne Earth Stations (AES) include specific protection to the Space Research Services (SRS) earth stations and to the Tracking and Data Relay Satellite System (TDRSS) within the 13.40 – 14.4 GHz-band

Row 44 has filed an application for license authorization to operate up to 1000 technically identical AES units in the 14.05 – 14.47 GHz-band.

The Row 44 AESs receive from, and transmit to, the same GSO satellite transponder under control of a Ground Earth Station (GES) and Network Operations Center (NOC). They, and the terrestrial network to which they are connected, comprise the Row 44 system.

This Coordination Agreement has been prepared to ensure that operation of the Row 44 AESs conform to FCC requirements for protection of the SRS Network.

Row 44 has the authority to negotiate and sign this Coordination Agreement for their AMSS system and NASA has the authority to negotiate and sign this agreement for the TDRSS and SRS Network sites listed in Section 3.1.

2. AUTHORITY

NASA concludes this agreement pursuant to 42 USC §2473 © (5) and (6) and section 203 © (5) of the National Aeronautics and Space Act of 1958 as amended, in addition to the Manual of Regulations and Procedures for Federal Radio Frequency Management (National Telecommunications & Information Administration Redbook), May 2003 Edition, May 2008 Revision.

3. Space Research Services Earth Stations

TDRSS Earth Station Sites:

Table 1 provides a list of TDRSS earth stations sites requiring interference protection. The White Sands and Guam sites are currently operational. The Blossom Point, MD site is planned for operation in about 2.5 to 3 years. Also provided are the TDRSS satellite orbital locations currently supported by each earth station site.

Earth Station Site	Latitude (D,M,S)	Longitude (D,M,S)	TDRSS Satellite Degrees East Long.*
Continental United States			
White Sands, New Mexico	N32 30' 18.686"	W106 36' 37.153"	-174
Antenna Size – 18.3 meter			-171
Antenna Gain – 66.4 dBi			-150
Elevation – 1456 m			-79
			-62
			-49
			-47
			-41
Blossom Point, MD			-12
N382544/W770502			-41
Antenna Size - 16.5-20 m			-47
Maximum Antenna Gain -66.7			-49
dBi			-62
Elevation - 0 meter			-79
United States Territory[1]			
Guam	N13 36' 0"	E144 54' 0"	85
Antenna Size – 11 meter			89
Antenna Gain – 61.9 dBi			-171/-174

[1] Should Row 44 extend operations outside of CONUS, it shall provide the same protection to NASA's TDRSS Earth Stations sites around the world (such as Guam) as will be provided to the other Station sites covered by this Agreement.

Table 1. Existing TDRSS Earth Station Sites

Ephemeris data on existing TDRSS spacecraft indicated in Table 1 may be found at the following Web sites:

a. http://fdf.gsfc.nasa.gov/prod_center/pc_frame_page.htm
Select Retrieve Other Products
Select Retrieve 2-line Element Sets (Celestial BBS)
Under NORAD Two-Line Element Sets, Select Current Data
Select Tracking and Data Relay Satellite System (TDRSS)

b. Obtain the NORAD orbital elements directly at:

http://celestrak.com/NORAD/elements/

choose Tracking and Data Relay Satellite System (TDRSS)

Additional TDRSS Earth Station Sites:

NASA shall provide Row 44 at least two months written notice of when the Blossom Point, MD earth station is about to become operational. Protection of this site must be provided by its planned operational date of use.

NASA may unilaterally add additional TDRSS earth station sites to the list in Table 1 above. NASA will notify Row 44 as soon as it knows that a new earth station is being planned and has the coordinates of the newly planned site.

Earth Site Protection Limits:

The TDRSS protection limits are listed in the Table 2 below.

Frequency Band	Interference Threshold Limit Measured at Antenna Output	Reference Percentage of Time
13.40 – 14.00 GHz	-176 dBW/ kHz	Never to be Exceeded
14.00 – 14.05 GHz	-146 dBW/ MHz	Never to be Exceeded
14.05 – 14.40 GHz	-100 dBW	Never to be Exceeded

Table 2. TDRSS Protection Limits

For interference calculations, the TDRSS spacecraft can have an inclination angle up to 15 degrees. In calculating the interference threshold levels in Table 2, the antenna patterns in Figure 1 below should be used. The antenna pattern for the Blossom Point site will be similar to the WSC pattern in Figure 1.

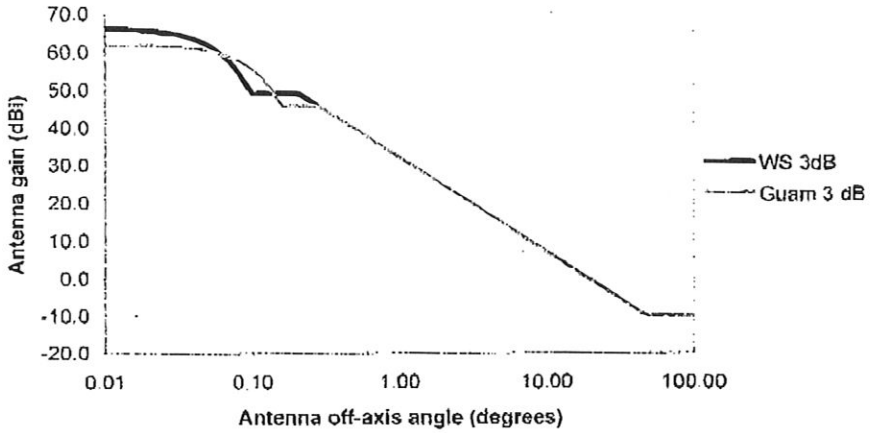


Figure 1. TDRSS Earth Station Antenna Gain Patterns

Note: This antenna pattern is calculated using Annex III of Appendix 8 of the ITU Radio Regulations. with the following modifications:

$G_1 = 5 + 15\log(D/\lambda)$

$\varphi_r = 12.02\ (D/\lambda)^{-0.6}$

Where Gmax and D are given in Table 1.

4. Operational Coordination Agreement

NASA and Row 44 agree to the following:

a. The purpose of this Coordination Agreement is to provide protection to the TDRSS earth station sites listed in Table 1 and any future TDRSS earth station sites.

b. The level of protection afforded to the sites in Table 1, and any future TDRSS earth station sites which NASA adds to Table 1 pursuant to Section 3.2 of this Agreement, shall be equal to or greater than the Interference Threshold Limits shown in Table 2.

4.1 This Coordination Agreement may be reviewed periodically by the signatories to the agreement following commencement of service by Row 44 under an operational license from the FCC. The purpose of the review is to assess the effectiveness of this agreement and update this, or subordinate operational agreements, as appropriate.

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

4.3 FINANCIAL OBLIGATIONS: Each party shall be responsible for funding its own responsibilities under this Agreement. No provision of this Agreement shall be interpreted to require obligation of funds in violation of the Anti-Deficiency Act 31 U.S.C § 1341.

Row 44 agrees to:

4.4 Monitor, control and cease transmissions from any AES that would exceed the thresholds given in Table 2 within line-of-sight of the sites listed in Table 1.

4.5 Monitor, control and cease transmissions from any AES that would exceed the thresholds given in the Table 2 within line-of-sight of such additional sites as NASA may require.

4.6 Respond expeditiously to a NASA request for protection of the sites listed in Section 3.1. or additions thereto as provided for in Section 3.2. in accordance with the threshold limits of Section 3.3.

4.7 Respond expeditiously to a NASA request to isolate a source of interference to a TDRSS earth station suspected to be from an AES.

4.8 Provide a central point of contact (on a 24 hour, 7 day basis) for interference resolution and other contact.

NASA agrees to:

4.9 Maintain an open dialog with Row 44 concerning any perceived breach of interference thresholds that may be attributable to an AES that is not in compliance with this Coordination Agreement.

4.10 Provide timely notification to Row 44 of changes or additions to TDRSS earth station sites. TDRSS spacecraft orbital positions or interference thresholds listed in this Coordination Agreement.

5. Assignment and Termination

5.1 This Coordination Agreement shall be binding upon the parties hereto and their respective successors and assigns.

5.2 This Coordination Agreement may be terminated by either party upon 6 months written notice to the other.

5.3 CONTINUING OBLIGATIONS: The obligation of Row 44 to protect the NASA TDRSS earth stations from interference as described in this agreement will survive termination or expiration of this Agreement.

6. Points of Contact

6.1 Points of contact concerning this Coordination Agreement:

Name: Ronald Carbery
Title: Acting Director NASA Spectrum Policy
Organization: NASA
Address: NASA Headquarters
300 E Street SW
Washington D.C. 20546-0001
Telephone: (202) 358-4808
Facsimile: (202) 358-2865
e-mail: Ron.Carbery@nasa.gov

Name: John Guidon
Title: CEO
Organization: Row 44
Address: Row 44, Inc.
31280 Oak Crest Drive
Westlake Village, CA 91341
Telephone:(818) 706-3111
Facsimile: (818) 706-9431
e-mail: jguidon@row44.com

5.1 Points of contact for technical concerns related to this Coordination Agreement:

Name: Roger D. Porter
Title: Goddard Spectrum Manager
Organization: NASA
Address: Goddard Space Flight Center
Mission Services Program Office
Greenbelt, MD 20771

Telephone: (301) 286-5089
Facsimile: (301) 286-1724
e-mail: Roger.D.Porter@nasa.gov

Name: James Costello
Title: VP, Engineering
Organization: Row 44
Address: Row 44, Inc
31280 Oak Crest Drive
Suite 5
Westlake Village, CA 91341
Telephone: (480) 390-1075
Facsimile: (818) 706-9431
e-mail: jcostello@row44.com

6. **Signatures**

This Coordination Agreement is being made in good faith by both parties and is effective on the date on of final signature.

For: The National Aeronautics and Space Administration:

By: _____

Name: Badri Younes

Title: Associate Assistant Administrator For Space Communications and Navigation (SCAN)

Date: May 21, 2008

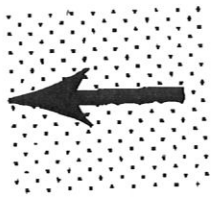
For: Row 44, Incorporated:

By: _____

Name: John LaValle

Title: Chief Operating Officer

Date: 19 May 2008



A Coordination Agreement
Between the National Science Foundation ("NSF") and
Row 44 Inc. ("Row44") for Operation of the
Row 44 AMSS and Radio Astronomy Sites
Jointly Sharing the 14.0-14.5 GHz Band

Row 44 is applying for a license to operate an aeronautical mobile satellite service (AMSS) over North America including the Continental United States (CONUS), Canada and Mexico in the 14.0-14.5 GHz Fixed Satellite Service (FSS) band. The AMSS terminals will be installed aboard commercial aircraft and operate with transponders in the Geostationary Satellite Orbit (GSO) arc. This coordination agreement and the pending Federal Communications Commission (FCC) license comply with FCC Part 25 rules and the recommendations of the International Telecommunication Union (ITU) as a product of the World Radiocommunication Conference WRC-03.

1.0 Overview

1.1 The band 14.47-14.5 GHz is used by the radio astronomy service in accordance with footnotes US342 to the U.S. Table of Frequency Allocations

1.2 The band 14.0-14.5 GHz has been allocated to mobile satellite service including the aeronautical mobile satellite service (AMSS) on a secondary basis with the provision that government services including the radio astronomy service in the 14.47-14.50 GHz band be protected from interference from the AMSS service.

1.3 Row 44 applied and was granted a special temporary authority (STA) on December 11, 2007 for fixed station testing. Row 44 plans to submit a license application to the FCC for AMSS operation in the 14.0-14.5 GHz band to allow service aboard commercial aircraft flying in North America.

1.4 The AMSS service will allow aircraft earth stations (AES) to transmit and receive information from a ground earth station (GES) via a transponder in the Geostationary Satellite Orbit (GSO) arc under the control of a ground-based network operation center (NOC). The terrestrial network will utilize Hughes Network Systems HX150 licensed ground terminals with Call Signs E940460 and E00016.

1.5 This Coordination Agreement ensures that the Row 44 AMSS system complies with both Part 25 FCC requirements and ITU recommendations for radio astronomy protection.

1.6 Negotiation and signatures of this agreement are to be executed by Row 44 and the Electromagnetic Spectrum Management Unit of the NSF for the Radio Astronomy sites identified in Section 2.1.

2.0 National Science Foundation Radio Astronomy Observatories

2.1 Radio Astronomy Site Listing

The Radio Astronomy sites under NSF support and listed in Table 2-1 make measurements in the 14.47-14.50 GHz band. These sites, including sites associated with

the Very Long Baseline Array (VLBA), are to be protected during their operation in accordance with the description provided in Section 3.

Table 2-1 Current Radio Astronomy Sites

Observatory	Latitude (D,M,S)	Longitude (D,M,S)
National Astronomy and Ionosphere Center (NAIC) site:		
Arecibo, PR.....	18 20 39	66 45 10
National Radio Astronomy Observatory (NRAO) sites:		
Green Bank Telescope, WV.....	38 25 59	79 50 23
Very Large Array, Socorro, NM.....	34 04 44	107 37 06
VLBA sites:		
St. Croix, VI	17 45 24	64 35 01
Hancock, NH	42 56 01	71 59 11
N. Liberty, IA.....	41 46 17	91 34 27
Ft. Davis, TX.....	30 38 06	103 56 41
Los Alamos, NM.....	35 46 30	106 14 44
Pie Town, NM.....	34 18 04	108 07 09
Kitt Peak, AZ	31 57 23	111 36 45
Owens Valley, CA.....	37 13 54	118 16 37
Brewster, WA.....	48 07 52	119 41 00
Mauna Kea, HI	19 48 05	155 27 20

2.2 Additional Radio Astronomy Sites

NSF may add new radio astronomy sites to the list given in Table 2-1. In this case NSF shall give Row 44 at least 2 months notice of modifications to existing sites, or the inclusion of any additional Radio Astronomy sites to operate in the 14.47 - 14.5 GHz band.

3.0 Operational Coordination Agreement

NSF and Row 44 agree to the following stipulations:

3.1 To provide protection to the Radio Astronomy sites listed in Table 2-1 during their operational period, the following aggregate power flux densities (pfd) in the 14.47-14.50 GHz band shall be no greater than:

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

3.2 Within a year following initiation of the licensed Row 44 AMSS service, authorized NSF and Row 44 personnel shall periodically review the terms of this Coordination Agreement. If required, modifications of this Coordination Agreement will be negotiated and instituted.

3.3 Any changes in the points of contact given in Section 5 shall be identified and reported by the respective party in a reasonable period.

Row 44 agrees to the following stipulations:

3.4 Row 44 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 the following stipulations:

3.5 Provide Row 44 points of contact given in Section 5 a current schedule of Radio Astronomy measurements to be conducted in the 14.47-14.5 GHz band for the sites identified in Table 2-1.

3.6 Via the National Astronomy and Ionosphere Center (NAIC) and the National Radio Astronomy Observatory (NRAO) provide Row 44 points of contact given in Section 5 any data that is not in accordance with the provisions in this Coordination Agreement.

4.0 Termination Conditions

4.1 This Coordination Agreement shall be binding for Row 44 and NSF.

4.2 Either party providing a written notice of six months may execute termination of this Coordination Agreement.

5.0 Points of Contact

5.1 Points of contact for this Coordination Agreement are:

Name: Dr. Andrew W.Clegg	Name: James Costello
Organization: National Science Foundation	Organization: Row 44
Title: Program Director, Electromagnetic Spectrum Management Unit	Title: Vice President, Engineering
Address: 4201 Wilson Boulevard,	Address: 31280 Oak Crest Drive, Suite 5

Room 1045	
City State Zip: Arlington VA 22230	City State Zip: Westlake Village, CA 91361
Phone: (703) 292-4892	Phone: 818.706.3111
Fax: (703) 292-9034	Fax: 818.706.9431
E-mail: esm@nsf.gov	E-mail: jbcostello@ROW44.com

5.2 Points of contact for Radio Astronomy observation schedules are:

Dr. Harvey Liszt	Name:Dr. Murray Lewis
Title: Director, Spectrum Management	Title: Spectrum Manager
Organization: NRAO	Organization: National Astronomy and Ionosphere Center
Address: 520 Edgemont Rd Charlottesville VA 22903	Address: Arecibo Observatory HC3 Box 53995 Arecibo PR 00612
Phone: 434-296-0344	Phone: 787-878-2612
Fax: 434-296-0278	Fax: 787-878-1861
E-mail: hliszt@nrao.edu	E-mail: prcz@naic.edu

6.0 **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.

For the National Science Foundation

By: A W Clegg

Name: Dr. Andrew W. Clegg
Title: Program Director, Electromagnetic Spectrum Management Unit

Date: 5/6/08

For Row 44

By: _____

Name: JOHN GOLDON
Title: C.E.O.

Date: 4-18-08
Title: Director of Contracts

Date: _____

APPENDIX C. Radiation Hazard Analysis

A.1. GSAA Antenna

A.1.1. Introduction

This exhibit constitutes the radiation hazard analysis for Row 44's transmitter using the FCC procedure outlined in FCC Bulletin #65. The limit for exposure to RF energy, for frequencies greater than 1.5 GHz, is 5 mW/cm^2 for up to a six minute duration (occupational/controlled exposure) and a 1 mW/cm^2 for up to 30 minute duration (categorized as general population/ uncontrolled exposure).[1]

Analysis for exposure to radiation is presented for the near field, far field, and the transition region. Appropriate separation-distances are provided for the controlled and uncontrolled exposure scenarios considering individuals located in the direction of either the antenna's main beam or its side lobes.

A.1.2. Analysis

The extent of the near field region for the main beam is defined in terms of the radius R_{nf} according to the relation

Equation 1 – Near Field Region Radius

$$R_{nf} = \frac{D^2}{4\lambda}$$

where D is the maximum dimension of the antenna panel, and λ is the transmit signal's wavelength.

The near field maximum power density, S_{nf}, is determined from

Equation 2 – Near Field Maximum Power Density

$$S_{nf} = 0.1\,\eta\,\frac{P_{PA}}{A}\left(\frac{in\ mW}{cm^2}\right)$$

where P_{PA} is the transmit power (after cable losses are accounted for) and A is the surface area of the antenna aperture, and η is the efficiency of the antenna aperture.

The far field region for the main beam is defined as beginning and continuing out-from a radius R_{ff}, given by

Equation 3 – Far Field Region Radius

$$R_{ff} = 0.60\left(\frac{D^2}{\lambda}\right)$$

The far field power density S_{ff} at the minimum far field radius and farther is given in terms of the EIRP denoted by P_{EIRP} according to

Equation 4 – Far Field Power Density

$$S_{ff} = \frac{P_{ERIP}}{(4\pi)\left(R_{ff}^2\right)}$$

(The value of P_{EIRP} should already consider coax losses and aperture efficiency.)
Note that when the radius is expressed in meters, the Power Density is in units of W/m^2. The results are converted to units consistent with the FCC limits (mW/ cm^2) by multiplying values in W/m^2 by 0.1.

A.1.2.1. Near Field Exposure from Main Antenna Beam

The GSAA antenna has the "pseudo-rectangular" dimensions of D=0.627 m (24.7 inches) and h=0.198 m (7.8 inches). However, all considered, the adjusted surface area "A" equals 0.0971 m^2. This is achieved by starting with the rectangular surface area of 0.124 m^2 (0.627 m x 0.198 m) minus a 0.10 factor (i.e., multiplied by a 0.90 factor) for the area absent at the four corners, and a 0.87 factor thereafter to compensate for the mini-horn perimeter thicknesses).

At the highest frequency of 14.5 GHz, the wavelength is 0.0207 m. The near field radius is then R_{nf} = 4.75 m

The antenna aperture efficiency factor, η, is 0.77 and the feeder coax loss is 4.40 dB.
Based on the wavelength and the panel-width given farther above, the Far Field radius is then R_{ff} = 11.41 m

In the operation of GEE's system, the antenna may be fed with ten different signal levels, as provided in Table 6 and Table 7. The associated Near Field radius Power Density Values are:

Table 6 - Transmit Power, EIRP, and Near Field Power Density as a Distance R_{nf}

HPA Power (Watts)	HPA Power (dBm)	Transmit Power (dBm)*	S_{nf} (mW/cm^2)
25.00	43.98	39.58	7.200
22.28	43.48	39.08	6.417
19.86	42.98	38.58	5.720
17.70	42.48	38.08	5.098
15.77	41.98	37.58	4.543
14.06	41.48	37.08	4.049
12.53	40.98	36.58	3.609
11.17	40.48	36.08	3.216
9.95	39.98	35.58	2.867
8.87	39.48	35.08	2.555
7.91	38.98	34.58	2.277
7.05	38.48	34.08	2.029
6.28	37.98	33.58	1.809
5.60	37.48	33.08	1.612
4.99	36.98	32.58	1.437
4.45	36.48	32.08	1.280
3.96	35.98	31.58	1.141
3.53	35.48	31.08	1.017
3.15	34.98	30.58	0.906
2.81	34.48	30.08	0.808
2.50	33.98	29.58	0.720

*Incorporates Coax Feeder Loss

(Note that the equation for the maximum Power Density in the Near Field considers a given radiated signal/power confined-to and passing-through a physical area corresponding to that of the antenna aperture. Along these lines, the S_{nf} values cannot be assumed to vary with distance from the antenna, for locations within the Near Field.)
The associated Far Field radius Power density values are as well:

Table 7 – Transmit Power, EIRP, and Far Field Power Density at Distance R_{ff}

Transmit Power (Watts)	Transmit Power (dBm)	EIRP (dBm)	Sff (mW/cm2)
25.00	43.98	72.98	1.214

Transmit Power (Watts)	Transmit Power (dBm)	EIRP (dBm)	Sff (mW/cm2)
22.28	43.48	72.48	1.082
19.86	42.98	71.98	0.965
17.70	42.48	71.48	0.860
15.77	41.98	70.98	0.776
14.06	41.48	70.48	0.683
12.53	40.98	69.98	0.609
11.17	40.48	69.48	0.542
9.95	39.98	68.98	0.483
8.87	39.48	68.48	0.431
7.91	38.98	67.98	0.384
7.05	38.48	67.48	0.342
6.28	37.98	66.98	0.305
5.60	37.48	66.48	0.272
4.99	36.98	65.98	0.242
4.45	36.48	65.48	0.216
3.96	35.98	64.98	0.192
3.53	35.48	64.48	0.172
3.15	34.98	63.98	0.153
2.81	34.48	63.48	0.136
2.50	33.98	62.98	0.121

Row 44 Entertainment is considering exposure to two values of Power Density: 5 mW/cm^2 and 1 mW/cm^2.

A.1.2.2. 5 mW/cm^2 Analysis

Some of the S_{nf} values in Table 6 are greater than 5 mW/cm^2, and some are less than 5 mW/cm^2. As the Near Field analysis assumes that the Power Density in the Near Field does not vary with distance, for cases where S_{nf} values exceed 5 mW/cm^2, there is no location in the Near Field where the Power Density is less. An individual therefore cannot be located in the Near Field anywhere whatsoever at all to avoid such an exposure level. We'll defer this analysis to the transition region between the Near and Far Fields.
Assuming that the Power Density decreases linearly between the Near Field radius and the Far Field radius, the distance at which the Power Density will equal 5 mW/cm^2 (for the selected TX powers) is given in Table 8.

Table 8 – Separation for Controlled Exposure Limit (Main Beam)

Transmit Power (dBm)	Separation for Controlled Limit (5 mW/cm^2)	
	Meters	Feet
43.98	7.200	23.622
43.48	6.522	21.397
42.98	5.761	18.900
42.48	4.907	16.098

Somewhat similar to the above, applicable to cases where S_{nf} values are less than 5 mW/cm^2, in attempting to determine the location at which the Power Density may equal 5 mW/cm^2, we cannot project a location closer than R_{nf}.
For such cases in the Near Field, a precautionary stance will be adopted. For these specific power levels, Table 9 references the Near Field radius of 4.75 meters (15.6 feet) as the minimum physical separation to facilitate an exposure no greater than 5 mW/cm^2.

Table 9 – Separation for Controlled Exposure Limit (Main Beam)

Transmit Power (dBm)	Separation for Controlled Limit (5 mW/cm^2)	
	Meters	Feet
41.98	4.754	15.596
41.48	4.754	15.596
40.98	4.754	15.596
40.48	4.754	15.596
39.98	4.754	15.596
39.48	4.754	15.596
38.98	4.754	15.596
38.48	4.754	15.596
37.98	4.754	15.596
37.48	4.754	15.596
36.98	4.754	15.596
36.48	4.754	15.596
35.98	4.754	15.596
35.48	4.754	15.596
34.98	4.754	15.596
34.48	4.754	15.596
33.98	4.754	15.596

A.1.2.3. 1 mW/cm^2 Analysis

As the S_{nf} values are greater than 1 mW/cm^2, distances greater than R_{nf} values where the 1 mW/cm^2 will be encounter need to be considered.

The EIRP and the resulting Far Field Power Density at distance R_{ff} are once again provided in Table 10 for each transmit power value.

Table 10– Transmit Power, EIRP, and Far Field Power Density at Distance R_{ff}

Transmit Power (Watts)	Transmit Power (dBm)	EIRP (dBm)	Sff (mW/cm2)
25.00	43.98	72.98	1.214
22.28	43.48	72.48	1.082
19.86	42.98	71.98	0.965
17.70	42.48	71.48	0.860
15.77	41.98	70.98	0.766
14.06	41.48	70.48	0.683
12.53	40.98	69.98	0.609
11.17	40.48	69.48	0.542
9.95	39.98	68.98	0.483
8.87	39.48	68.48	0.431
7.91	38.98	67.98	0.384
7.05	38.48	67.48	0.342
6.28	37.98	66.98	0.305
5.60	37.48	66.48	0.272
4.99	36.98	65.98	0.242
4.45	36.48	65.48	0.216
3.96	35.98	64.98	0.192

Transmit Power (Watts)	Transmit Power (dBm)	EIRP (dBm)	Sff (mW/cm2)
3.53	35.48	64.48	0.172
3.15	34.98	63.98	0.153
2.81	34.48	63.48	0.136
2.50	33.98	62.98	0.121

Some S_{ff} values exceed 1 mW/cm^2, and some do not.
For the TX levels where S_{ff} values exceed 1 mW/cm^2, the standard inverse-squared analysis will be used to identify the necessary separations listed in Table 11.

Table 11 – Separation for Uncontrolled Exposure Limit (Main Beam)

Transmit Power (dBm)	Separation for Uncontrolled Limit (1 mW/cm^2)	
	Meters	Feet
43.98	12.572	41.246
43.48	11.868	38.939

For the remaining TX levels, the Power Density values need to be interpolated between R_{nf} and R_{ff} to project the location at which 1 mW/cm^2 exists.
Assuming that the Power Density decreases linearly between the Near Field radius and the Far Field radius, the distances at which the Power Density equals 1 mW/cm^2 are projected according to Table 12.

Table 12 – Separation for Uncontrolled Exposure Limit (Main Beam)

Transmit Power (dBm)	Separation for Uncontrolled Limit (1 mW/cm^2)	
	Meters	Feet
42.98	11.34	37.21
42.48	11.11	36.45
41.98	10.85	35.60
41.48	10.56	34.64
40.98	10.23	33.57
40.48	9.86	32.37
39.98	9.45	31.01
39.48	8.99	29.50
38.98	8.47	27.80
38.48	7.89	25.89
37.98	7.24	23.75
37.48	6.51	21.35
36.98	5.69	18.65
36.48	4.76	15.63
35.98	3.73	12.24
35.48	2.57	8.43
34.98	1.27	4.16
34.48	-0.19	-0.63
33.98	-1.83	-6.01

*At these power levels, the value of power density at the near field radius is lower than the 1 mW/cm^2 limit. From a cautionary perspective, the value of the near field radius is assigned to be the minimum spacing for the 1 mW/cm^2 limit.

A.1.2.4. Exposure from Antenna Beam Side-Lobes

The previous calculations assumed the individual was located in the sight of the main antenna beam (The main antenna beam is less than 10 degrees beam-width in azimuth). The following analysis provides insight into the exposure when an individual is located to the side of or behind the antenna.

Table 13 provides Power Density values at distances R_{nf} and R_{ff} when an individual is located in the direction of the highest antenna side-lobe (which corresponds to a 17 dB gain reduction from the main beam).

Table 13 – Transmit Power, EIRP, and Far Field Power Density at Distance R_{ff}

Transmit Power (dBm)	Sidelobe (dB)	Transmit Power (dBm)*	EIRP (dBm)	S_{nf} (mW/cm^2)	S_{ff} (mW/cm^2)
43.98	-17	22.58	55.98	0.1437	0.0242
43.48	-17	22.08	55.48	0.1280	0.0216
42.98	-17	21.58	54.98	0.1141	0.0192
42.48	-17	21.08	54.48	0.1017	0.0172
41.98	-17	20.58	53.98	0.0906	0.0153
41.48	-17	20.08	53.48	0.0808	0.0136
40.98	-17	19.58	52.98	0.0720	0.0121
40.48	-17	19.08	52.48	0.0642	0.0108
39.98	-17	18.58	51.98	0.0572	0.0096
39.48	-17	18.08	51.48	0.0510	0.0086
38.98	-17	17.58	50.98	0.0454	0.0077
38.48	-17	17.08	50.48	0.0405	0.0068
37.98	-17	16.58	49.98	0.0361	0.0061
37.48	-17	16.08	49.48	0.0322	0.0054
36.98	-17	15.58	48.98	0.0287	0.0048
36.48	-17	15.08	48.48	0.0255	0.0043
35.98	-17	14.58	47.98	0.0228	0.0038
35.48	-17	14.08	47.48	0.02203	0.0034
34.98	-17	13.58	46.98	0.0181	0.0031
34.48	-17	13.08	46.48	0.0161	0.0027
33.98	-17	12.58	45.98	0.0144	0.0024

*Incorporates Coax Feeder Loss

As is obvious, neither the S_{nf} or S_{ff} values (at distances R_{nf} or R_{ff}) exceed even the uncontrolled limit of 1 mW/cm^2. Therefore, no minimum distance criteria of separation will apply for individuals located in directions outside the antenna's main beam.

A.1.3. Analysis

This exhibit presents the radiation hazard analysis for Row 44 Entertainment's transmitter transmitting at EIRP values of 32.98 to 42.98 dBW in increments of 0.5 dB. Considering the worst-case, individuals positioned in the direction of the main beam of the antenna, and in the controlled exposure environment should be at least 7.200 meters (23.62 feet) away from the antenna aperture (for a 6 minute duration). Under the same circumstance, individuals in an uncontrolled exposure environment should be at least 12.57 meters (41.25 feet) away from the antenna aperture (for a 30 minute duration).

For individuals located in directions which are outside the antenna's main beam, no minimum distance of separation is applicable.