BB30KU TECHNICAL APPENDIX

EXHIBIT 1

Radiation Hazard Analysis

BB30Ku

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

Earth Station Technical Parameter Table

Antenna Aperture Size	0.30m
Antenna Effective Diameter	0.30 m
Antenna Surface Area	0.071 sq. meters
Antenna Isotropic Gain	31.5 dBi
Number of Identical Adjacent Antennas	1
Nominal Antenna Efficiency (ε)	70%
Nominal Frequency	14.25 GHz
Nominal Wavelength (λ)	0.021 meters
Maximum Transmit Power / Carrier	40 Watts
Number of Carriers	1
Total Transmit Power	40.0 Watts
W/G Loss from Transmitter to Feed	2 dB
Total Feed Input Power	25.2 Watts
Radome Losses	1.5 dB
Effective RF Power at radome	17.9 Watts
Near Field Limit	$R_{nf} = D^2/4\lambda = 1.07$ meters
Far Field Limit	$R_{ff} = 0.6\ D^2/\lambda = 2.57$ meters
Transition Region	R_{nf} to R_{ff} = 1.07 meters to 2.57 meters

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

1.0 At the Antenna Surface

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

$PD_{as} = 4P/A =$ **142.8** mW/cm^2 (1)

Where: P = total power at feed, milliwatts

A = Total area of reflector, sq. cm

In the normal range of transmit powers for satellite antennas, the power densities at or around the reflector surface is expected to exceed safe levels. This area will not be accessible to the general public.

This antenna will incorporate a radome which has 1.0 dB of loss. The worst case power density at the surface of the radome is shown below:

$PD_{radome}=4P_{rad}/A$ = **101.1** mW/cm² (2)
Where: Prad = total power at feed less radome losses, milliwatts
A = Total area of reflector, sq. cm (this would represent worst case)

Operators and technicians should receive training specifying this area as a high exposure area. Procedures must be established that will assure that all transmitters are rerouted or turned off before access by maintenance personnel to this area is possible.

2.0 On-Axis Near Field Region

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

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

$PD_{nf} = (16\varepsilon P)/(\pi D^2)$ = **71.3** mW/cm² (3)
from 0 to 1.07 meters

Evaluation

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

3.0 On-Axis Transition Region

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

$PD_{tr} = (PD_{nf})(R_{nf})/R$ = dependent on R (4)
where: PD_{nf} = near field power density
R_{nf} = near field distance
R = distance to point of interest
PD_{tr} = **71.26** mW/cm²
For: $1.07 < R < 2.57$ meters

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

Evaluation

Uncontrolled Environment Safe Operating Distance, (meters), R_{safeu}: 726.9

.

Controlled Environment Safe Operating Distance, (meters), R_{safec}: 152.7

4.0 On-Axis Far-Field Region

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

$PD_{ff} = PG/(4\pi R^2)$ = dependent on R (5)
where: P = total power at feed
G = Numeric Antenna gain in the direction of interest relative to isotropic radiator
R = distance to the point of interest
For: $R > R_{ff} =$ 2.57 meters
$PD_{ff} =$ **30.5** mW/cm² at R_{ff}

We use Eq (5) to determine the safe on-axis distances required for the two occupancy conditions:

Evaluation

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

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

In the far field region, the power is distributed in a pattern of maxima and minima (sidelobes) as a function of the off-axis angle between the antenna center line and the point of interest. Off-axis power density in the far field can be estimated using the antenna radiation patterns prescribed for the antenna in use. Usually this will correspond to the antenna gain pattern envelope defined by the FCC or the ITU, which takes the form of:

$G_{off} = 32 - 25\log(\Theta)$
for Θ from 1 to 48 degrees; -10 dBi from 48 to 180 degrees
(Applicable for commonly used satellite transmit antennas)

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

For example: At two (2) degrees off axis At the far-field limit, we can calculate the power density as:

$G_{off} = 32 - 25\log(2) = 32 – 7.52$ dBi = 280.2 numeric

$PD_{2\ deg\ off\text{-}axis} = PD_{ff} \times 280.2/G =$ **6.05** mW/cm^2 (6)

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

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

$PD_{nf(off\text{-}axis)} = PD_{nf} / 100 =$ **0.71** mW/cm^2 at D off axis (7)

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

7.0 Evaluation of Safe Occupancy Area in Front of Antenna

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

$S = (D/ \sin \alpha) + (2h - D - 2)/(2 \tan \alpha)$ (8)

Where: α = minimum elevation angle of antenna

D = dish diameter in meters

h = maximum height of object to be cleared, meters

For distances equal or greater than determined by equation (8), the radiation hazard will be below safe levels for all but the most powerful stations (> 4 kilowatts RF at the feed).

For	D =	0.3 meters
	h =	2.0 meters, delta between antenna and object >1 m
Then:		
	α	S
	10	6.6 meters
	15	4.3 meters
	20	3.2 meters
	25	2.5 meters
	30	2.1 meters

8.0 Summary of Results

The earth station will be protected from uncontrolled access because it will be mounted on the top of an aircraft. There will also be proper emission warning signs placed and all operating personnel will be aware of the human exposure levels at and around the earth station. The applicant agrees to abide by the conditions specified in Condition 90399 provided below:

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

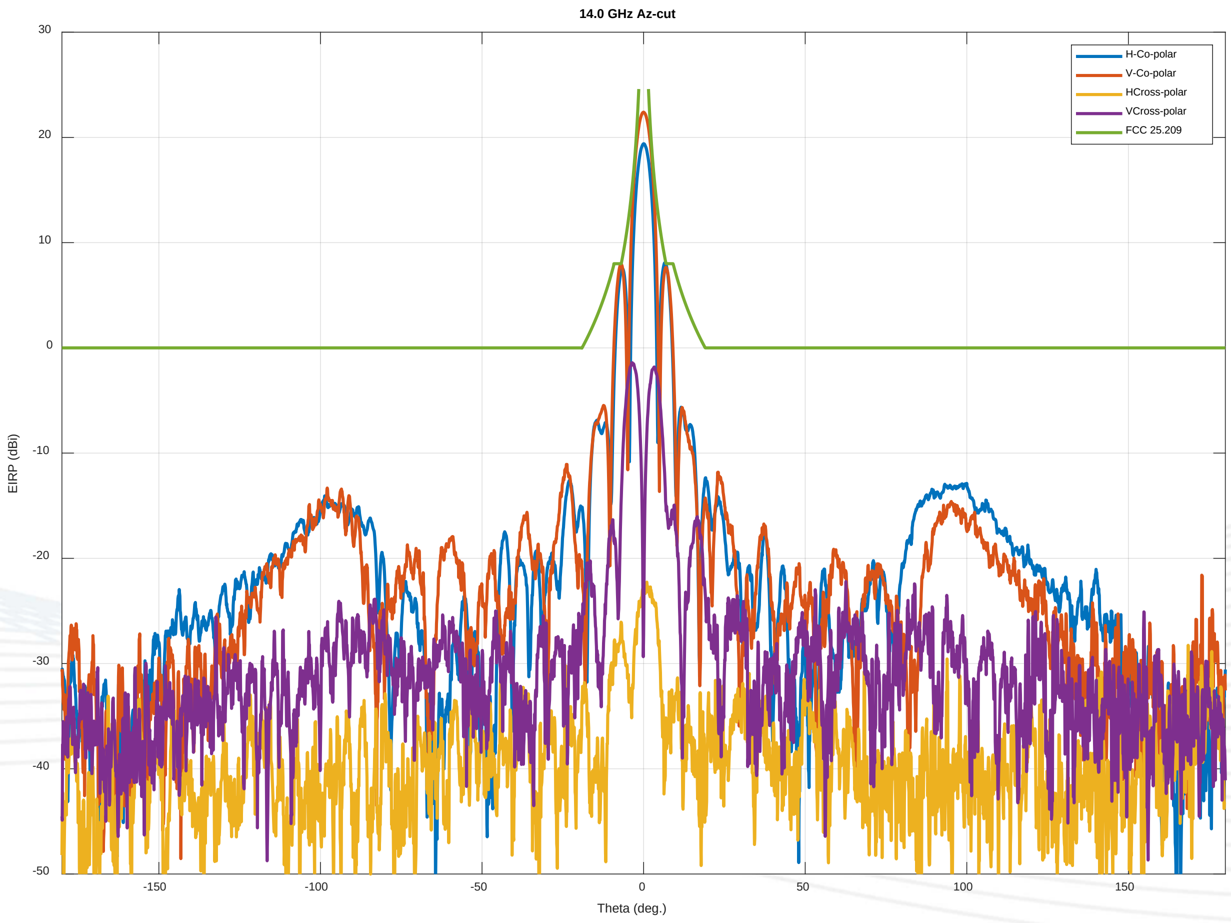
The table below summarizes all of the above calculations.

Parameter	Abbrevation	Value	Units	Formula
Antenna Diameter	D	0.3	meters	
Antenna Centerline	h	2	meters	
Antenna Surface Area	Sa	0.071	$meter^2$	
Antenna Ground Elevation	GE	2	meters	
Frequency of Operation	f	14.25	GHz	
Wavelength	λ	0.02105	meters	
HPA Output Power	P_{HPA}	40	Watts	
HPA to Antenna Loss	L_{Tx}	2	dB	
Radome Loss	L_{rad}	1.5	dB	
Transmit Power at Flange	P_F	25.24	Watts	$16\ PHPA / 10^{\frac{-L_{Tx}}{10}}$
Power After Radome	P_{Rad}	17.87	Watts	$16\ PF / 10^{\frac{-L_{Rad}}{10}}$
Antenna Gain	G_{es}	31.5	dBi	
Apeature Effeciency	η	0.70		
1. Reflector Calculations				
Antenna Surface Power Density	PD_{As}	1428.20	W/m^2	$16\ PF / \pi D^2$
		142.82	mW/cm^2	
Radome Surface Power Density	PD_{Rad}	1011.08	W/m^2	$16\ PRad / \pi D^2$
		101.11	mW/cm^2	Does Not meet Controlled Limits
				Does Not meet Uncontrolled Limits
2. On Axis Near Field Calculations				
Extent of Near Field	R_{NF}	1.07	meters	$D^2 / 4\lambda$
Near Field Power Density	P_{DNF}	712.62	W/m^2	$16\ PRad / \pi D^2$
		71.26	mW/cm^2	Does Not meet Controlled Limits
				Does Not meet Uncontrolled Limits
3. On Axis Transition Region Calculations				
Extent Of Transition Region, Minimum	R_{TR}	1.07	meters	$D^2 / 4\ \lambda$
Extent Of Transition Region, Maximum	R_{TR}	2.57	meters	$0.6\ D^2 / \lambda$
Worst Case Transition Region Power Density	P_{DTR}	71.26	mW/cm^2	Does Not meet Controlled Limits
				Does Not meet Uncontrolled Limits
Minimum Safe Distance, Uncontrolled Access	R_{SU}	762.69	meters	$P_{DNF}\ RNF / 1mW/cm^2$
Minimum Safe Distance, Controlled Access	R_{SC}	152.67	meters	$P_{DNF}\ RNF / 5mW/cm^2$
4. On Axis Far Field Calculations				
Distance to Far Field	R_{FF}	2.57	meters	$0.6\ D^2 / \lambda$
On Axis Power Density At Start of Far Field	P_{DFF}	305.26	W/m^2	$G_{ES}\ PRad / 4\ \lambda\ RFF^2$
		30.53	mW/cm^2	Does Not meet Controlled Limits
				Does Not meet Uncontrolled Limits
5. Off-Axis Far Field Power Density Calculations				
Far Field Power Density at sampl 2˚ Off-Axis		6.05	mW/cm^2	$P_{DFF} / \left[G\ @\ 2^{\circ} / G_{es} \right]$
				Meets Controlled Limits
				Meets Uncontrolled Limits
6. Off-Axis Power Density Calculations for the Near Field and Transitional Regions				
Power Density Off Main Beam Axis at 1 Antenna	$P_{DNF\text{-}off\text{-}axis}$	0.71	mW/cm^2	$16\ PRad / 100\ \pi D_{NF}^2$
Diameter Removed				Meets Controlled Limits
				Meets Uncontrolled Limits
7. Off-Axis Safe Distances From Earth Station				
Minimum Elevation Angle of Antenna	α_{min}	10	Degrees	
Height of Object to be Cleared	h	3	meters	
Height center of antenna is above the ground	G_E	2	meters	
	α	S		
	10˚	6.55 m		
	15˚	4.33 m		
	20˚	3.21 m		
	25˚	2.53 m		
	30˚	2.07 m		

Exhibit 2

Off-Axis EIRP Spectral Density Plots

EIRP per FCC 25.209 Tangent to GEO Arc



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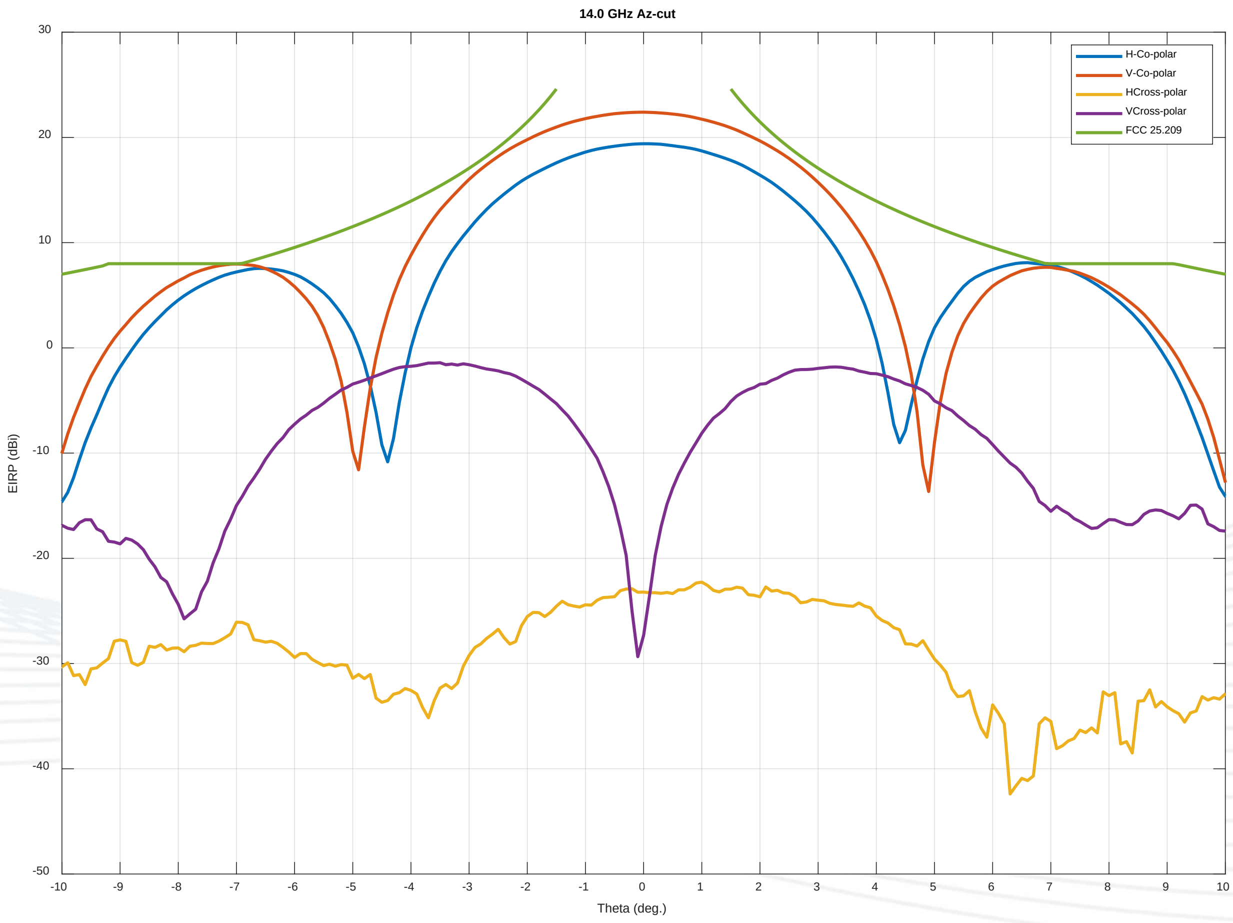
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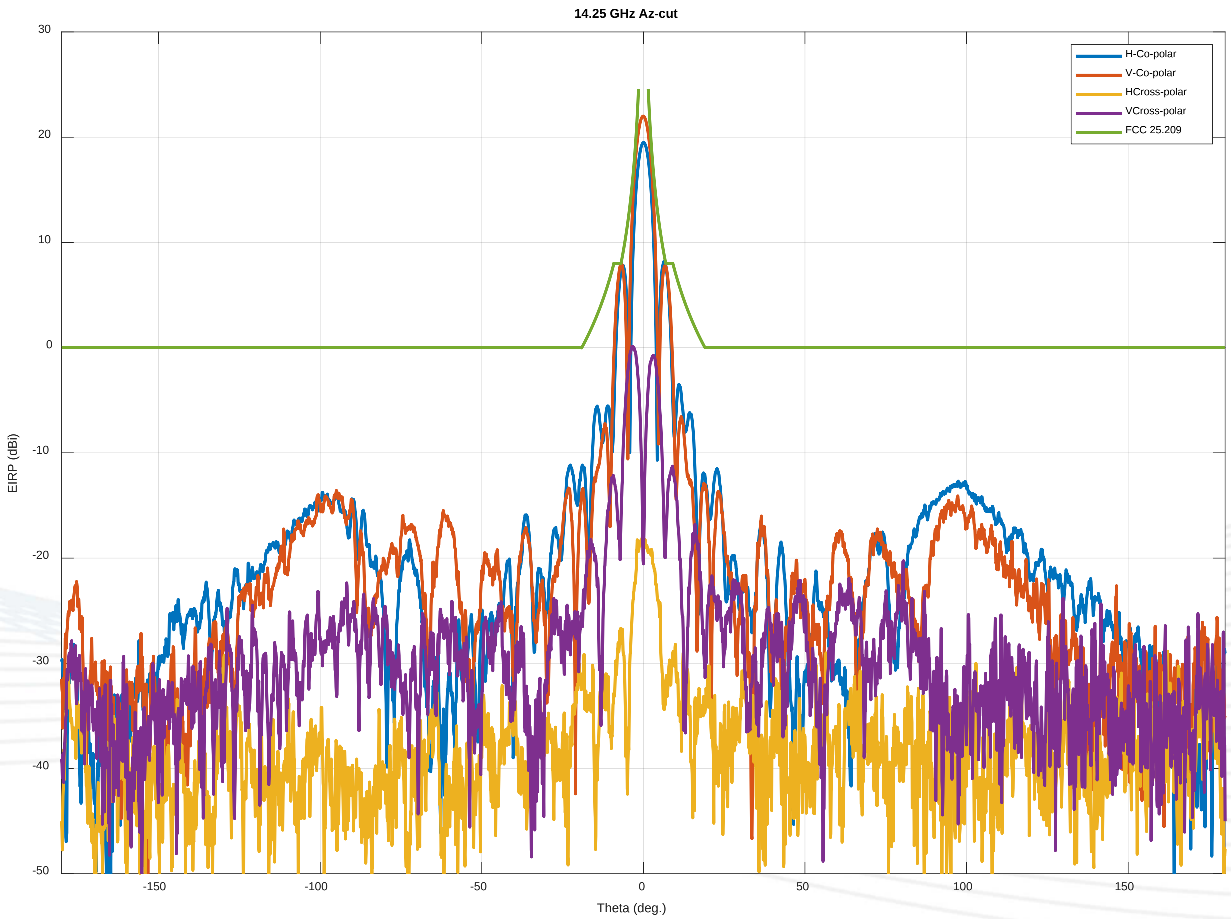
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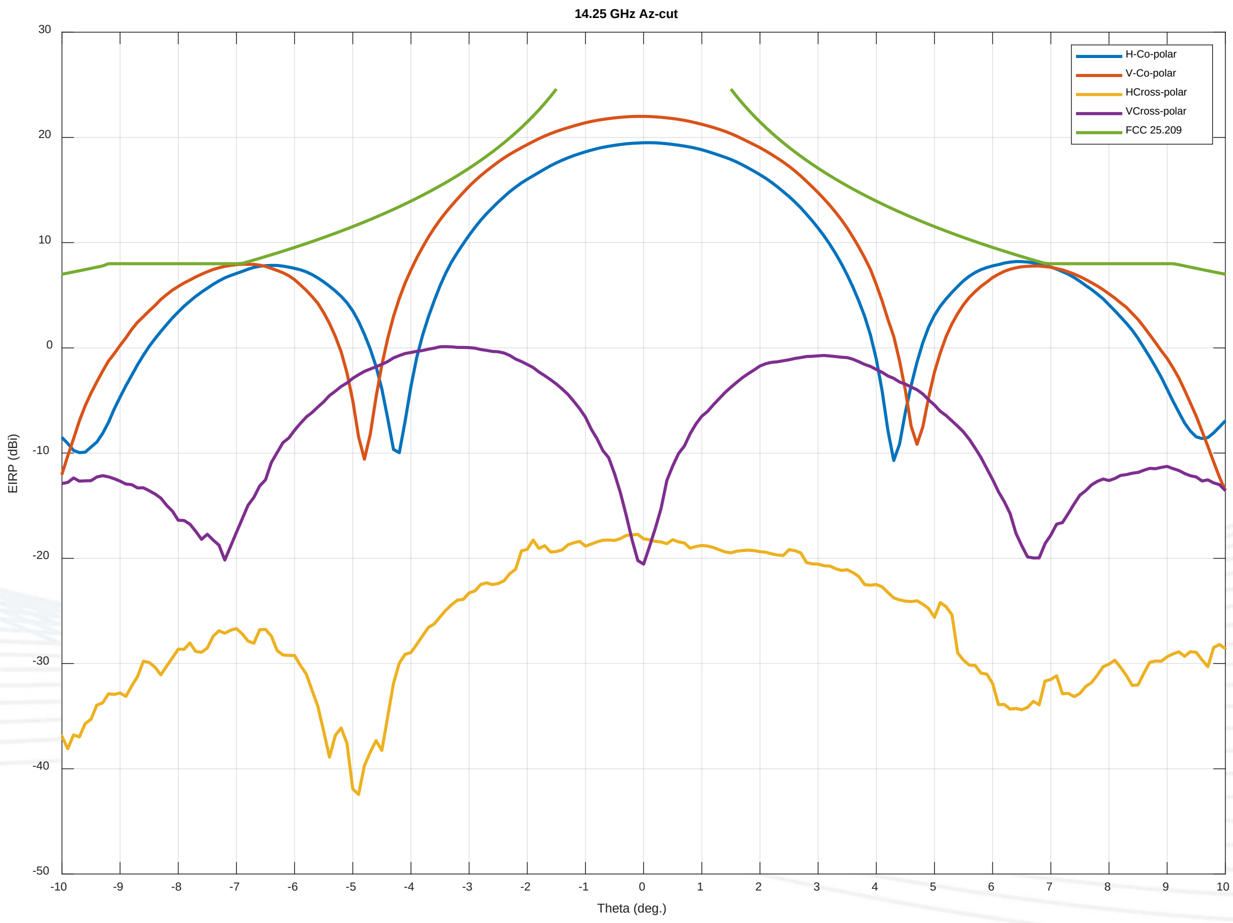

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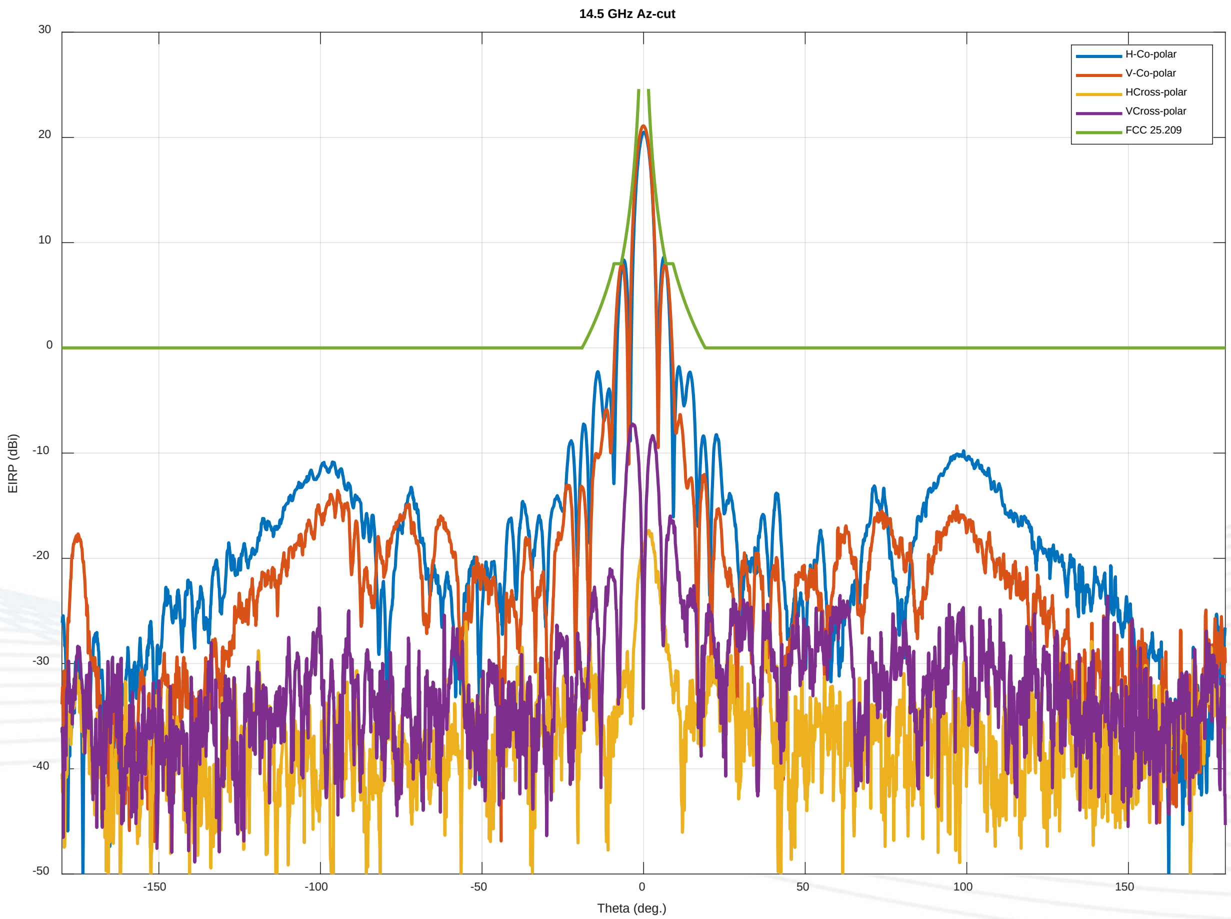
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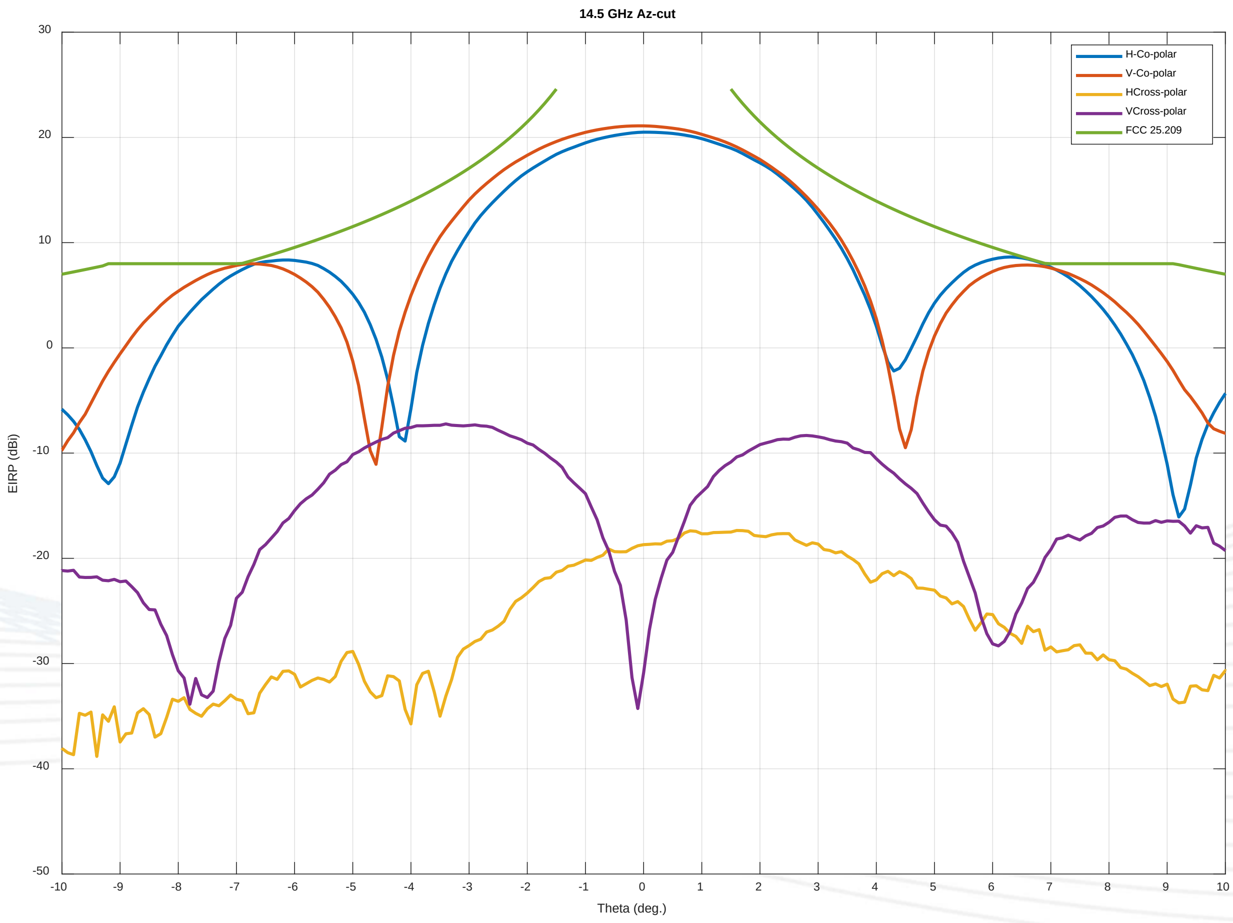
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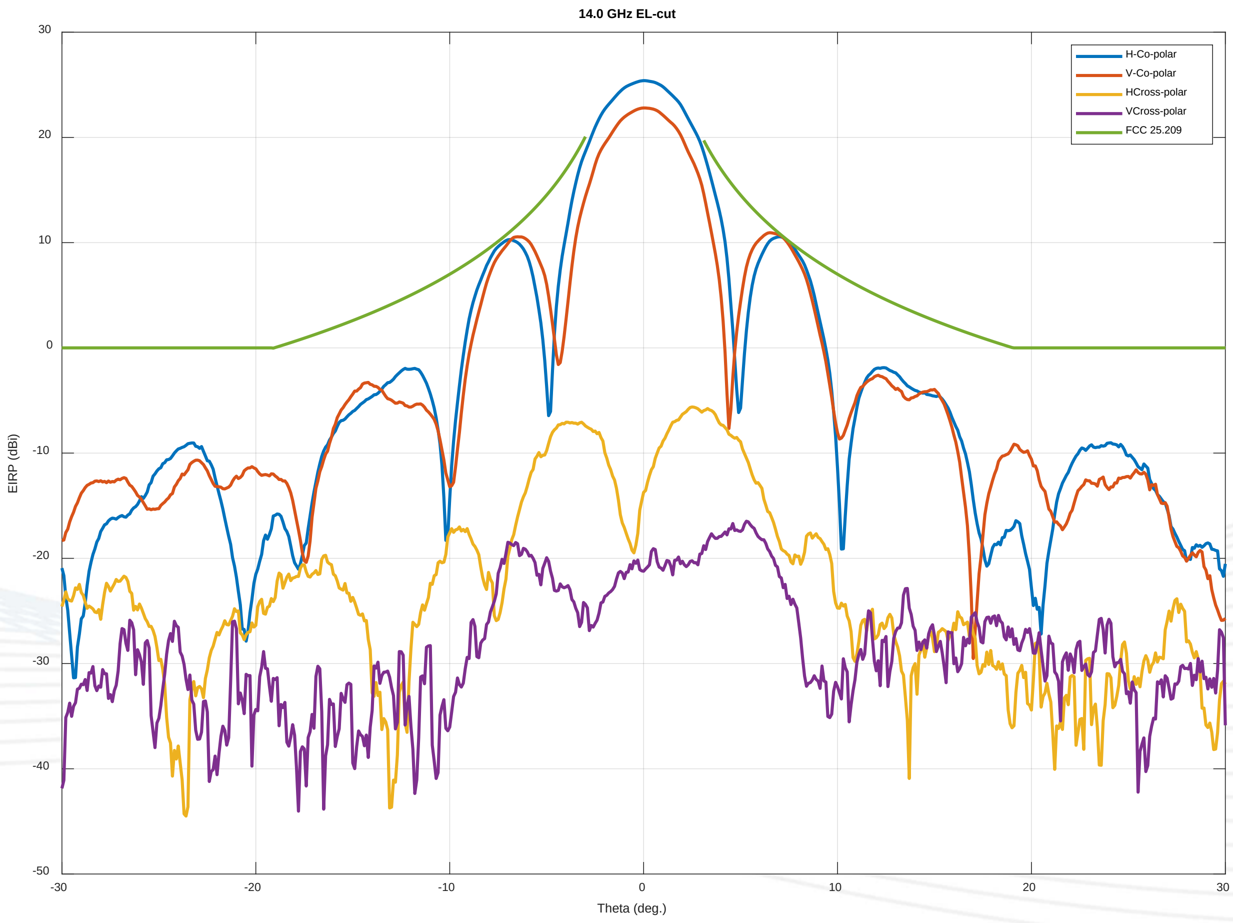
EIRP per FCC 25.209 Perpendicular to GEO Arc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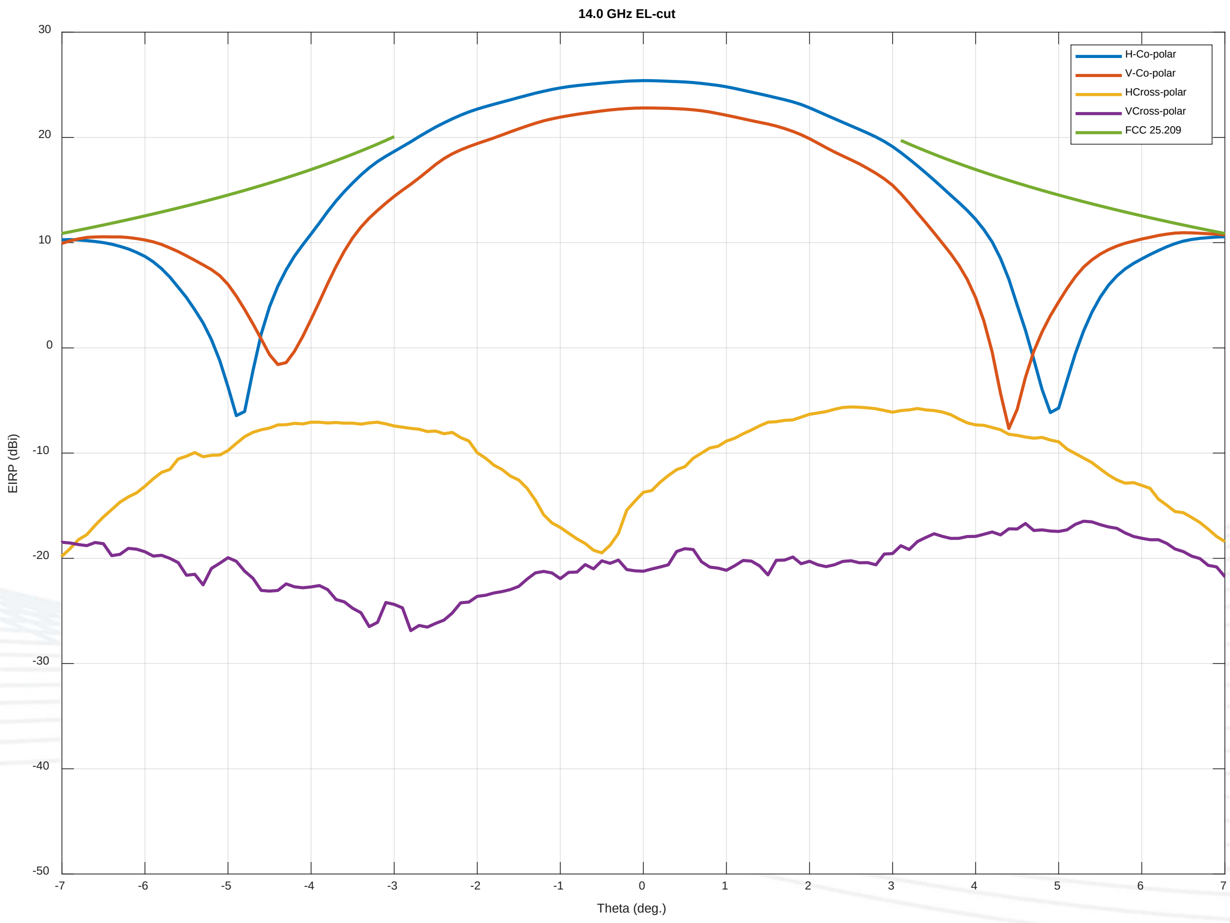
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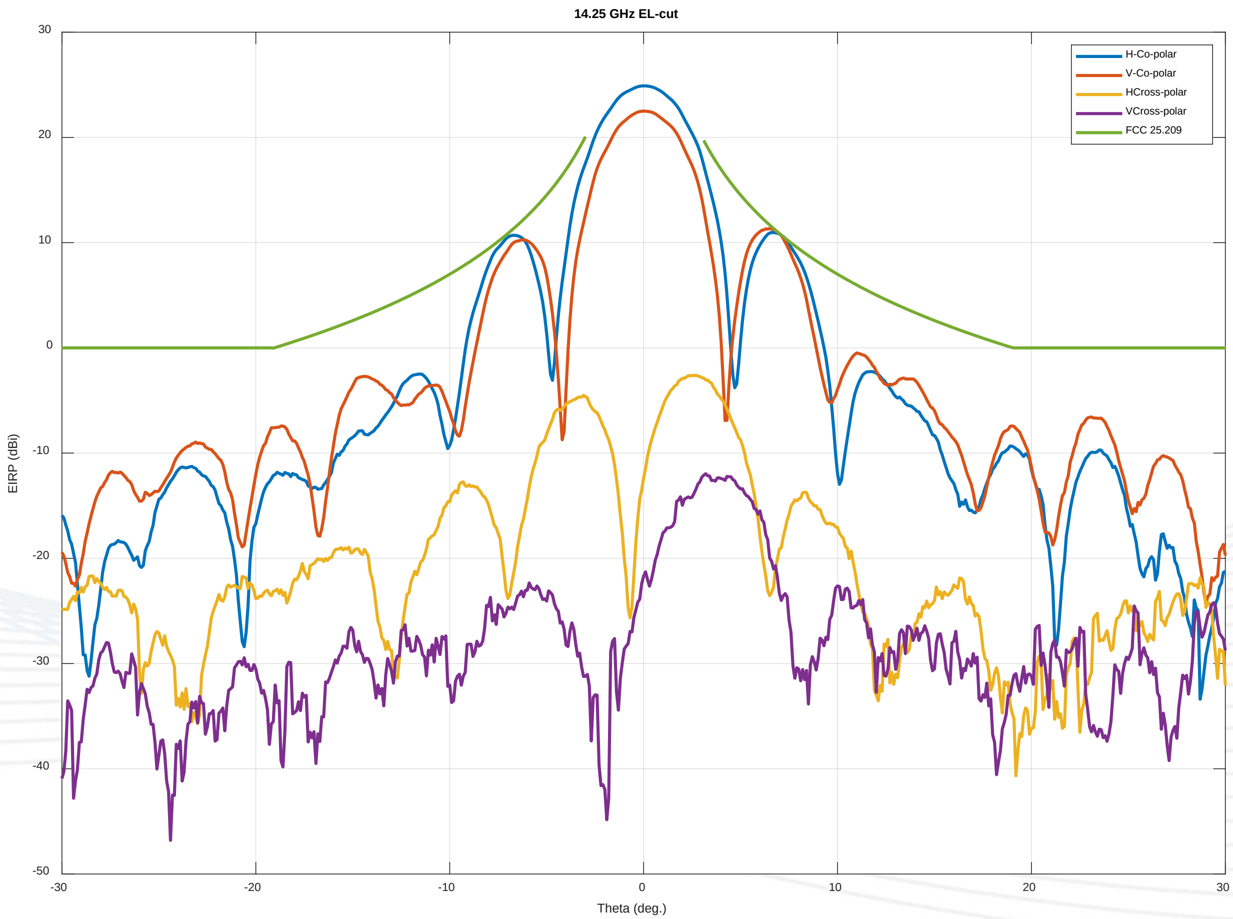
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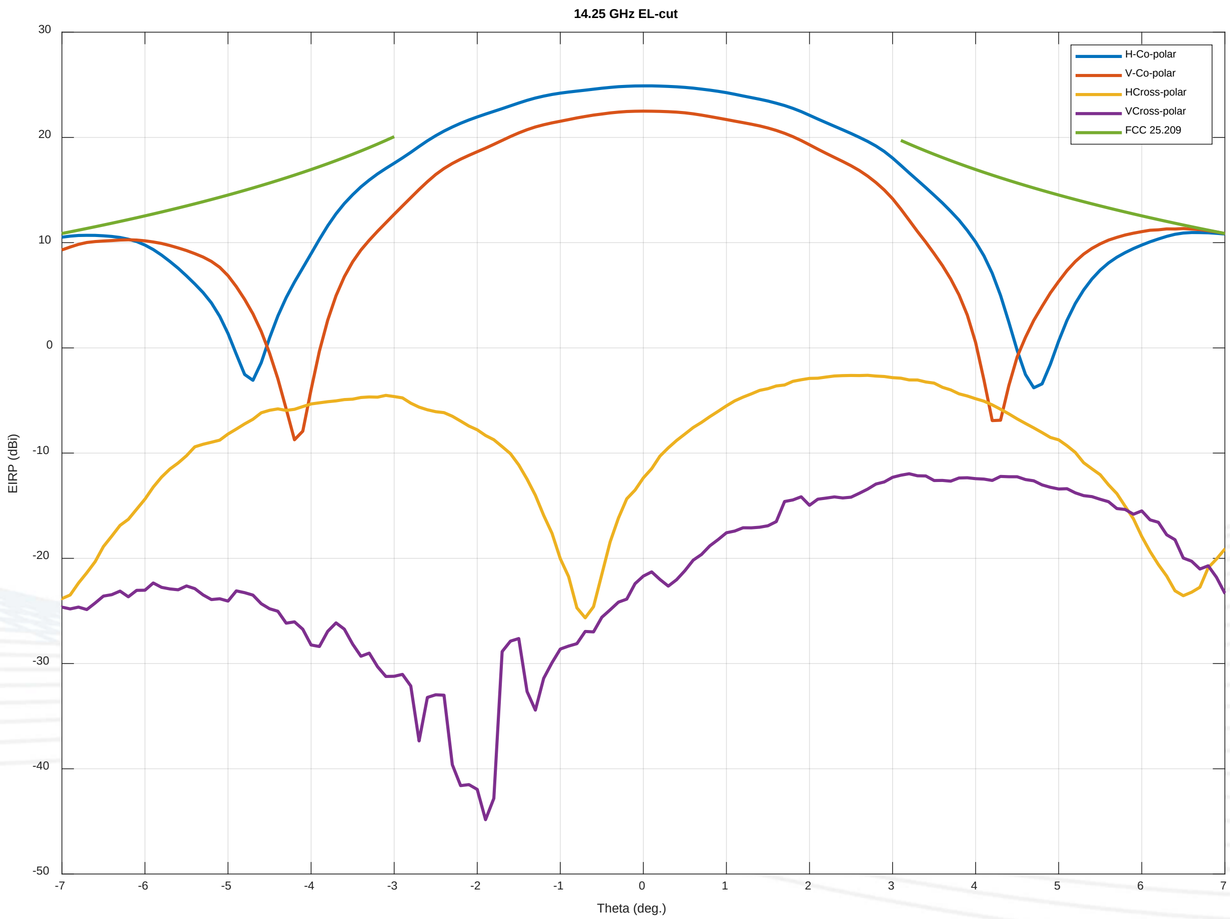
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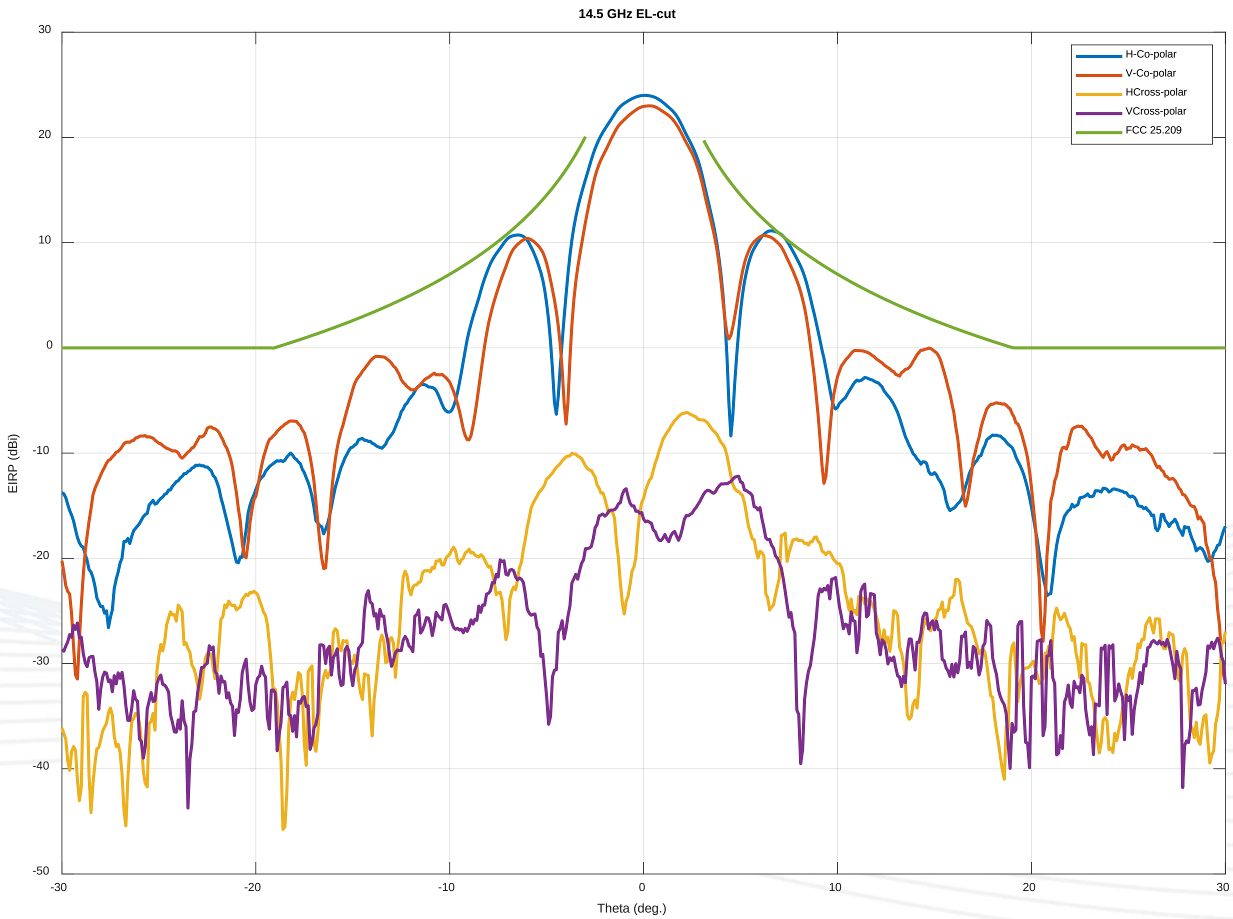
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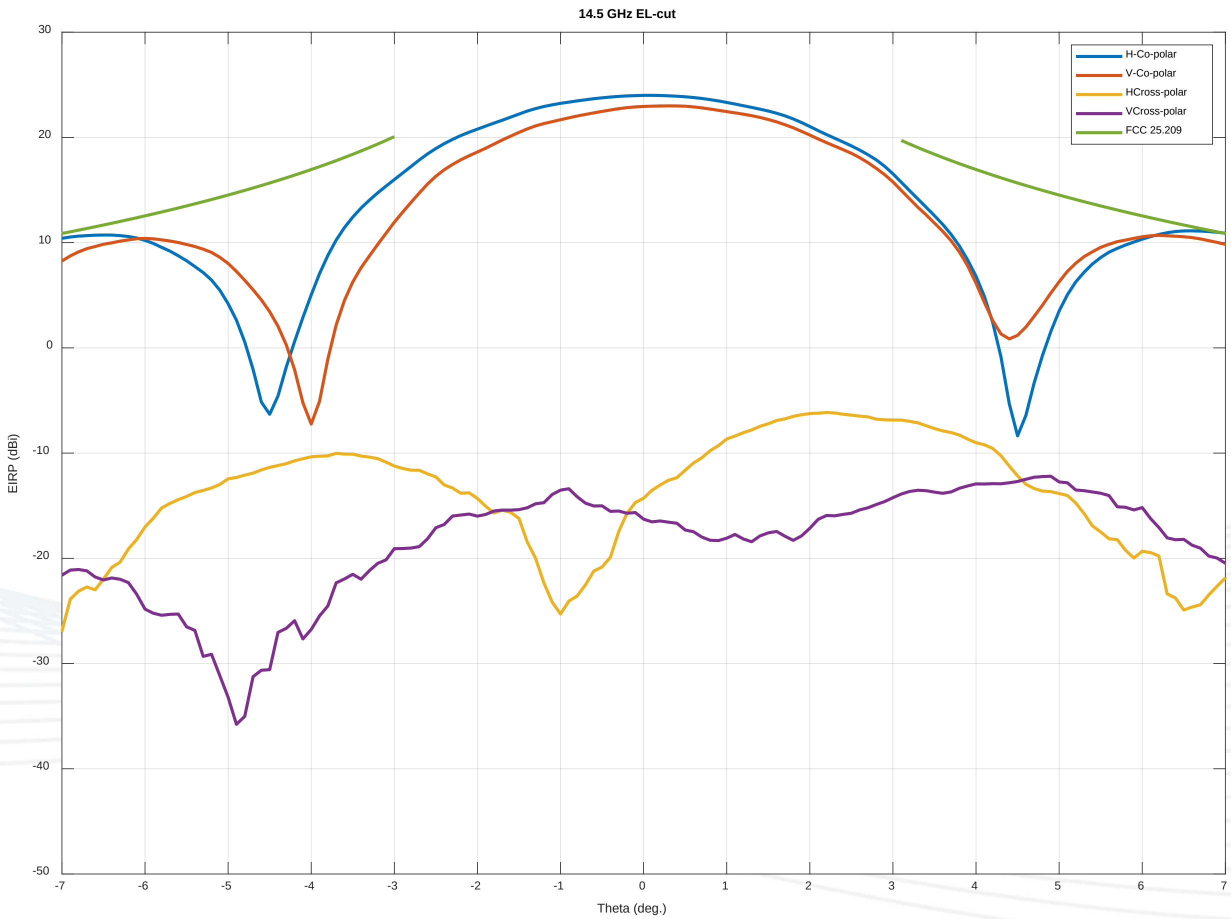
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Exhibit 3

Antenna Gain Patterns

Far Field radiation patterns of SkyTech BBIG30Ku antenna.

ID	*TRGD03_12/17*
Authors	*G. Dassano*
Date	*28/12/2018*
Version	*2*
Classification (*)	*CO*

Summary:

This report deals with the measurements of the radiation pattern of a sample of the parabolic reflector antenna BBIG30Ku manufactured by SkyTeck, operating in Ku band: The measurements were carried out in November 2017 in the Politecnico di Torino Antenna Laboratory (LACE). Measurements of radiation patterns have been carried out on the two transmission and the two reception antenna ports, for H and V polarizations, at two frequencies bands; in the frequency range 10.95-12.75 GHz (RX) and in the frequency range 13.75-14.5 GHz (TX).

**Classification: PU-Public, LI-Limited, CO-Company Confidential*

Document history

Version	*Date*	*Description*	*Authors*
1	December 28, 2017	Gain, XPD and patterns in RX and TX band for V and H polarizations (1st draft)	G. Dassano

Distribution list

Name	*Company*
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1. INTRODUCTION

In this document are reported the results of the tests (carried out on November 2017) on a 30cm parabolic reflector antenna for Ku band satellite communication, indicated as **BBIG30Ku,** manufactured by SkyTech. The antenna has a circular aperture with a diameter of 30 cm.

For this antenna the results shown in this report are:

In the RX and TX bands: the frequency swept maximum gain for the co-polarization on axis, and the XPD factor evaluated on axis.

The radiation pattern cuts (co- and cross-polarization) in the principal (Azimuth and Elevation) planes:

- *in RX band, in the angular range ±180° for AZ and ±30° for EL planes, and both polarizations ports (H and V), at 3 frequencies: 10.95, 11.85 and 12.75 GHz;*
- *in TX band, in the angular range ±180° for AZ and ±30° for EL planes, and both polarizations ports (H and V), at 4 frequencies, 250MHz spaced, from 13.75 to 14.5 GHz;*

All the measurements were carried out in LACE's outdoor far field test range, with a distance SRC-AUT of 150 m.

2. MEASUREMENTS FACILITIES DESCRIPTION

2.1 Gain and pattern measurements

The measurements have been performed in the outdoor test range of the Laboratory (see fig.1).

The present test range, who has replaced the old one used since the early '60es for pioneering works on space antennas, has been supplied from MI Technologies (formerly Scientific Atlanta) and installed in February 2008.

In this test range the Antenna Under Test (AUT), used as receiver, and the Source (SRC) are placed on the roof of two different buildings, the Department of Electronics and Telecommunications and the Department of Control and Computer Engineering. The two buildings are far apart (more than 150 m) without obstacles in between, and the height of both AUT and SRC is 30 m above the ground; the range is schematically shown in fig.1 (plan and elevation). It is also possible to use a SRC at a slightly lower level, to reduce the scattering from the back of the range.

Due to the elevated range, there are many Fresnel zones without obstacles. The effects of the reflection on the ground can be removed by a time windowing, with some directivity of the source and also considering that the incidence angle on the ground is near to the Brewster angle.

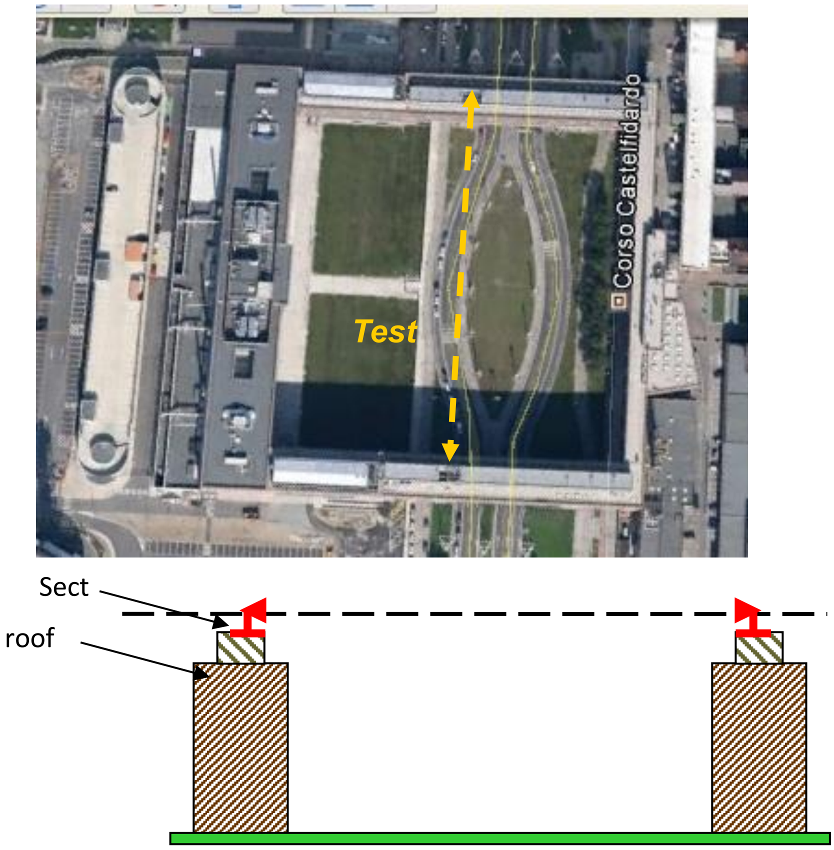


Fig.1: Plan view and vertical section of the outdoor test range

The design frequency interval is 100 MHz-50 GHz (the upgrade from 20 to 40 GHz has been added in 2011; from 40 to 50 GHz in 2015). The distance between SRC and AUT allows to test antennas up to 0.7m diameter at 40 GHz; at lower frequencies the maximum size in meters is given by $D \cong 4.7/f^{1/2}$, where f is the frequency in GHz. Corrections procedures are also available should the distance be less than $2D^2/\lambda$.

The dynamic range is around 90 dB (depending on the frequency). The receiver can handle up to 16 measurements channels, with external switching system, and 1 reference channel measured simultaneously with each signal channel, with 100 dB isolation Channel to Channel (110 dB . Reference Channel to Signal Channel). The accuracy in amplitude (Logarithmic mode) is ±.05 dB/10 dB over the full dynamic range (excluding effects of temperature, cross-talk and noise) and ±0.4 °/10 dB in phase over full dynamic range; the noise figure is 17 dB at 0.1 to 18 GHz. The most recent calibration of the whole system has been in June 2014.

The positioning system of the AUT is a 3-axis system (roll over azimuth over elevation), consisting of: MI53150 Az/El and MI6111 rotary positioner (see fig.2, left). The Az/El accuracies are respectively 0.03° and 0.05° with max load 1136 kg and bending moment 3390 N·m; the roll accuracy is 0.05° with max load 455 kg and bending moment 678 N·m. As a practical guideline, the system can measure antennas up to 2m in size and to 70 kg in weight: actual limits depend however on the shape of the antenna. This positioning system allows to take pattern cuts as well as raster scan of the pattern, and to measure circular and linear polarization.. Examples of measured radiation patterns are shown in fig. 3. The full system cabling diagram is shown in fig. 4.

As source antennas standard gain horns are used. Measurement accuracy for secondary lobe is estimated in about in ±1 dB; for gain in about ±0.5 dB

Fig.2: Outdoor test range: the AUT mount (left) and the upper SRC mount (right).

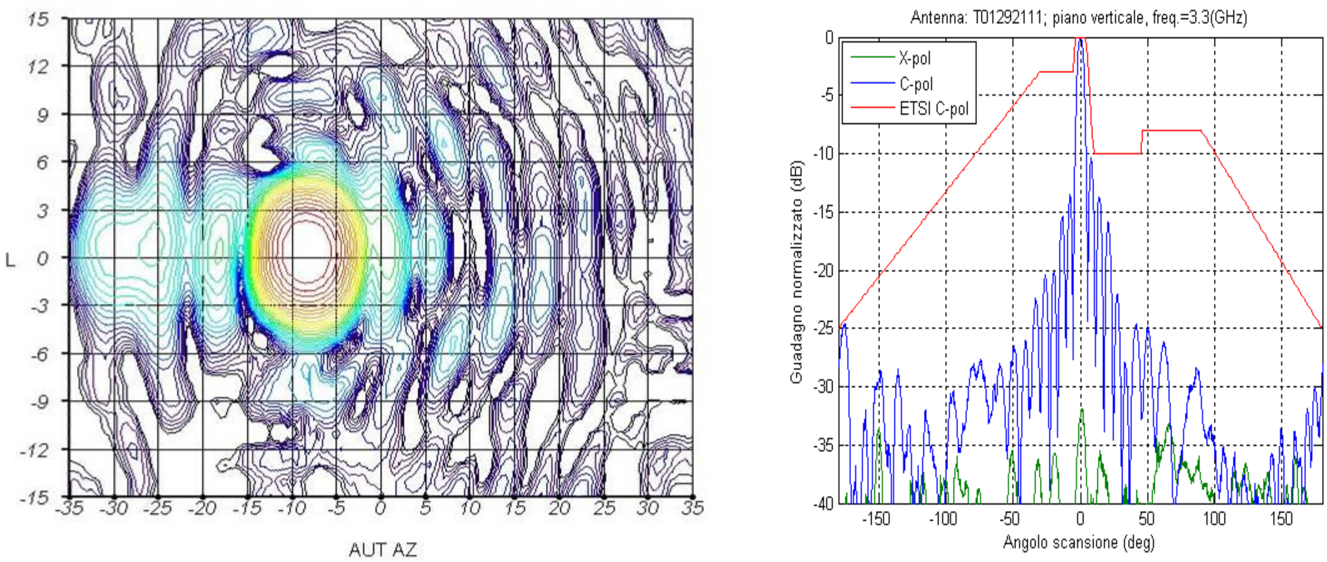
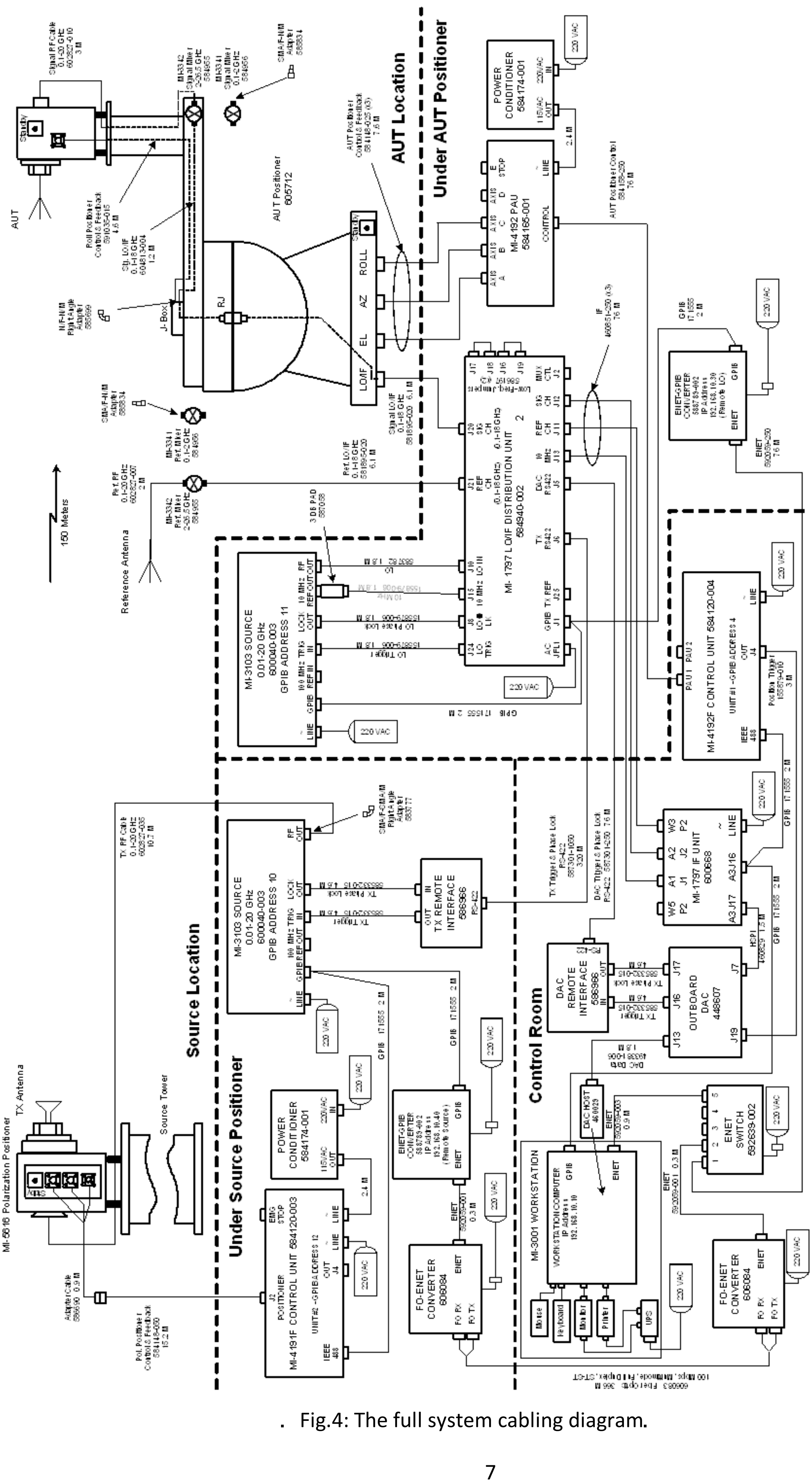


Fig.3: Examples of radiation patterns measured in the Outdoor Test Range.



. Fig.4: The full system cabling diagram.

3. MEASUREMENTS PROCEDURES

3.1 Gain measurement

The standard procedure for this type of measurement is the "substitution method". The Antenna Under Test (AUT) operates in reception. The maximum signal level received (at all ports) from the AUT, pointed with the maximum to the source antenna, is measured, with a frequency sweep in the required frequency band. Then the AUT is replaced by a Standard Gain Horn antenna (SGH) with known gain, with the maximum to the source antenna, and again the maximum signal level received from is recorded. The Gain of the AUT is derived from the simple formula (in dB)

$G_{AUT} = G_{SGH} + (P_{rAUT} - P_{rSGH})$

The gain vs frequency is plotted in Cartesian plot, in dB scale.

3.2. Radiation pattern measurements

Since the patterns are required in various phi-cuts (azimuth, elevation) as well as in a raster scan around the main beam, the standard procedure is to measure, at discrete frequencies, the received power from the AUT from each port, when transmitting from the source three different linear polarizations (V and H). The radiation patterns are plotted in dB scale, in the desired angular range.

4. Pictures of the measurement campaign.

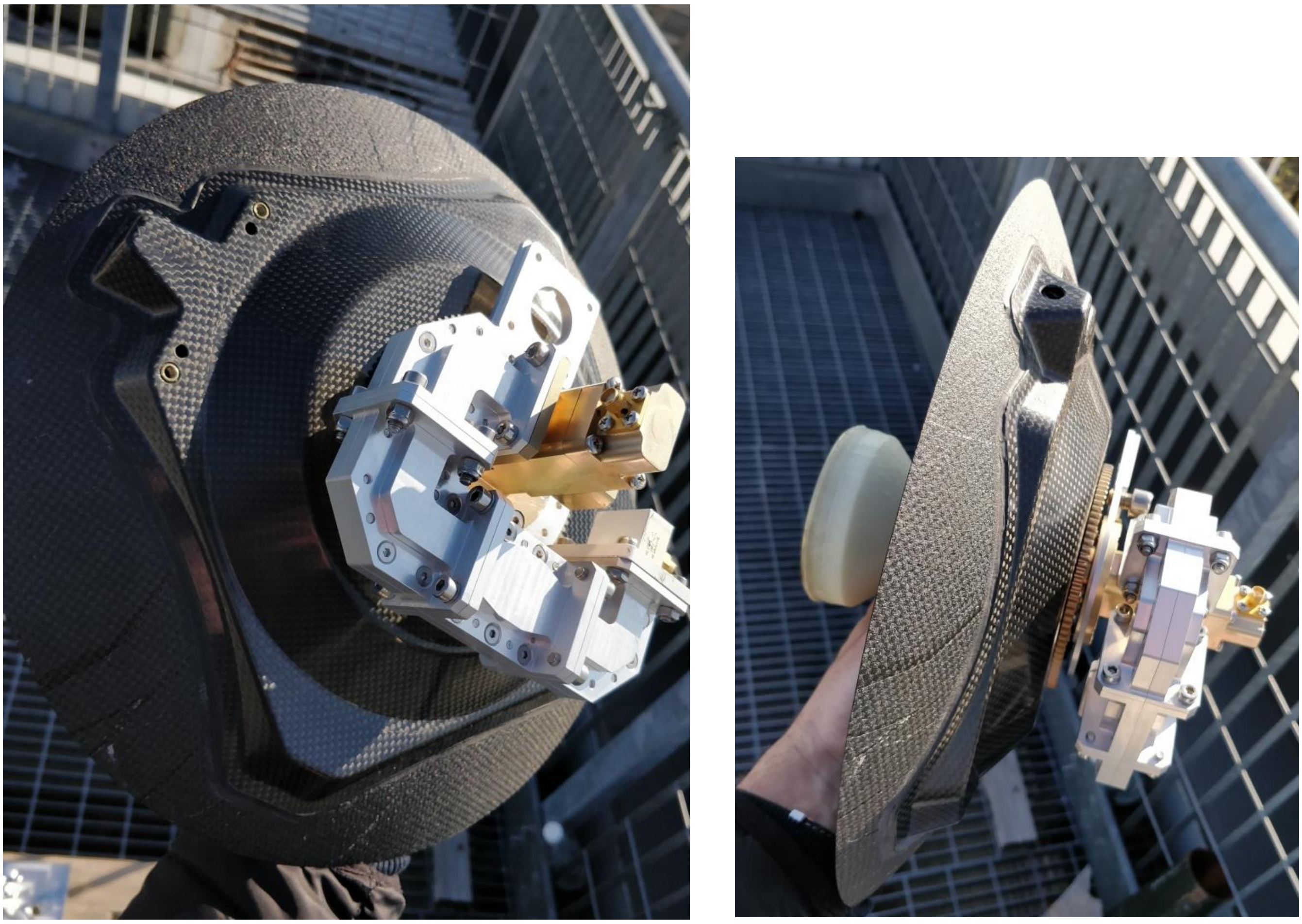
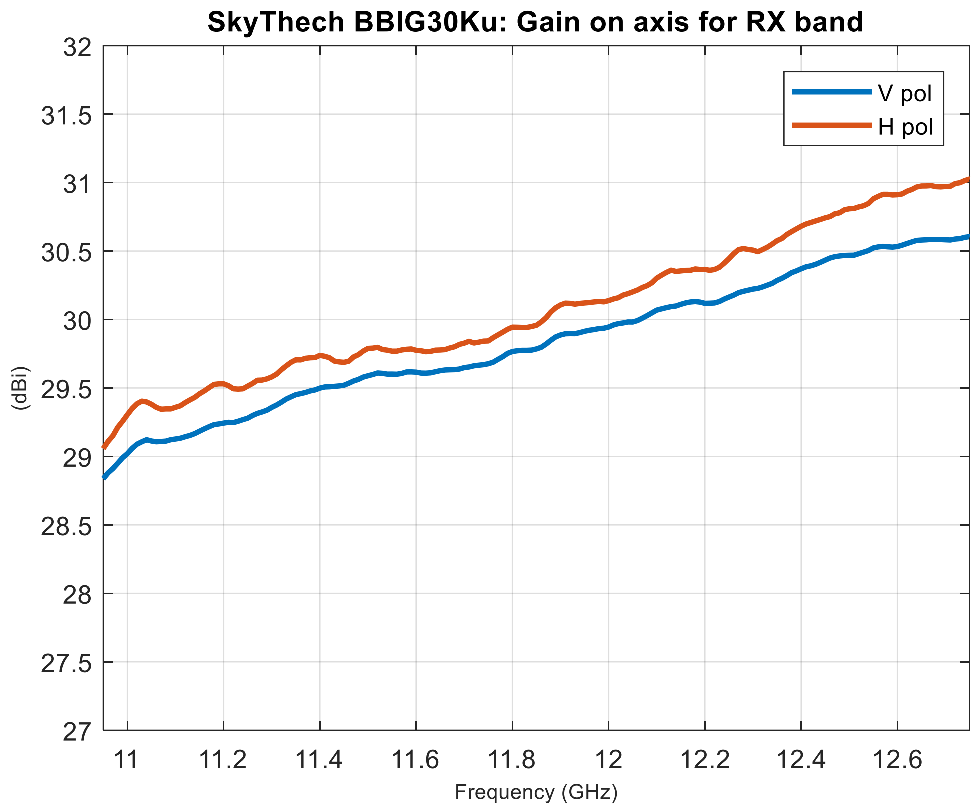
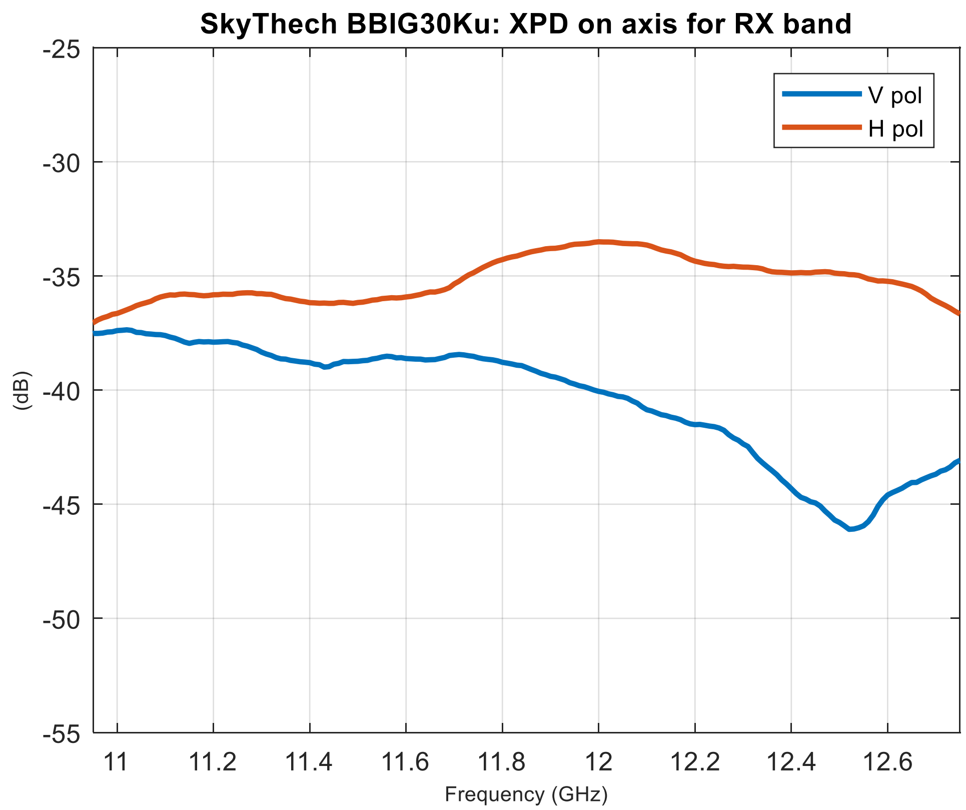
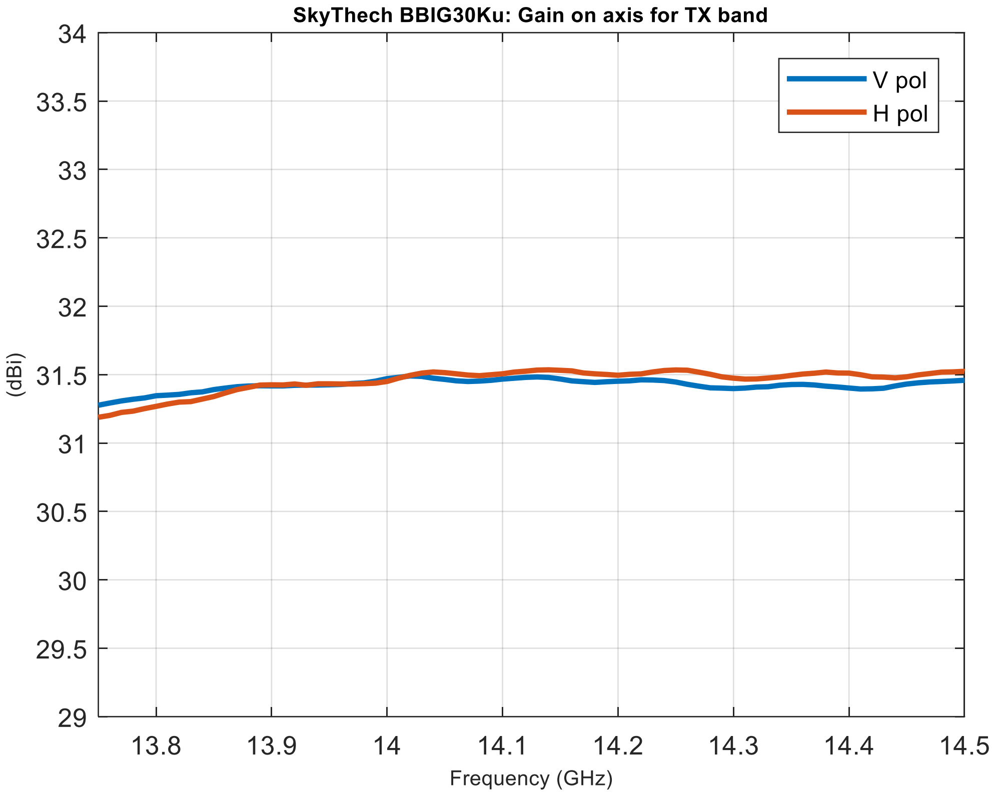


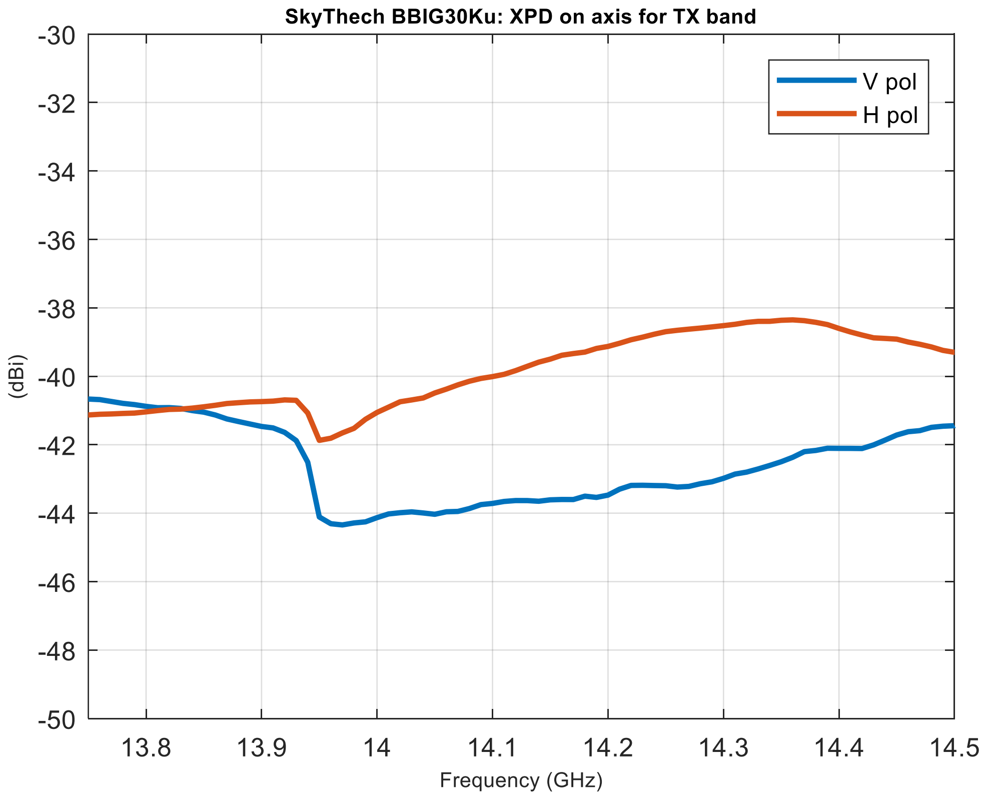
Fig.5: Antenna BBIG30Ku tested.

5. Gain and XPD measurements , TX / RX Bands.





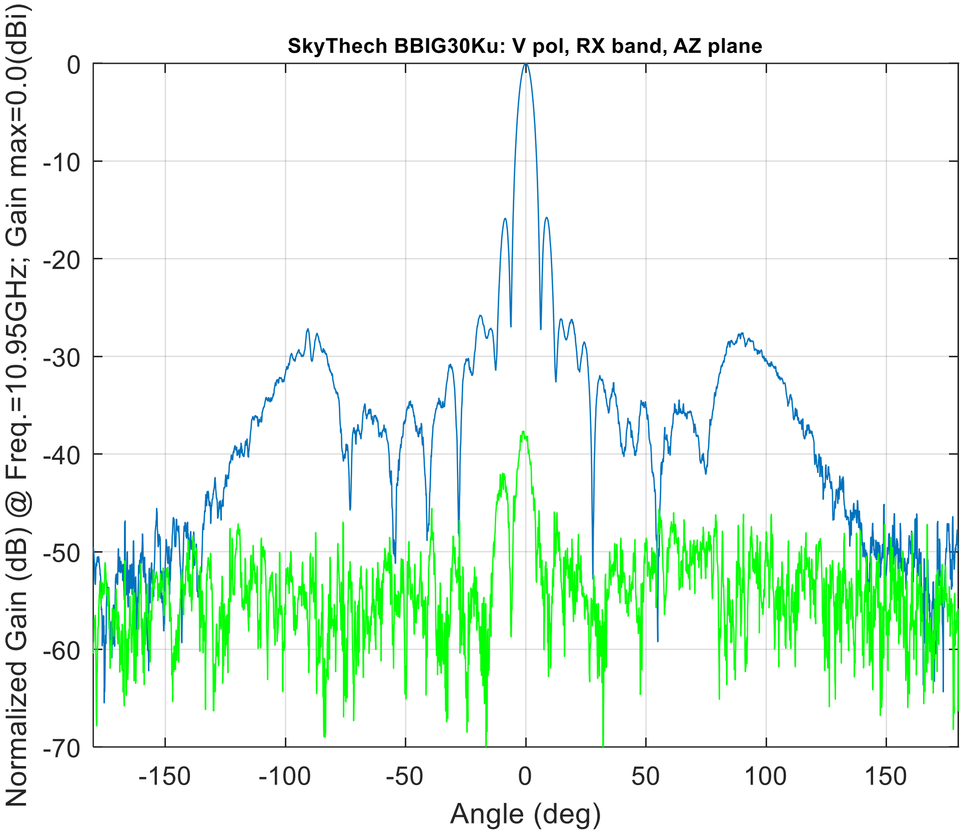

SkyThech BBIG30Ku: Gain on axis for TX band
34
33.5
33
32.5
32
31.5
31
30.5
30
29.5
29
(dBi)
13.8
13.9
14
14.1
14.2
14.3
14.4
14.5
Frequency (GHz)
V pol
H pol

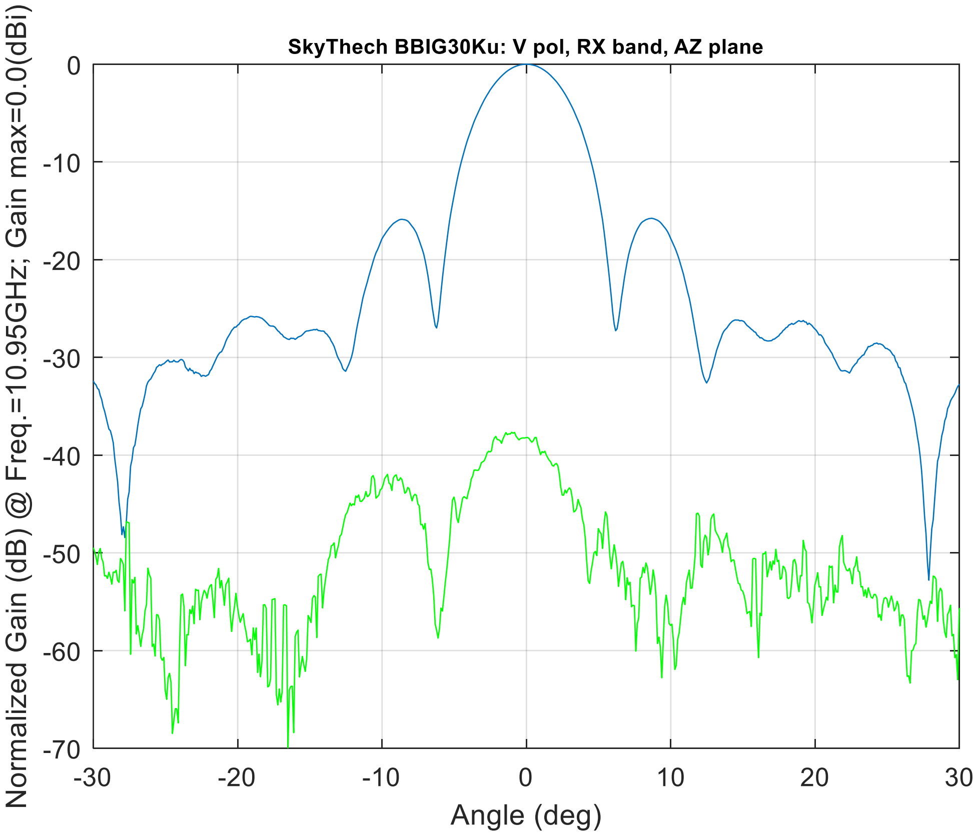

SkyThech BBIG30Ku: XPD on axis for TX band
-30
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
(dBi)
13.8
13.9
14
14.1
14.2
14.3
14.4
14.5
Frequency (GHz)
V pol
H pol

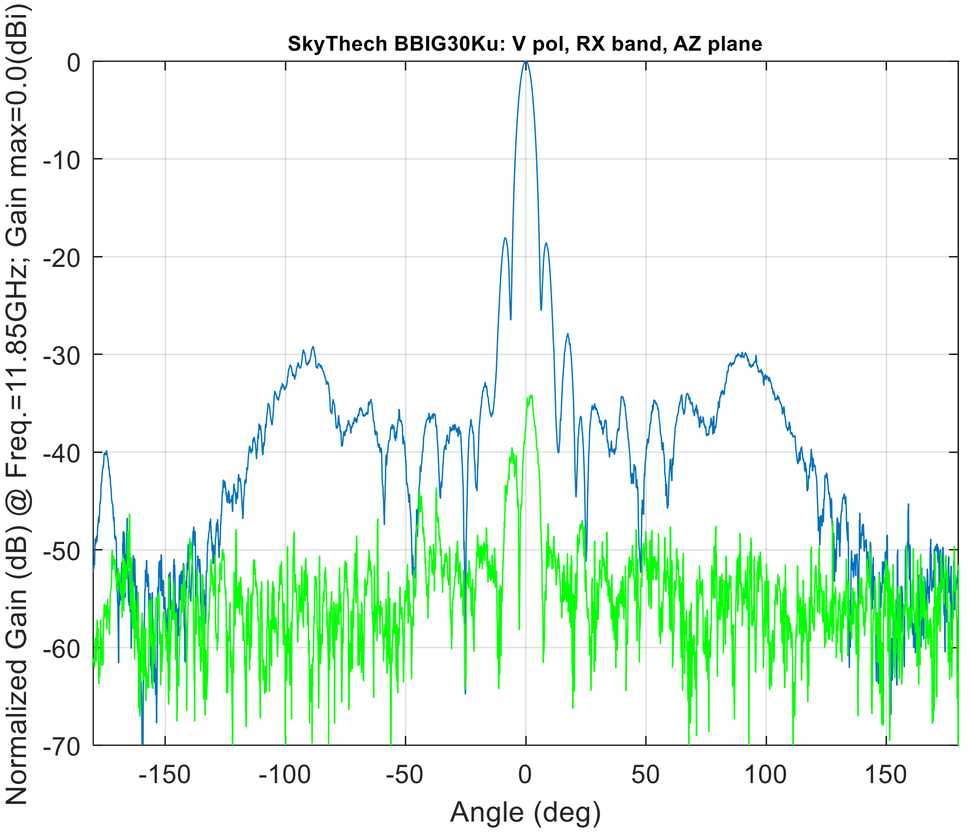
6. Radiation Pattern Measurements.

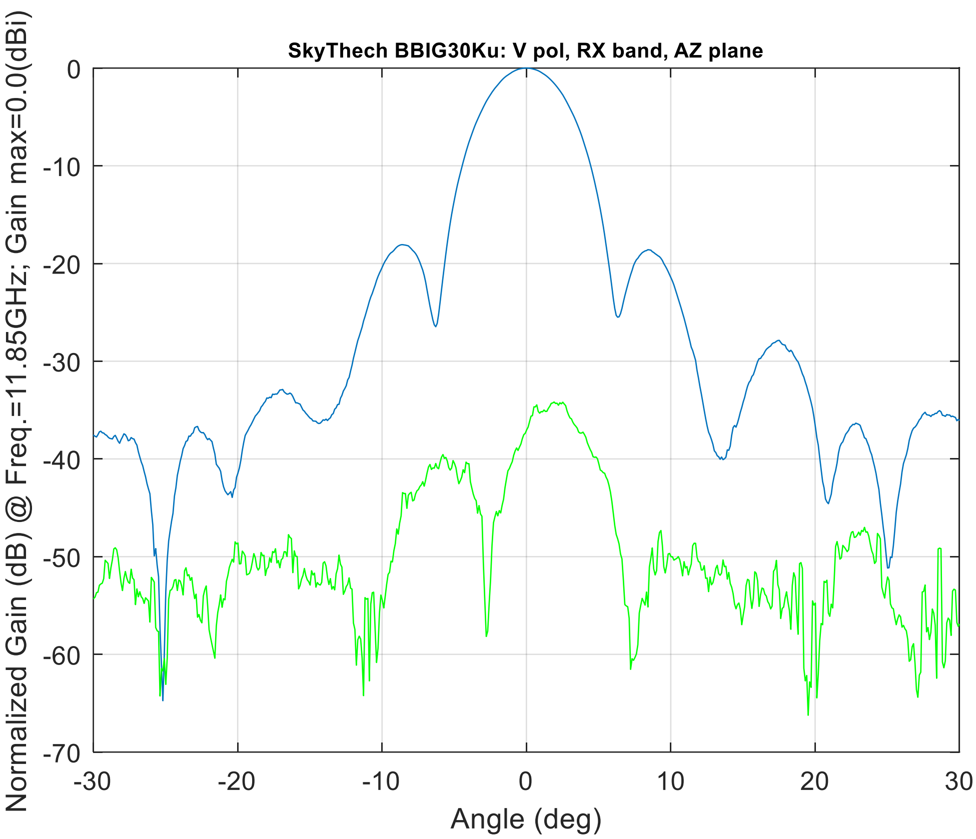
6.1: Radiation patterns in RX band (10.95-12.75 GHz).

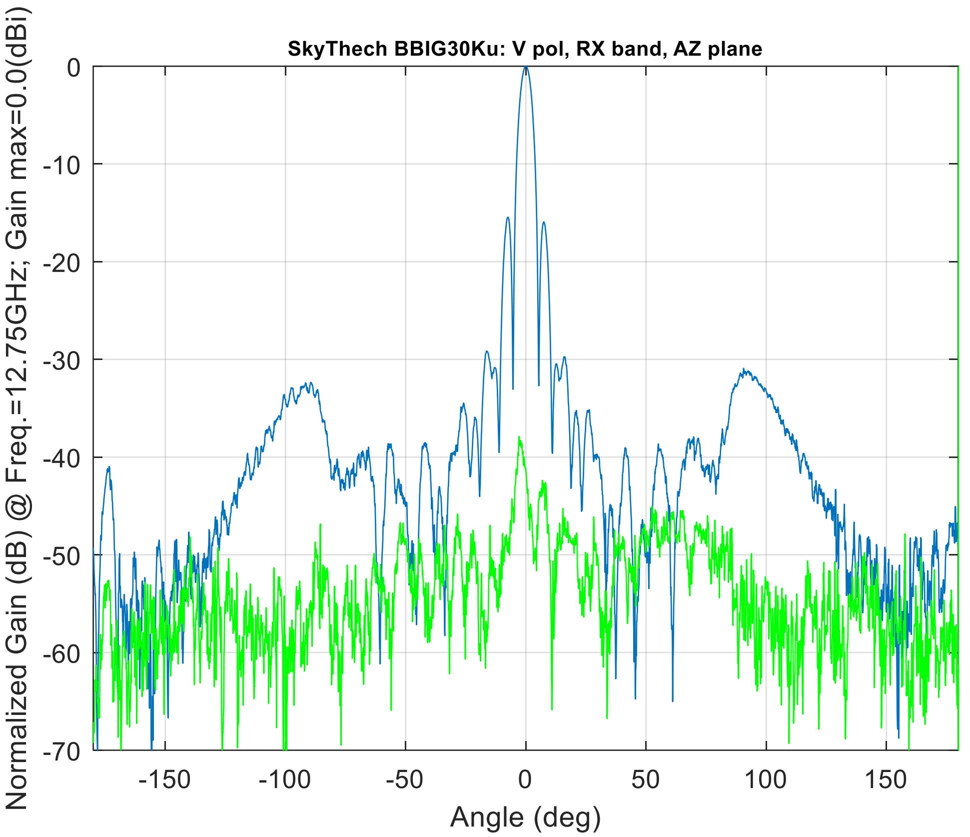
6.1.1: V-pol, AZ and EL plane plots.

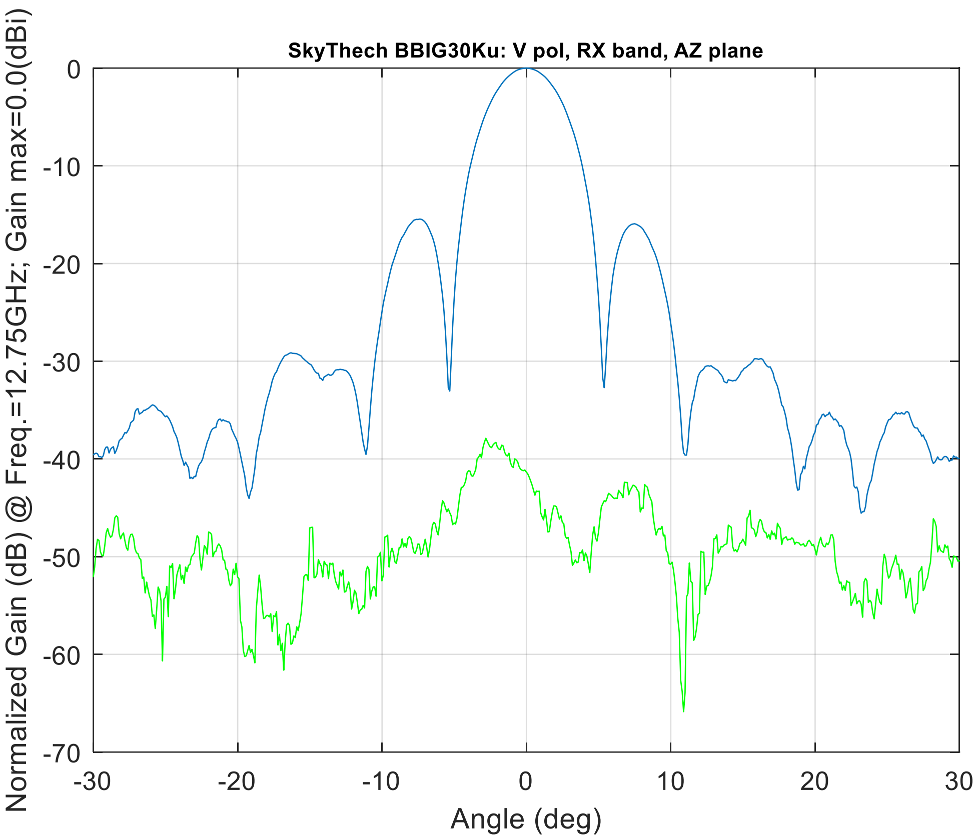


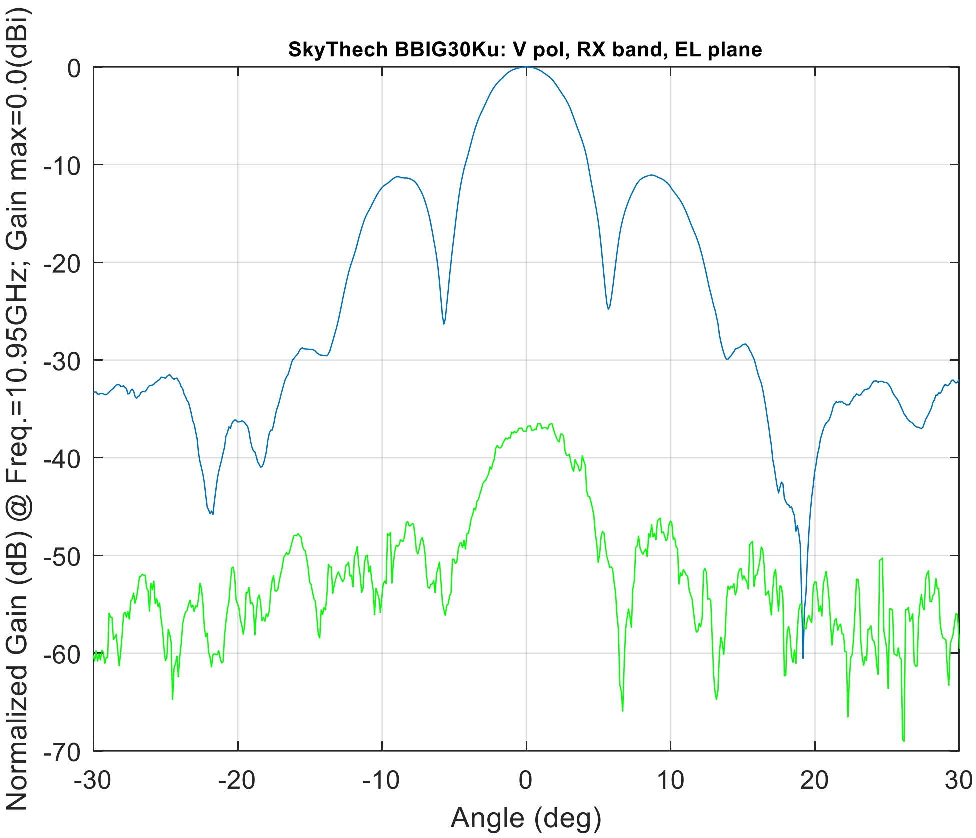


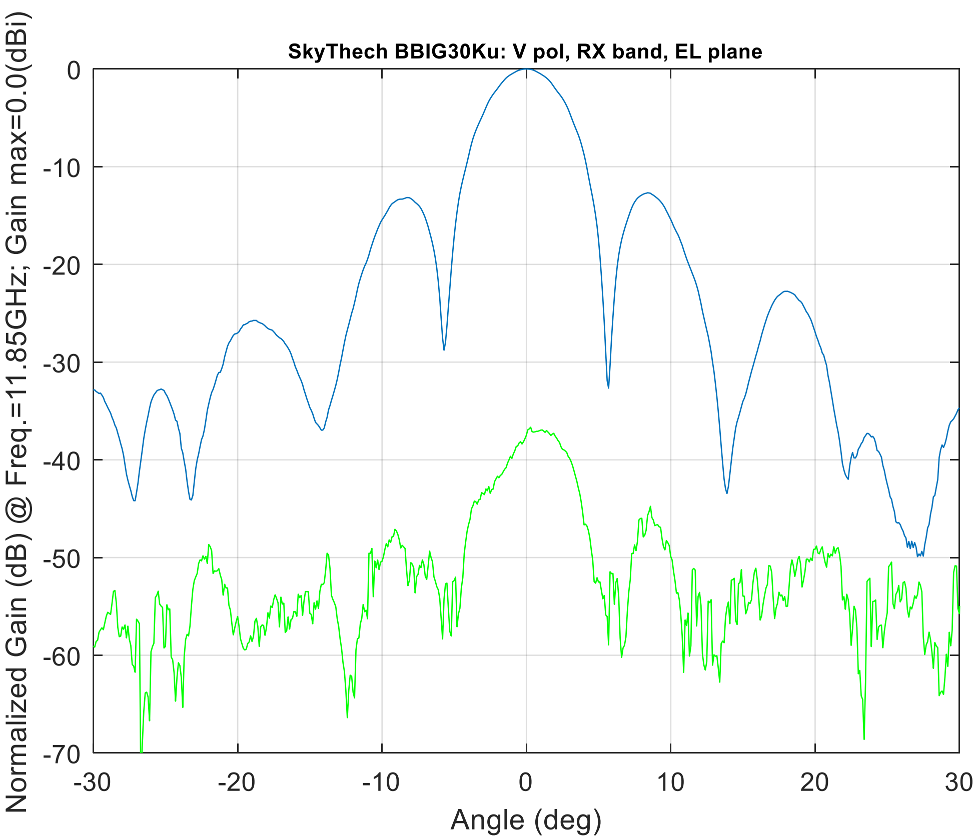

SkyThech BBIG30Ku: V pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=11.85GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150
Angle (deg)

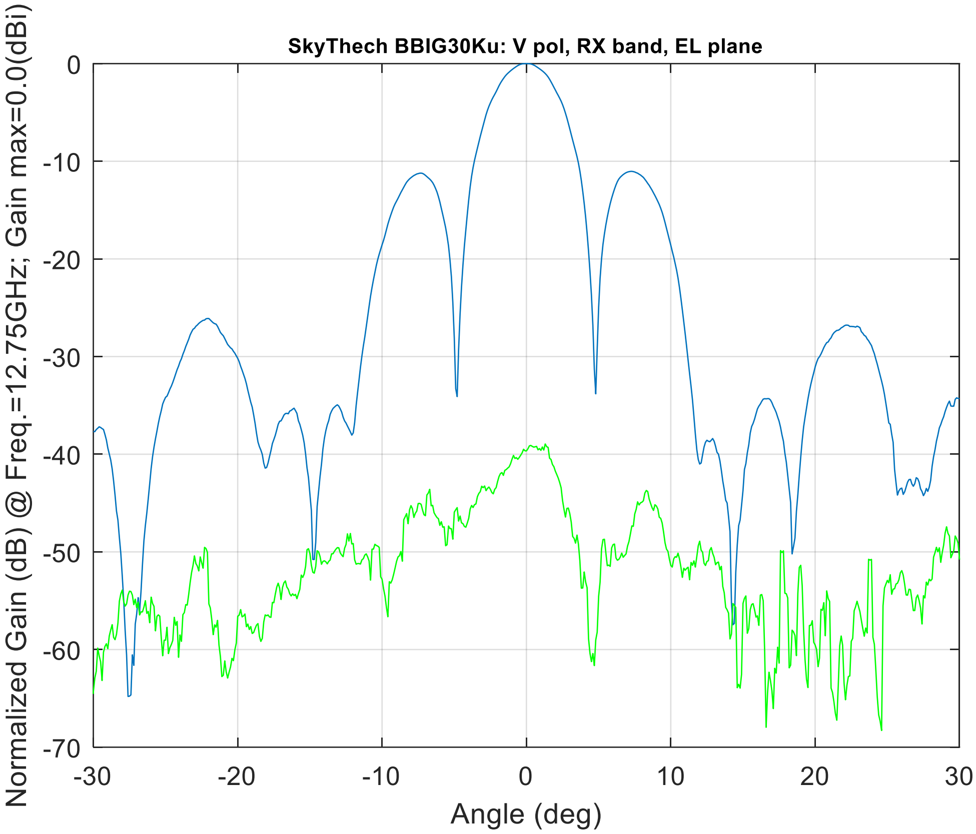

SkyThech BBIG30Ku: V pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=11.85GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)


SkyThech BBIG30Ku: V pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=12.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150
Angle (deg)

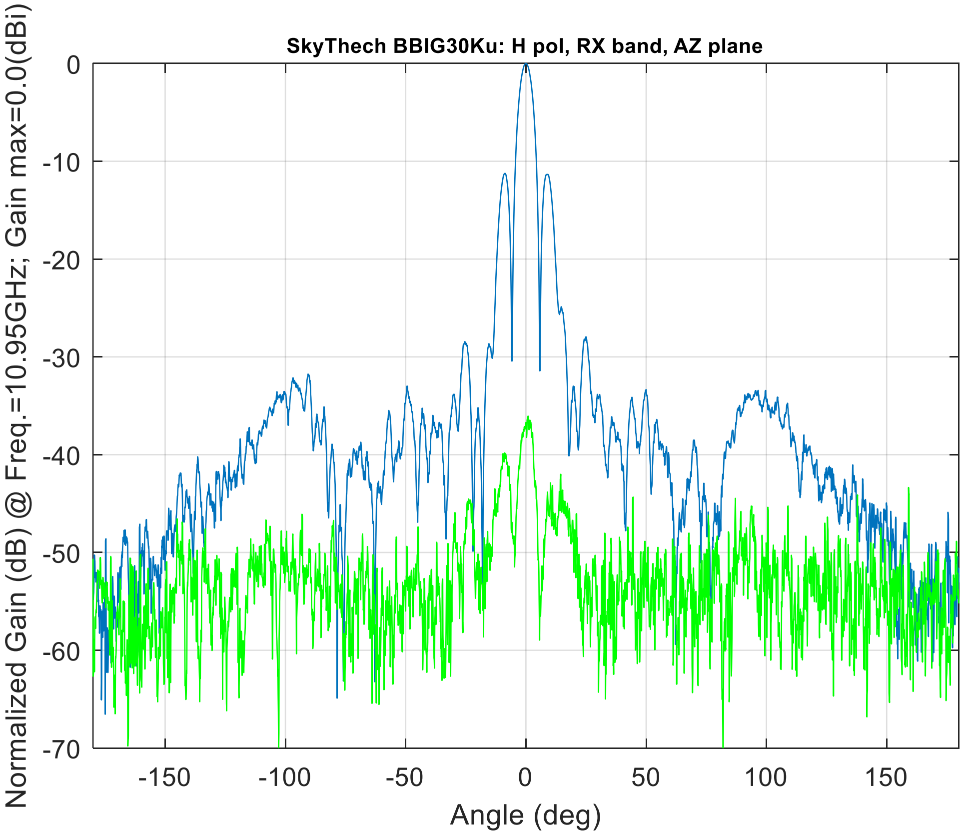

SkyThech BBIG30Ku: V pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=12.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

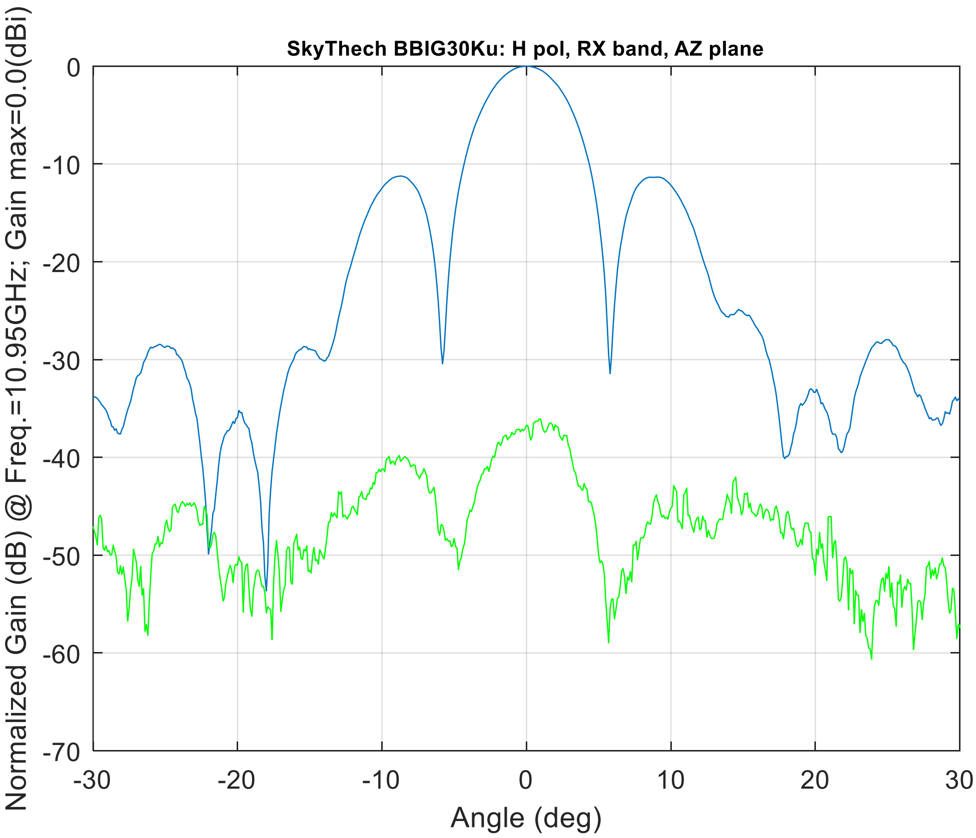

SkyThech BBIG30Ku: V pol, RX band, EL plane
Normalized Gain (dB) @ Freq.=10.95GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

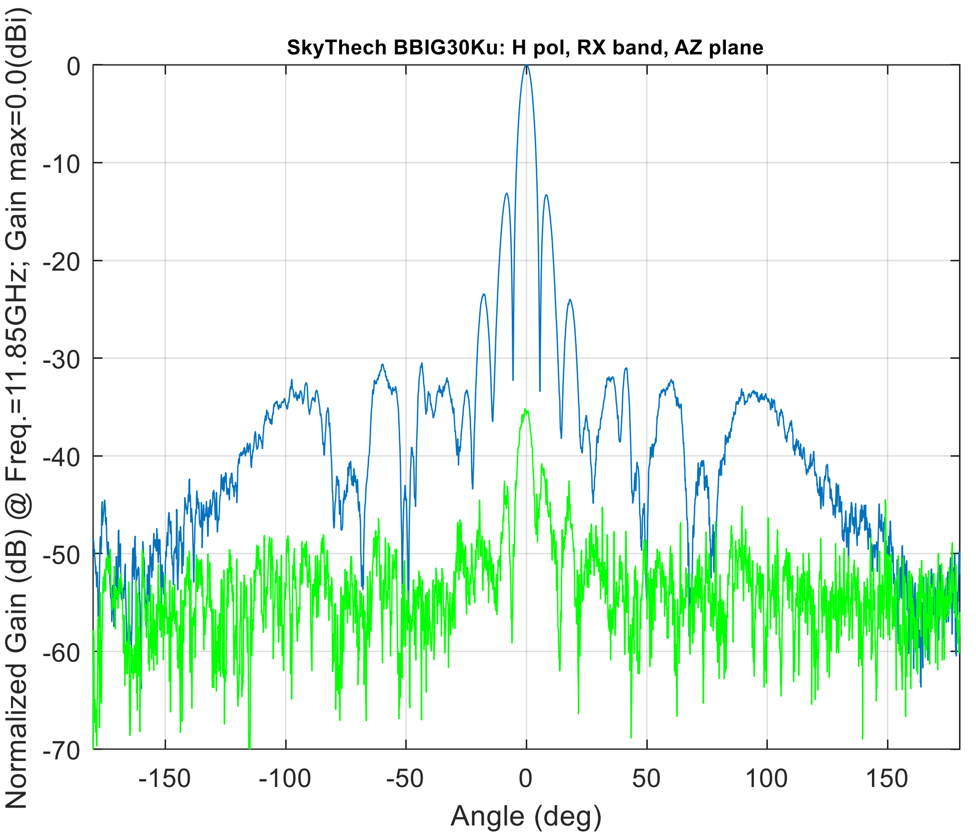

SkyThech BBIG30Ku: V pol, RX band, EL plane
Normalized Gain (dB) @ Freq.=11.85GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

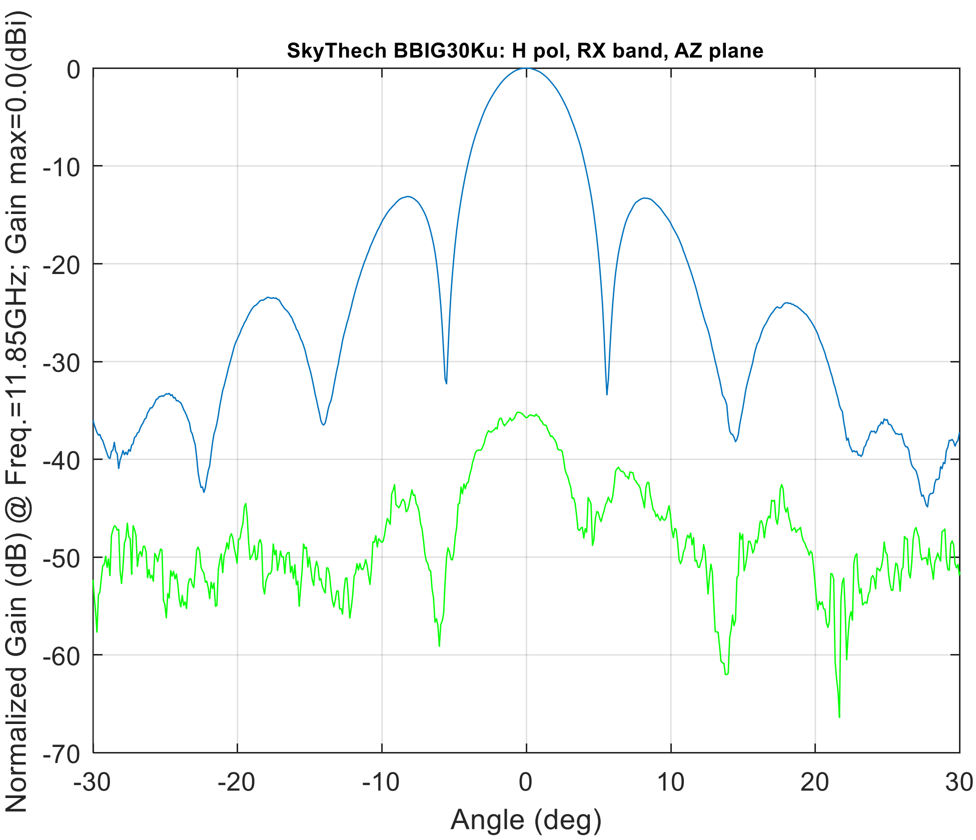

SkyThech BBIG30Ku: V pol, RX band, EL plane
Normalized Gain (dB) @ Freq.=12.75GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

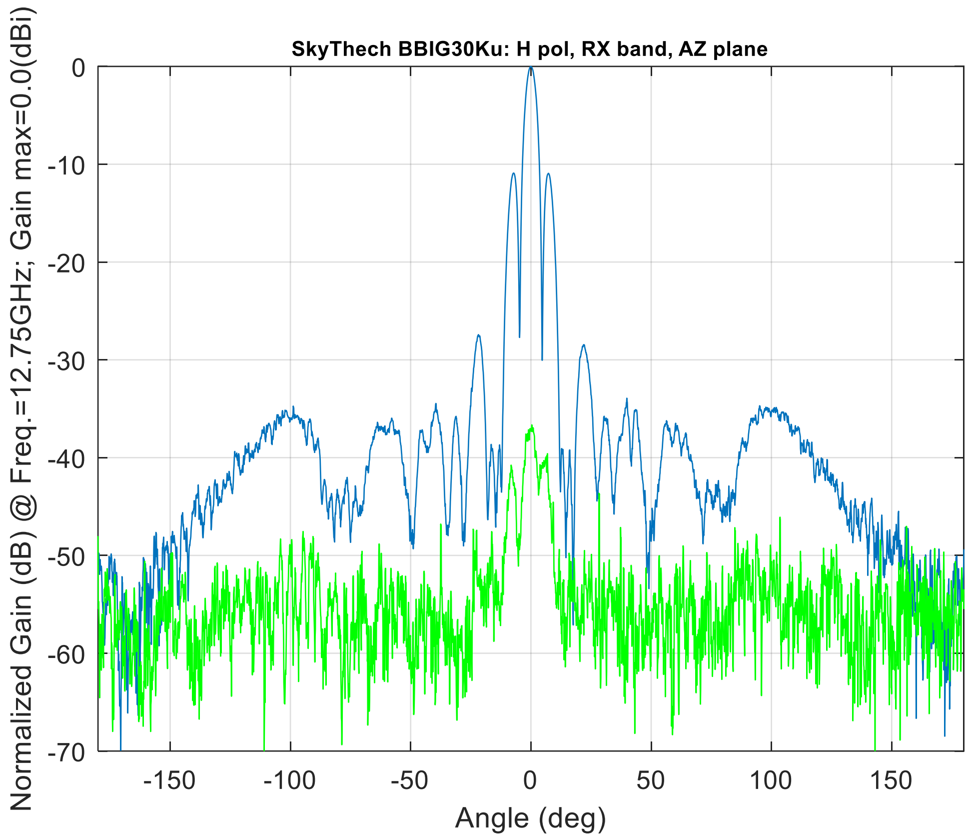
6.1.2: H-pol, AZ and EL plane plots.

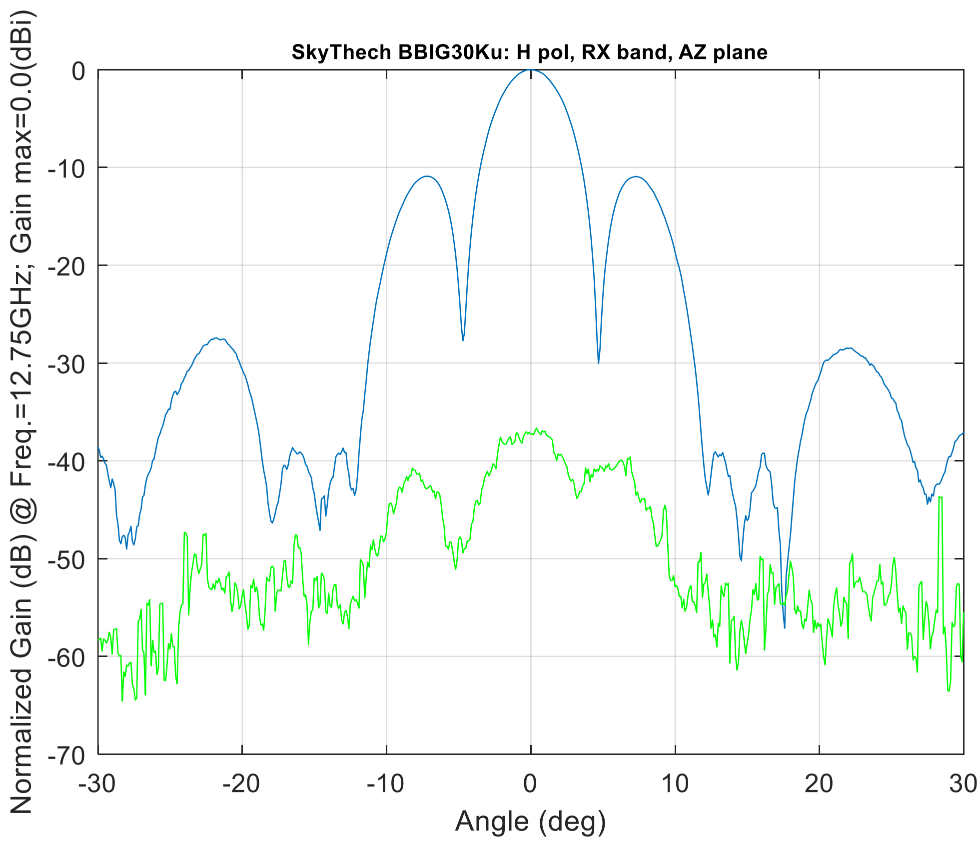


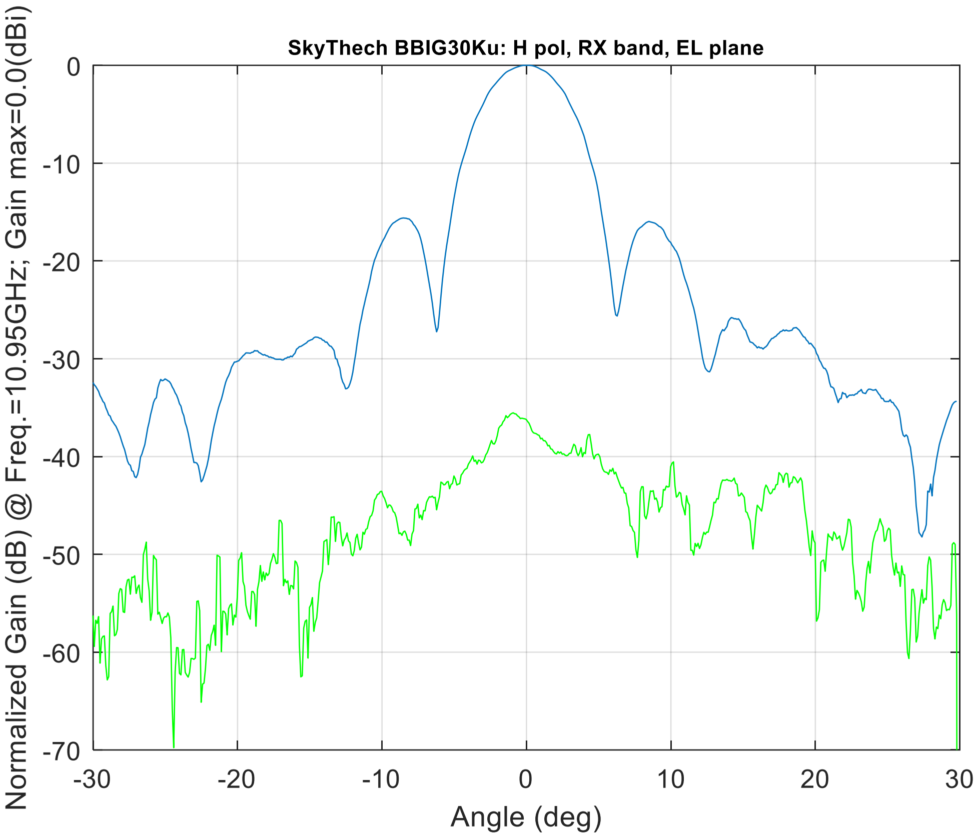


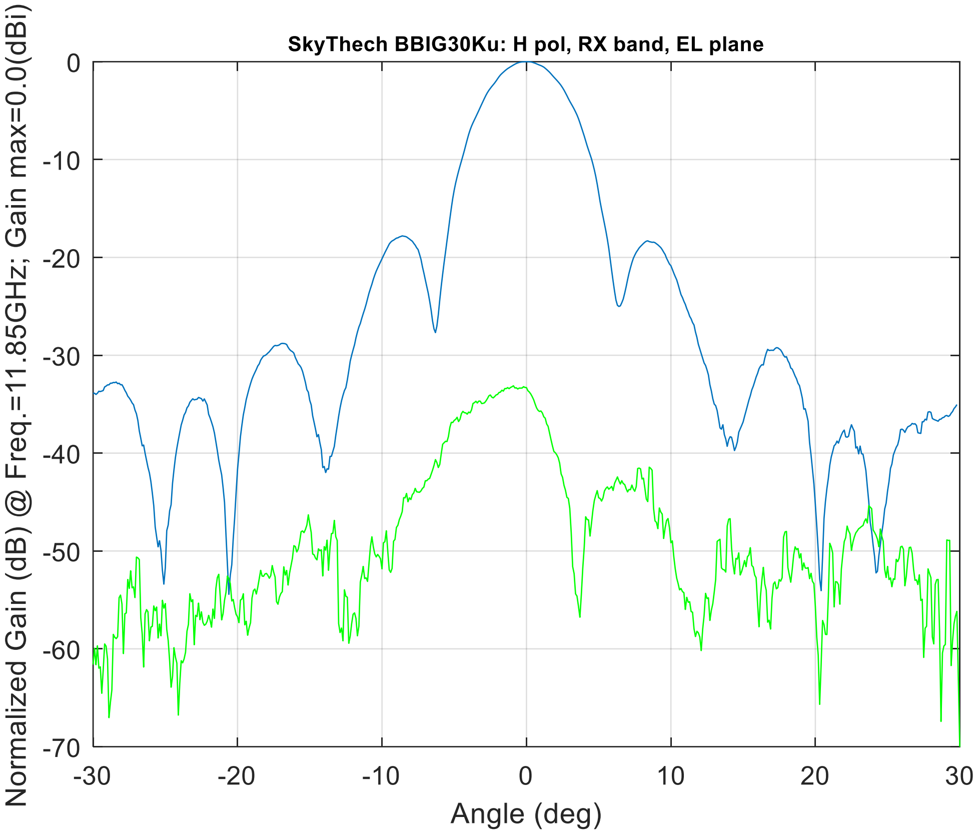

SkyThech BBIG30Ku: H pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=11.85GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

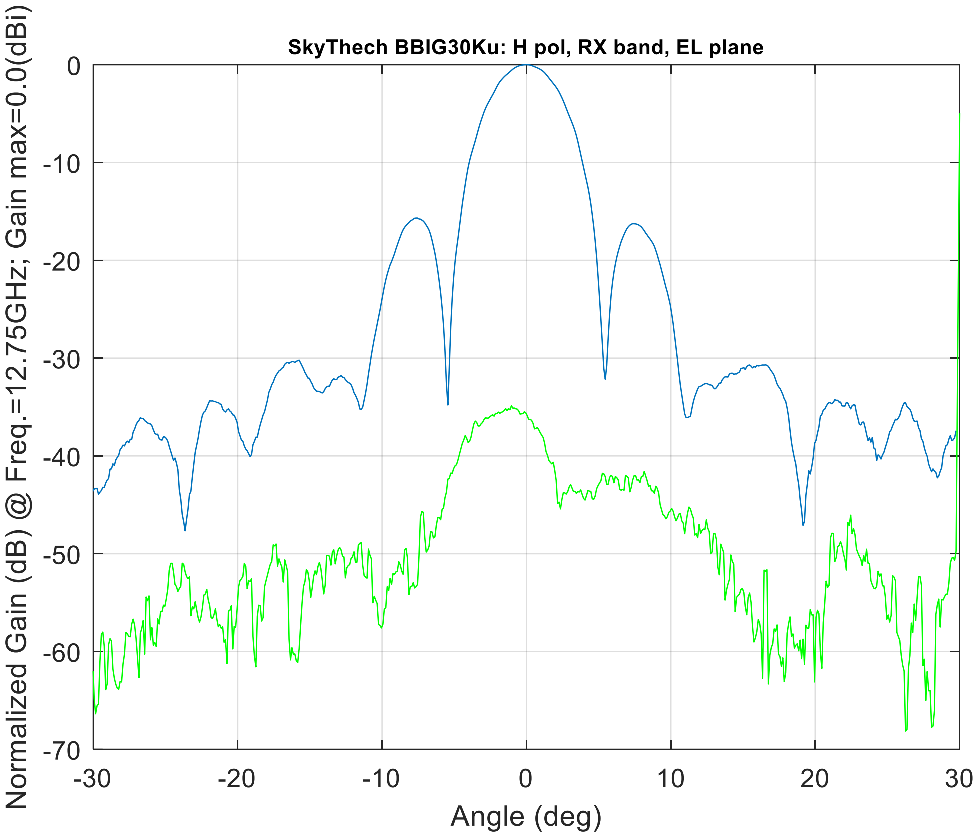

SkyThech BBIG30Ku: H pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=11.85GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30


SkyThech BBIG30Ku: H pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=12.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150
Angle (deg)


SkyThech BBIG30Ku: H pol, RX band, AZ plane
Normalized Gain (dB) @ Freq.=12.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

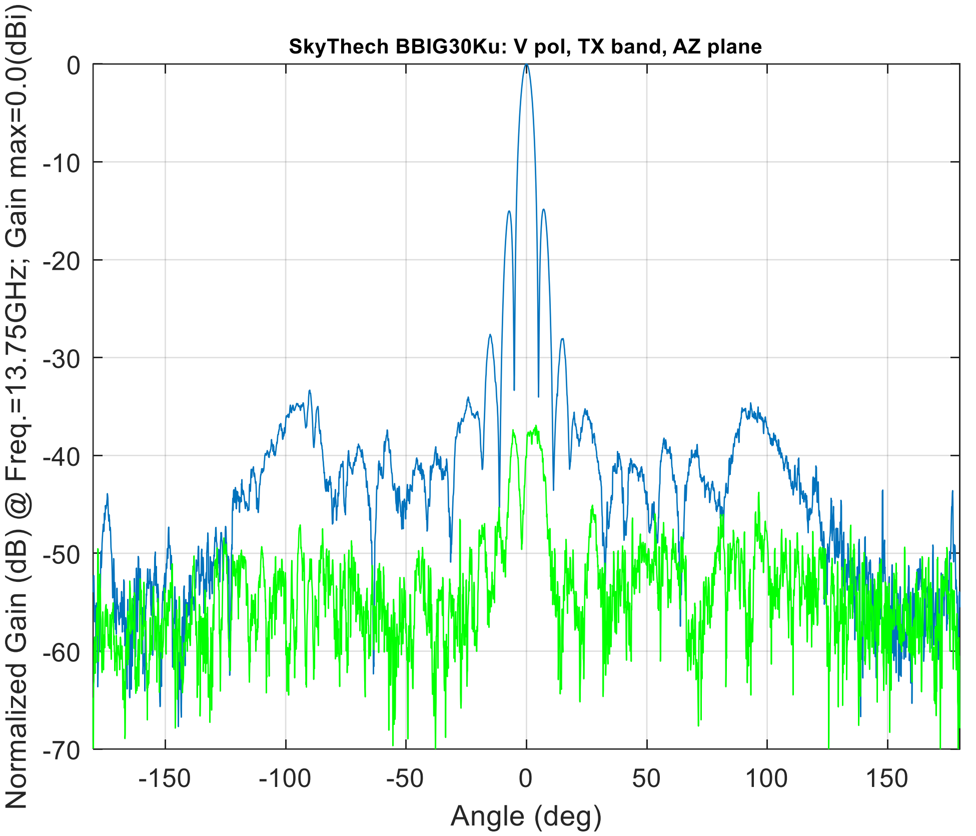

SkyThech BBIG30Ku: H pol, RX band, EL plane
Normalized Gain (dB) @ Freq.=10.95GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

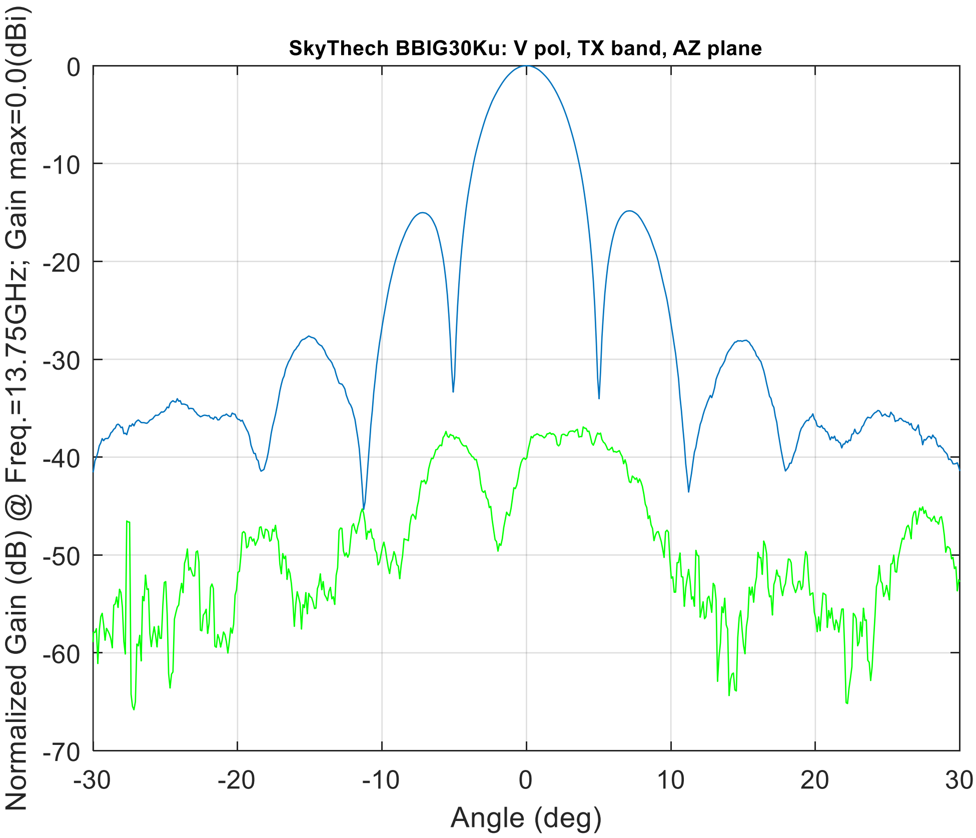

SkyThech BBIG30Ku: H pol, RX band, EL plane
Normalized Gain (dB) @ Freq.=11.85GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

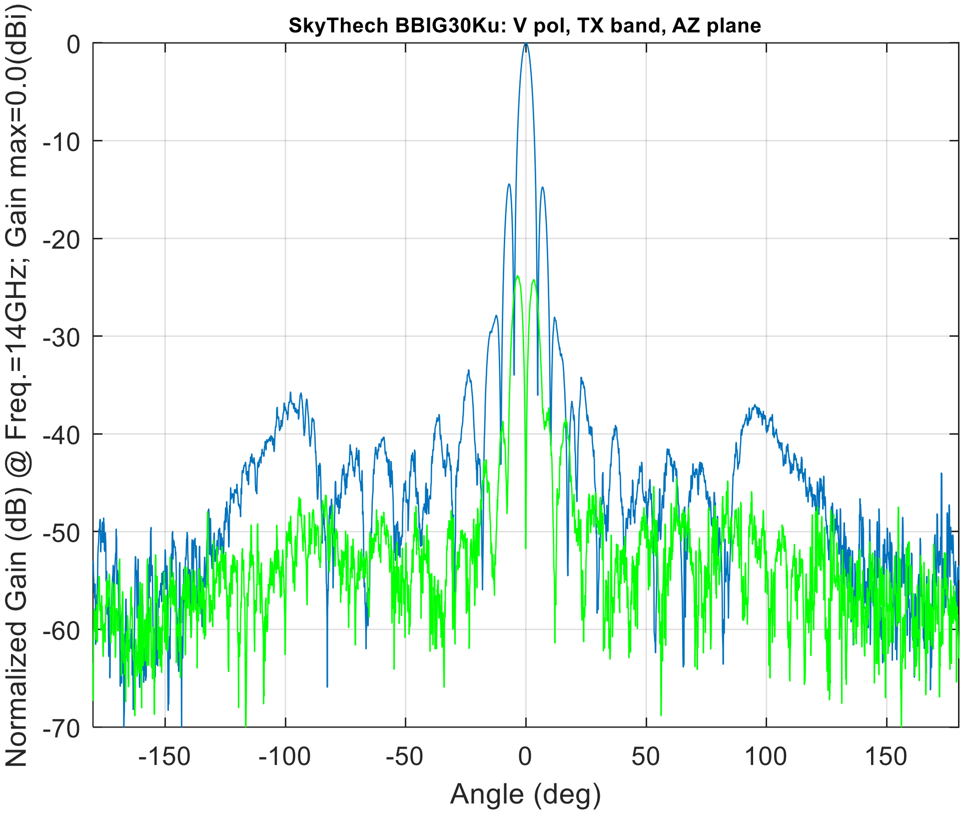

SkyThech BBIG30Ku: H pol, RX band, EL plane
Normalized Gain (dB) @ Freq.=12.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

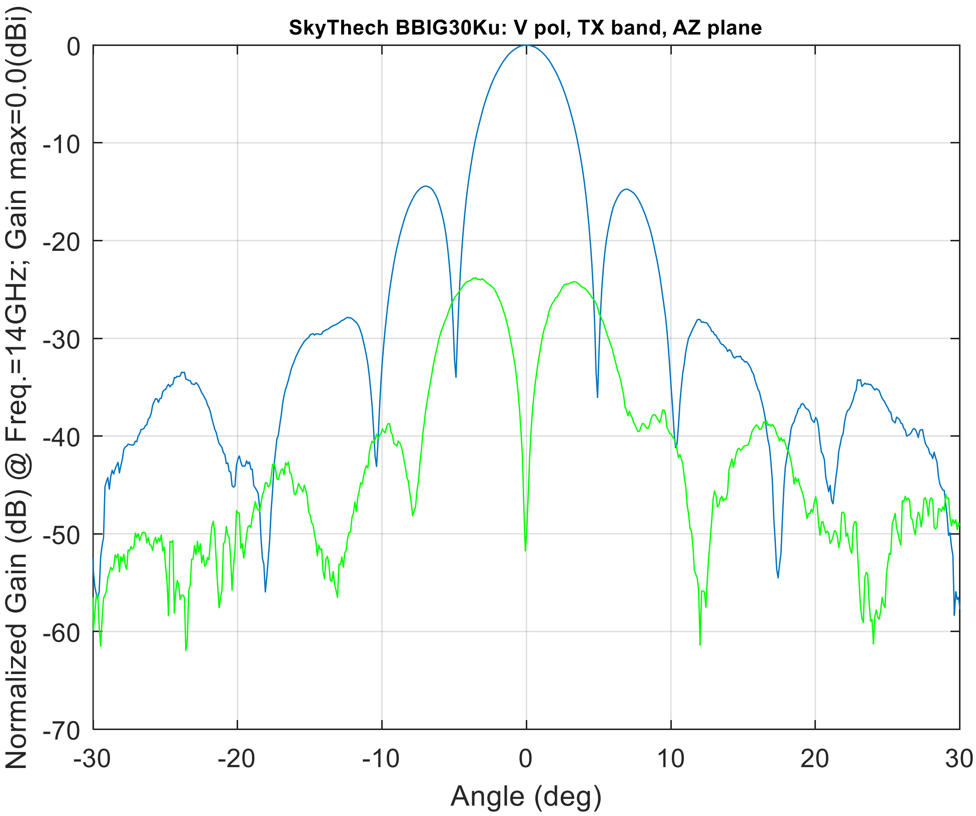
6.2: Radiation patterns in TX band (13.75-14.5 GHz) .

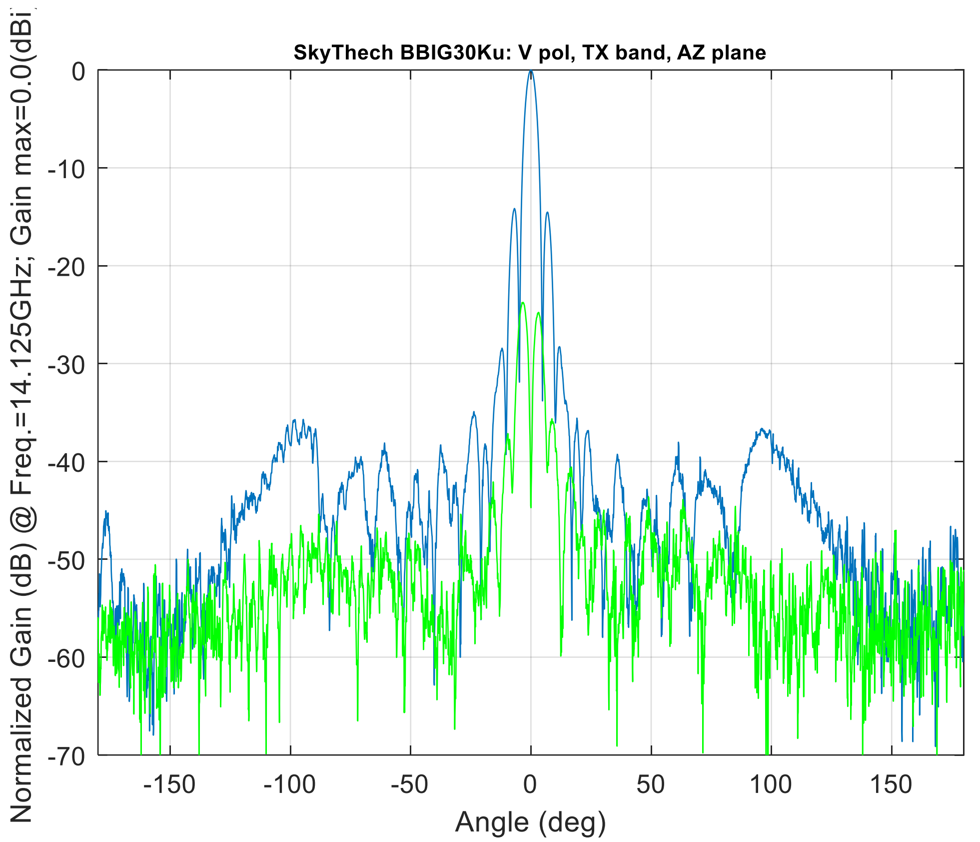
6.2.1: V-pol, AZ and EL plane plots.

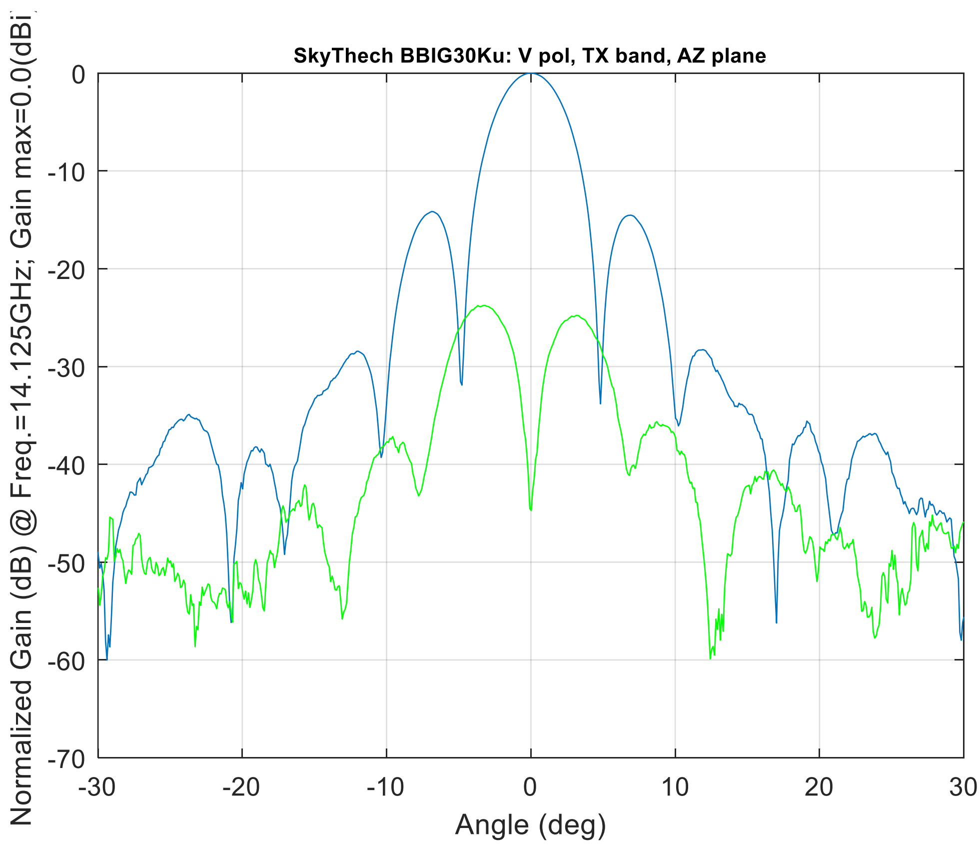


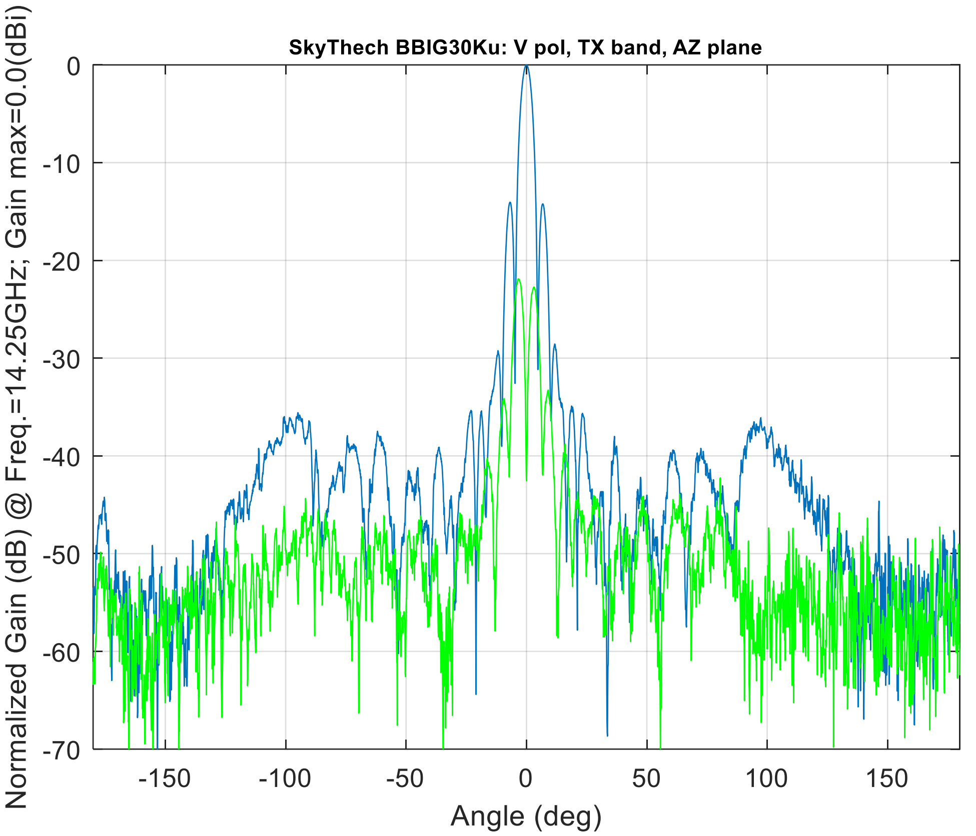


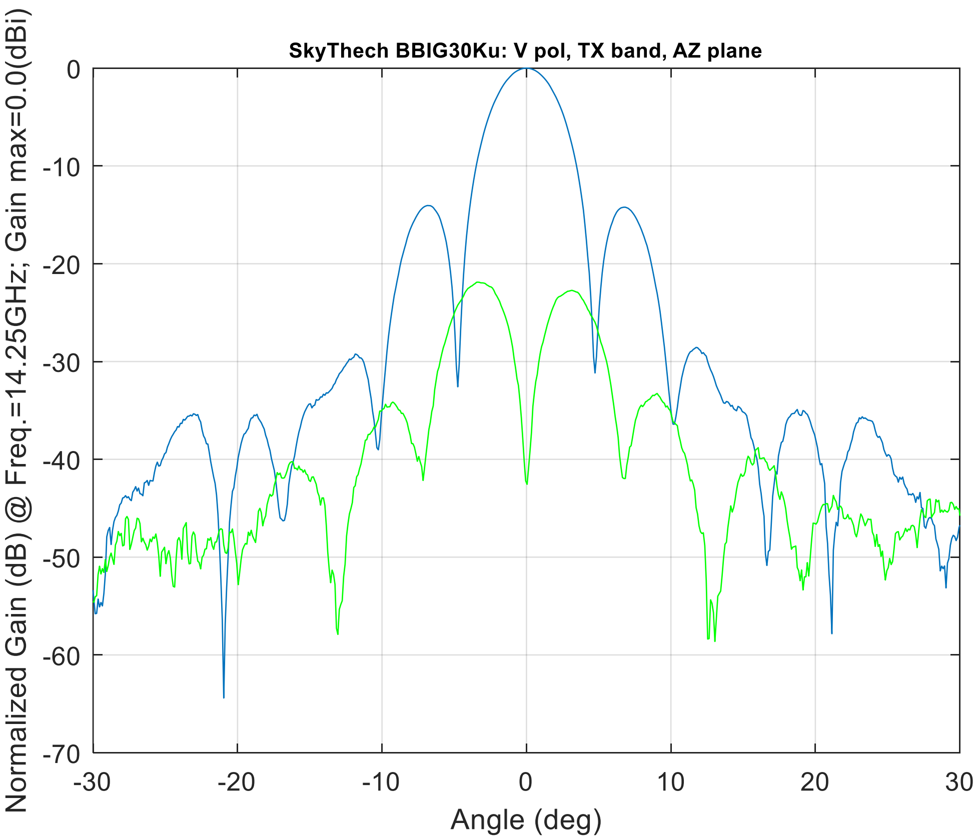

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

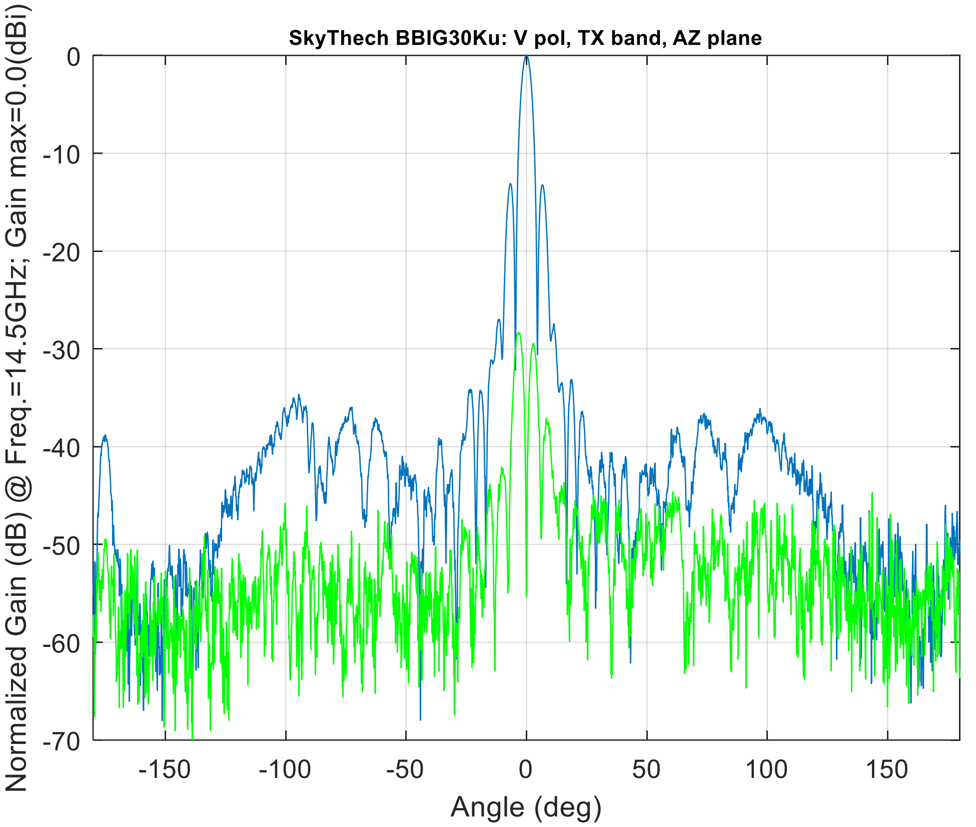

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

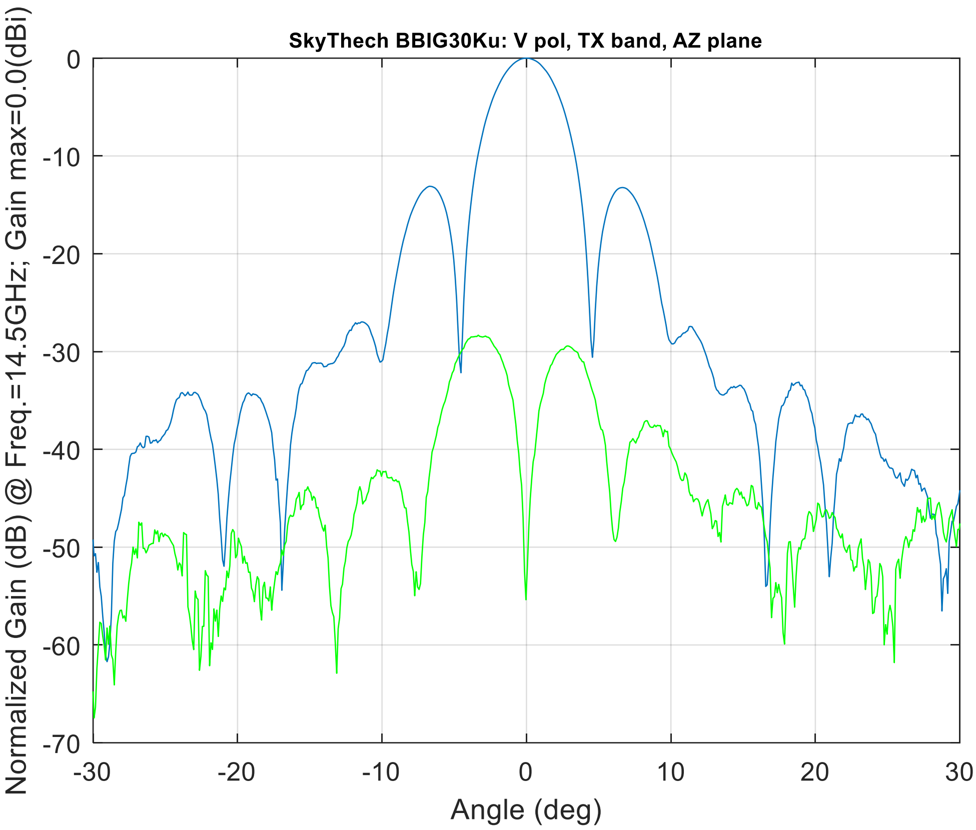

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.125GHz; Gain max=0.0(dBi
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

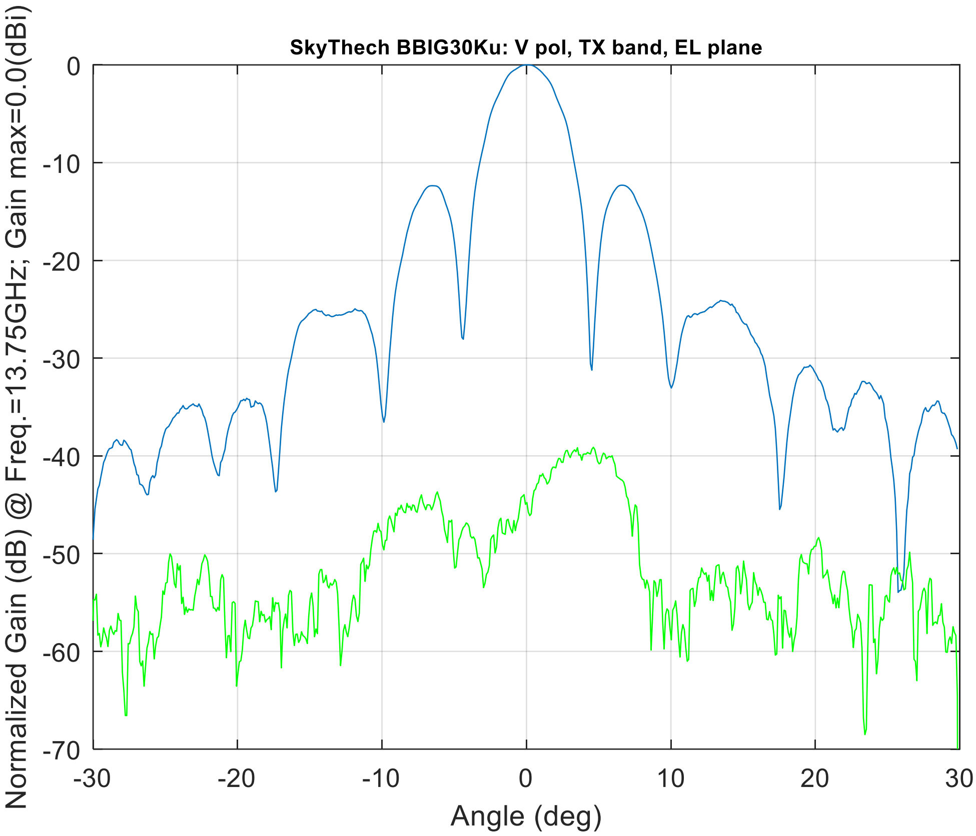

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.125GHz; Gain max=0.0(dBi
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

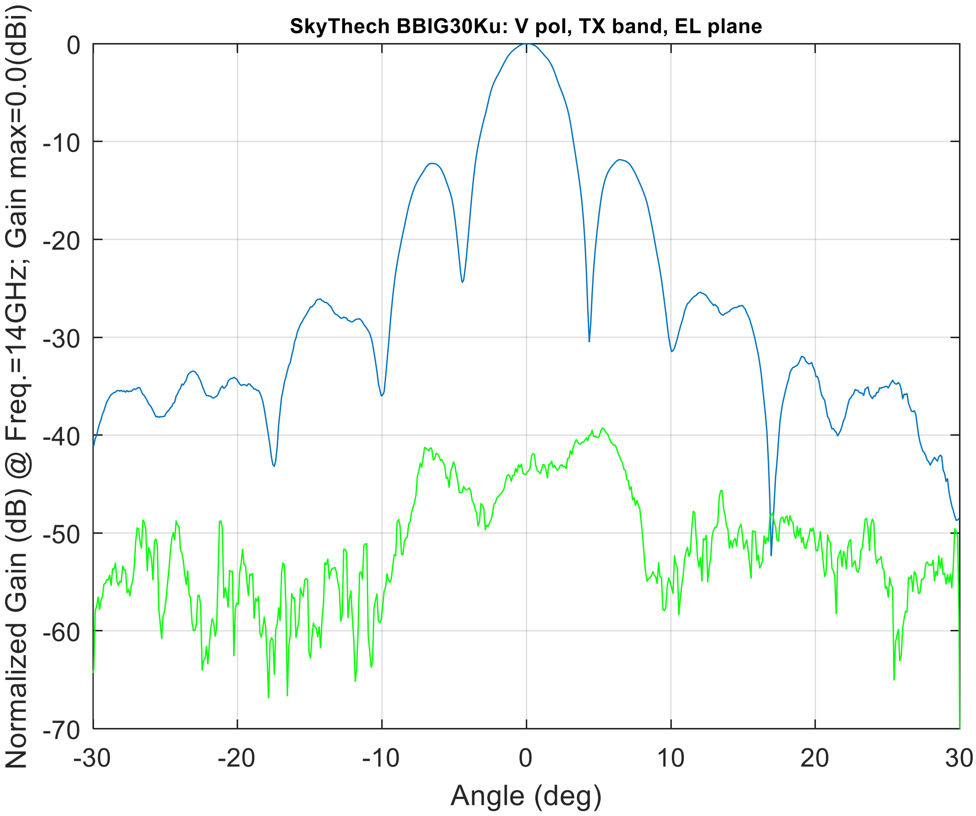

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.25GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

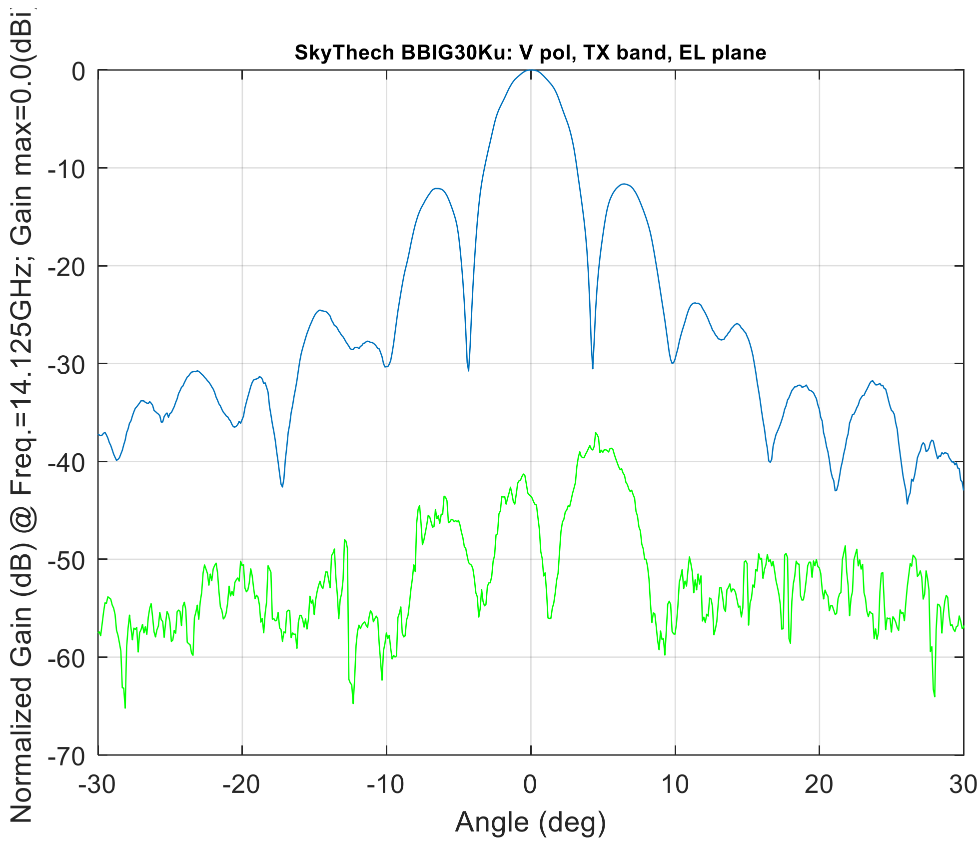

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.25GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

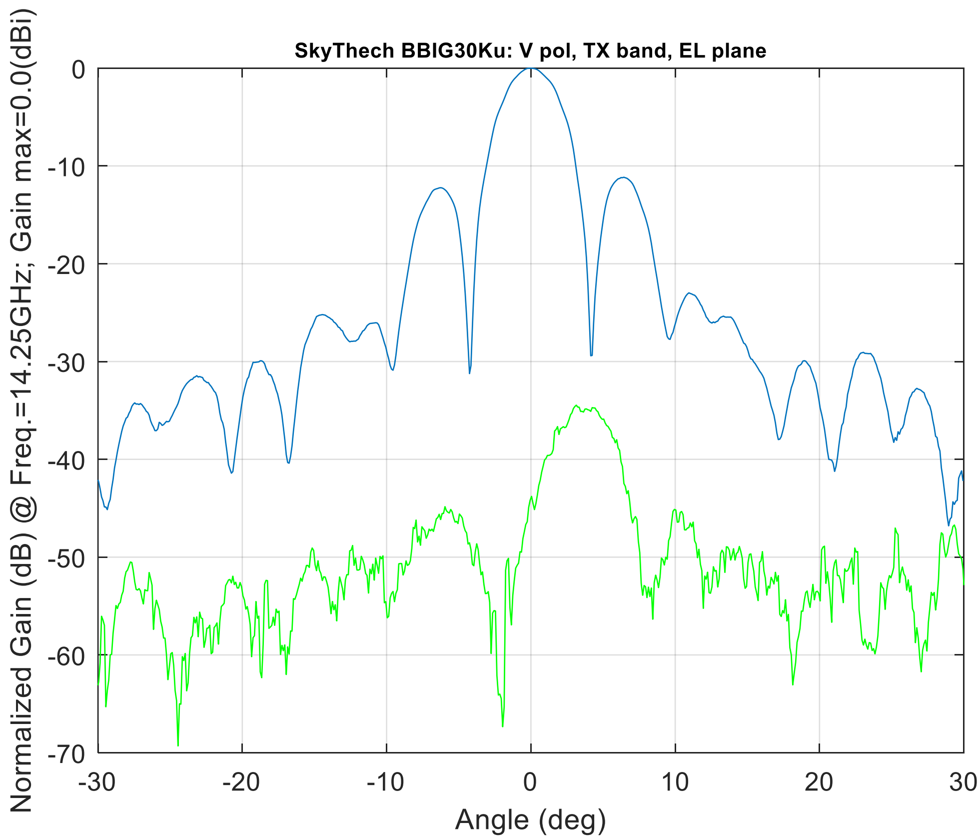

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.5GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150
Angle (deg)

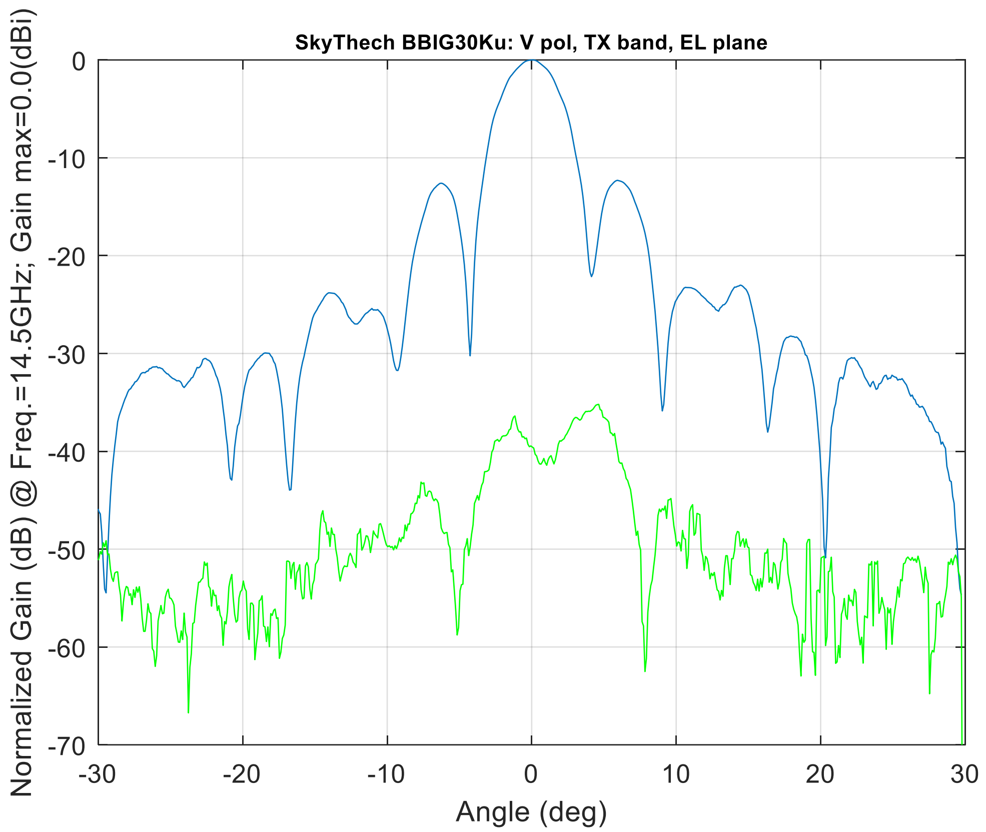

SkyThech BBIG30Ku: V pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.5GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)


SkyThech BBIG30Ku: V pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=13.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

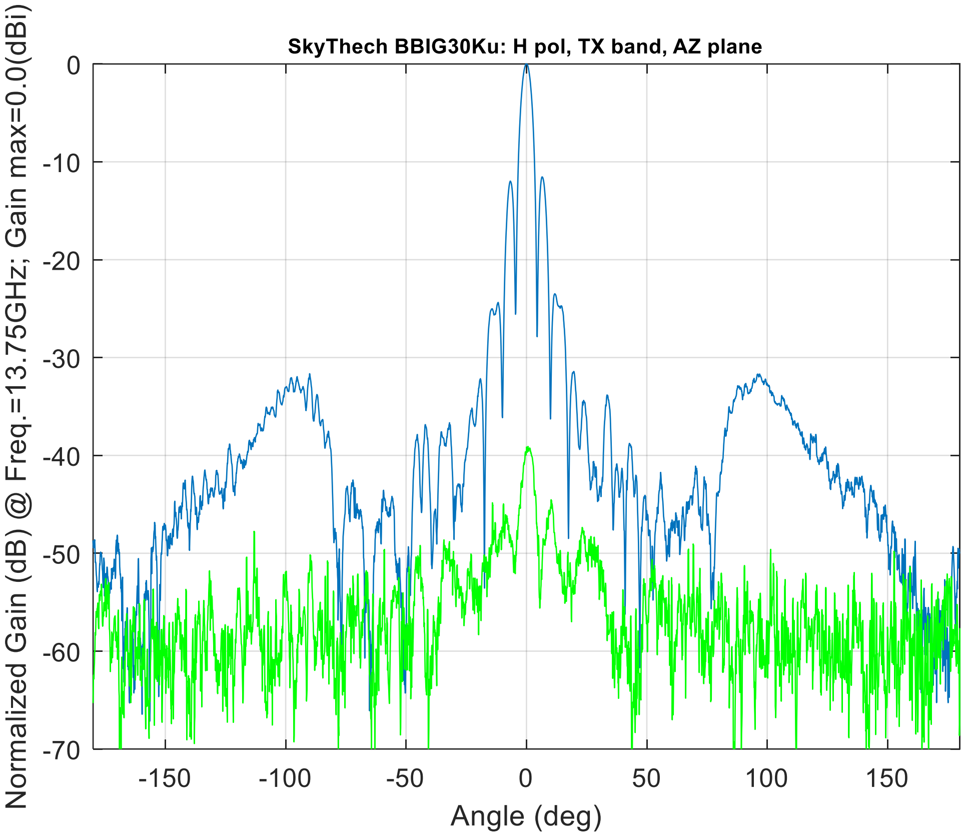

SkyThech BBIG30Ku: V pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

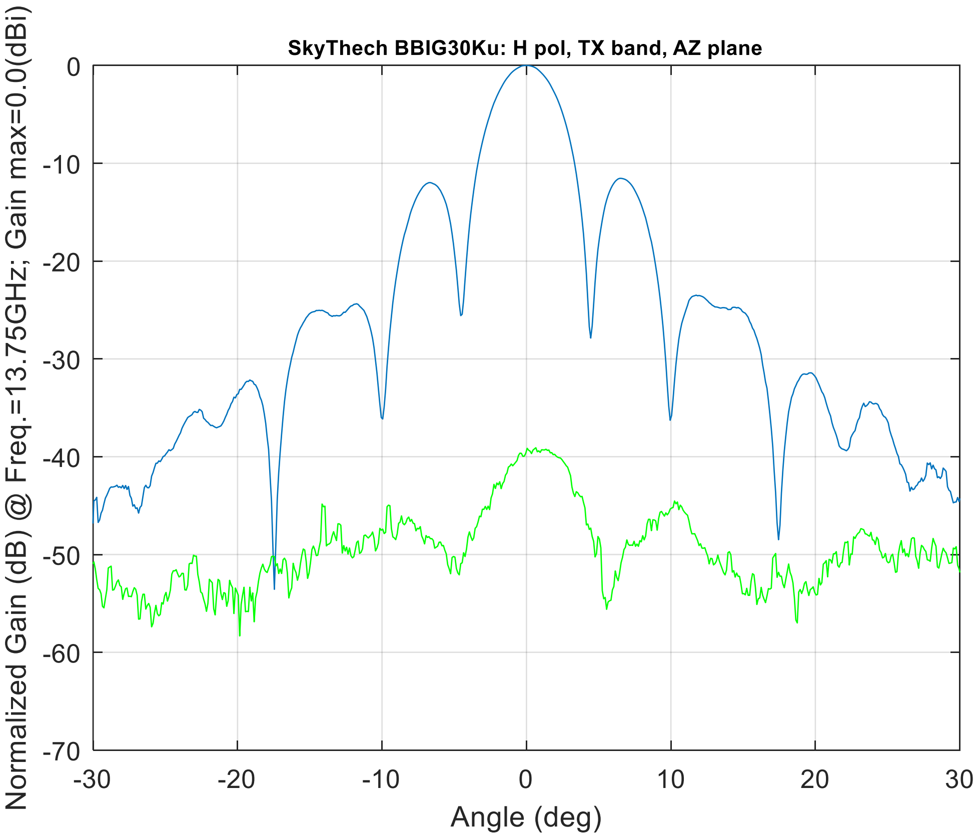

SkyThech BBIG30Ku: V pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14.125GHz; Gain max=0.0(dBi
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

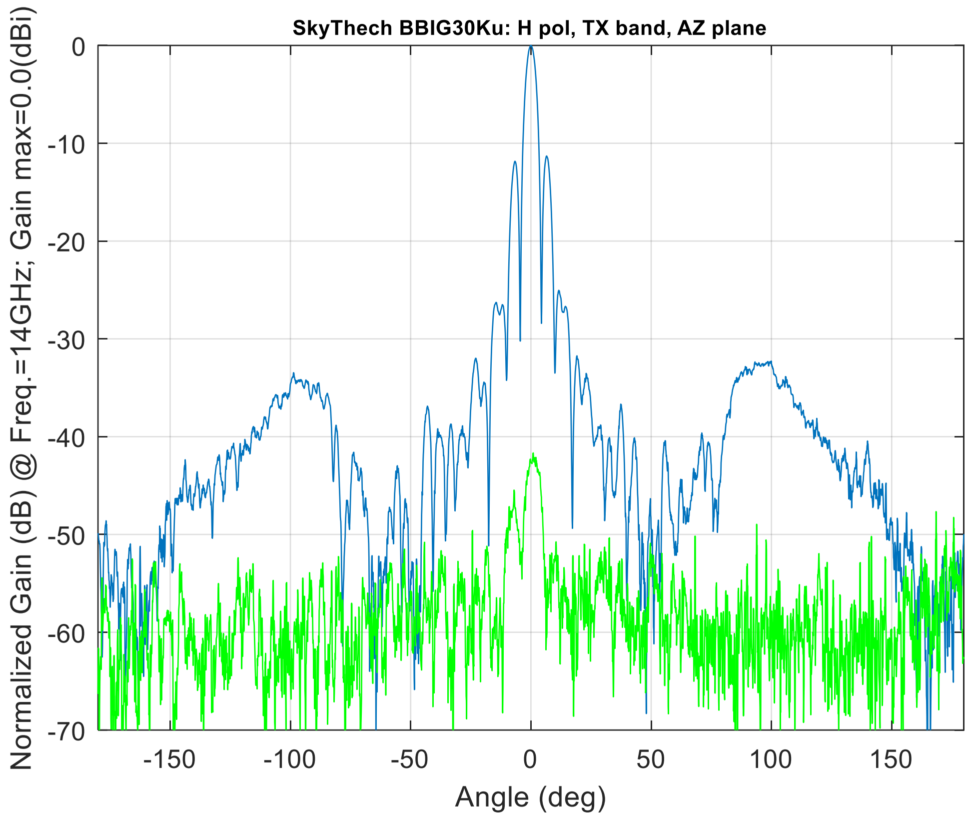

SkyThech BBIG30Ku: V pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14.25GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

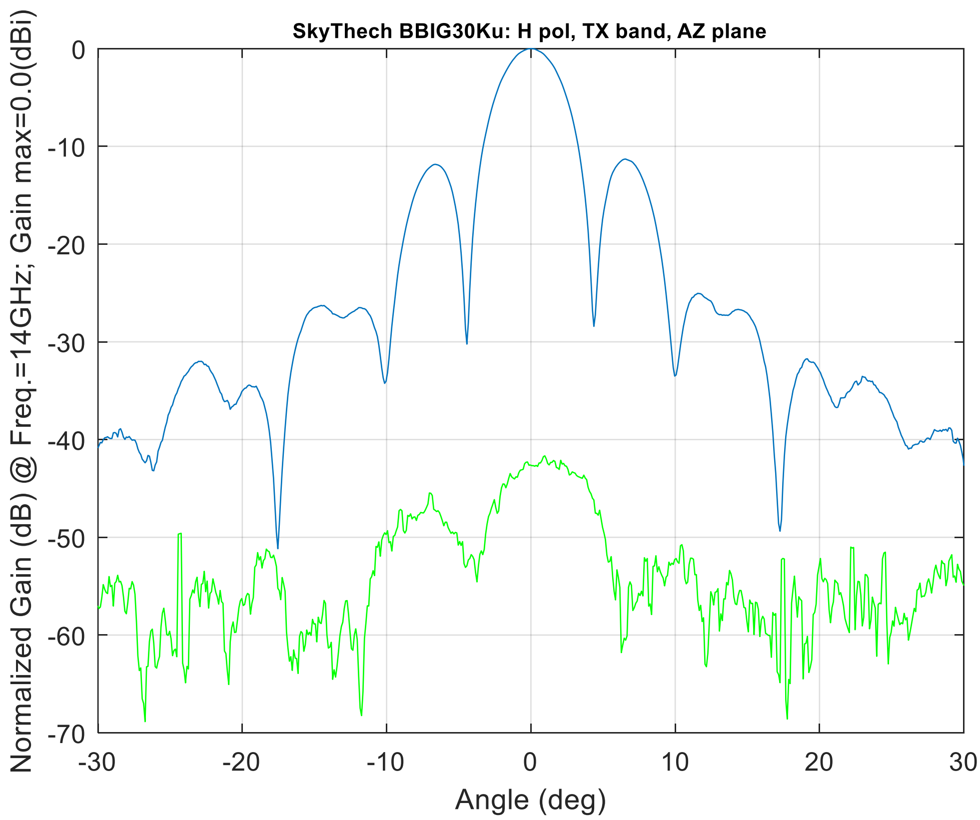

SkyThech BBIG30Ku: V pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14.5GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

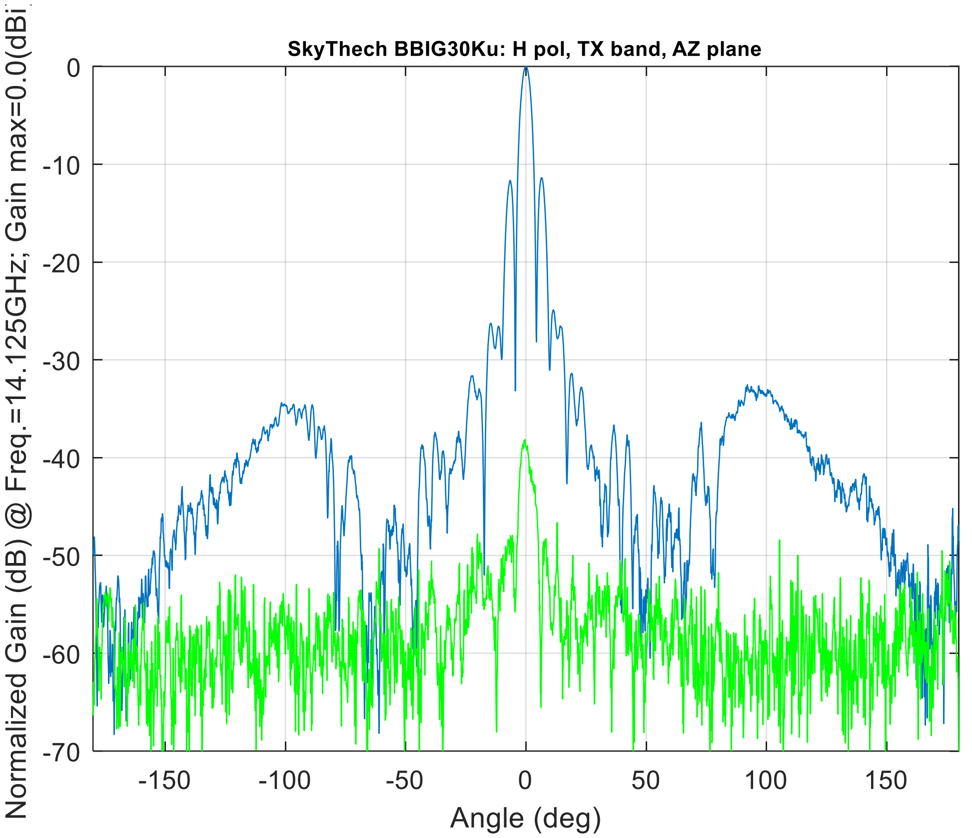
6.2.2: H-pol, AZ and EL plane plots.

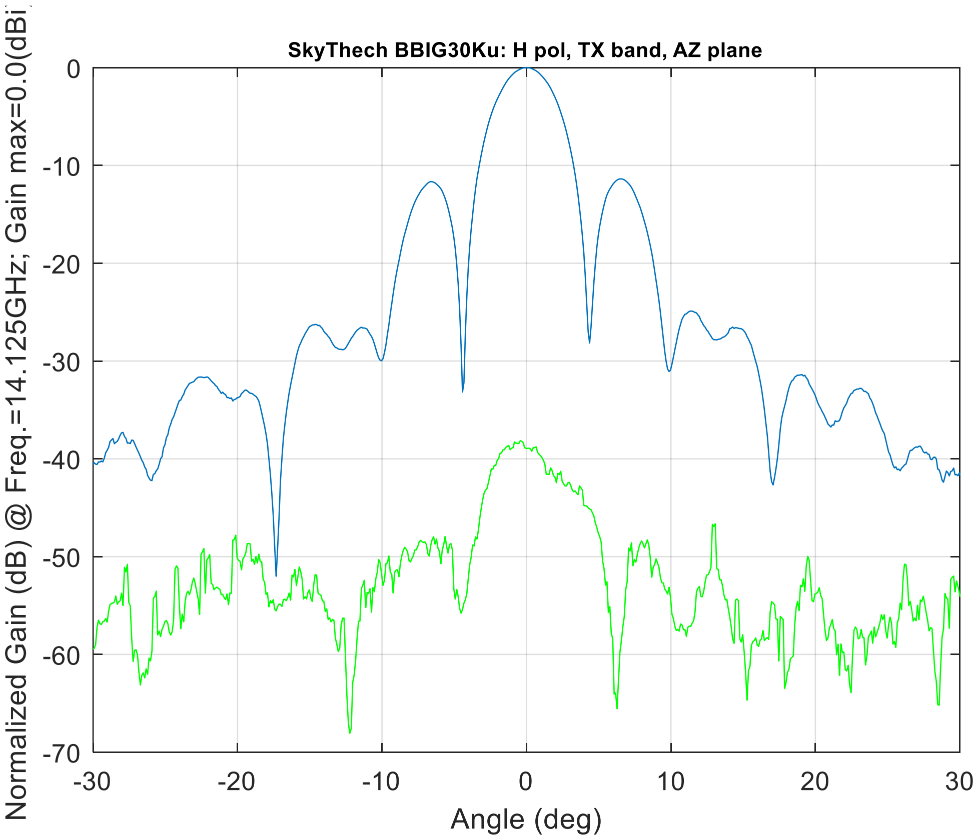


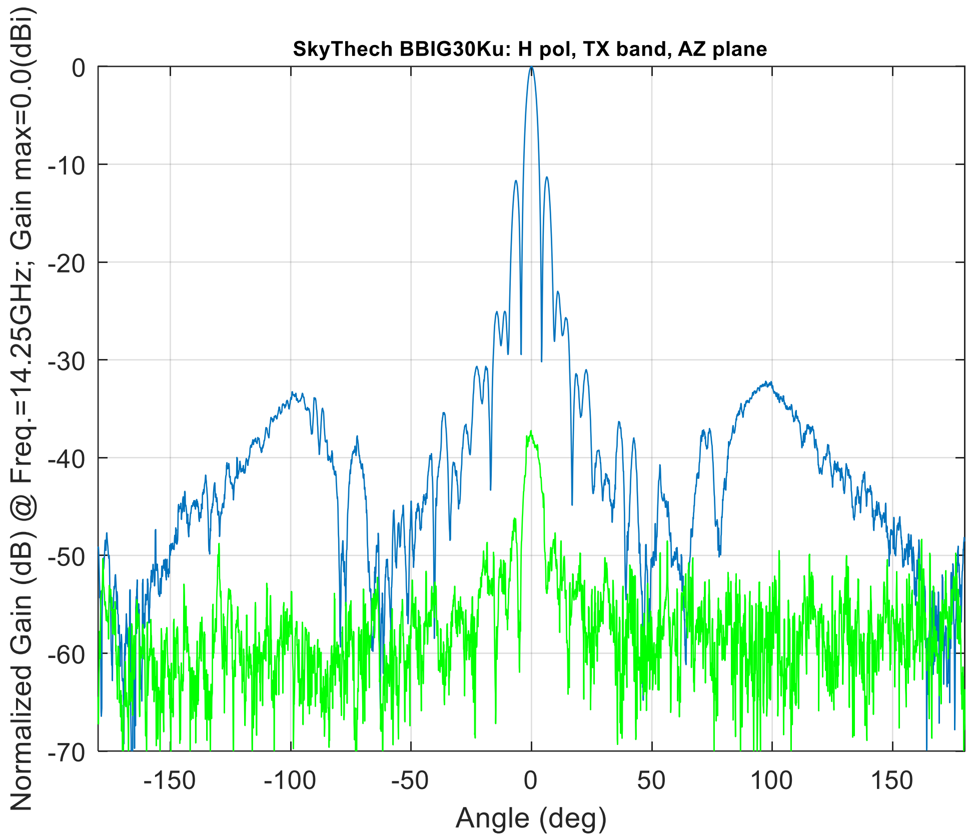


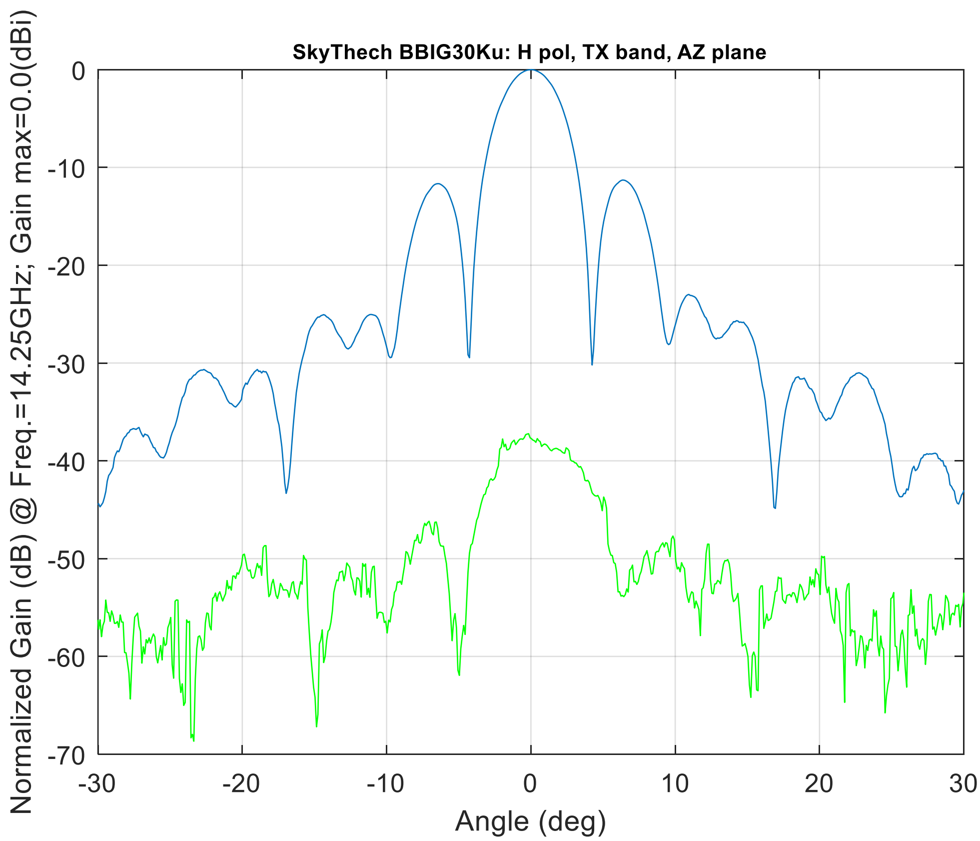

SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150
Angle (deg)

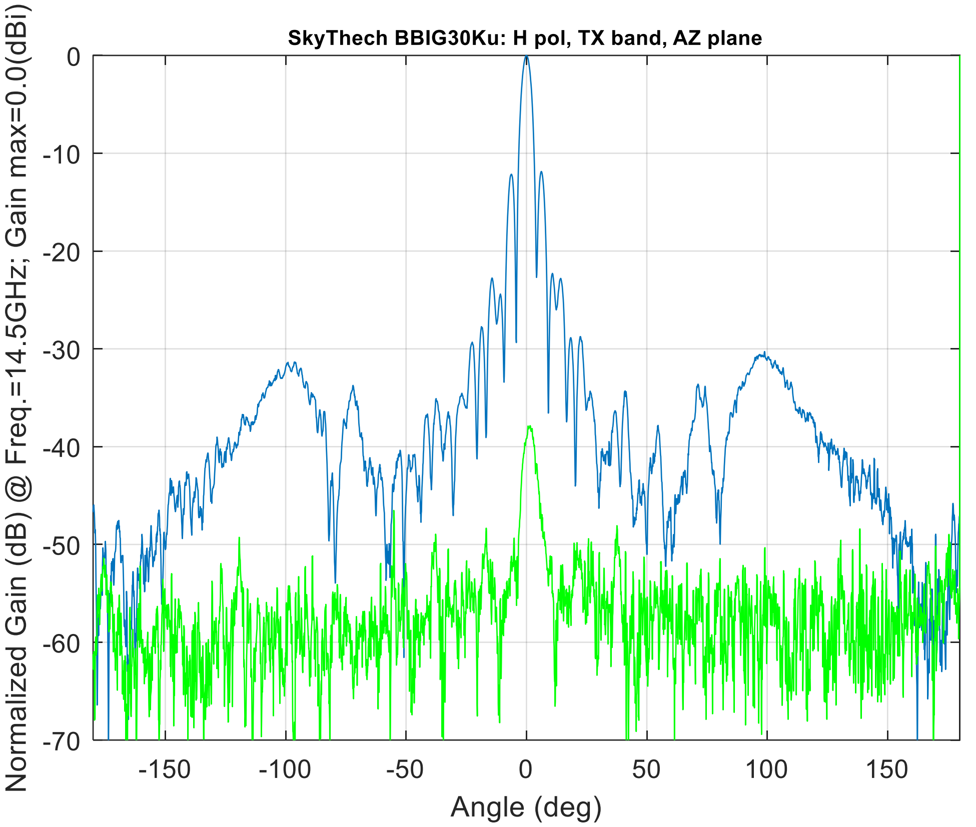

SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)

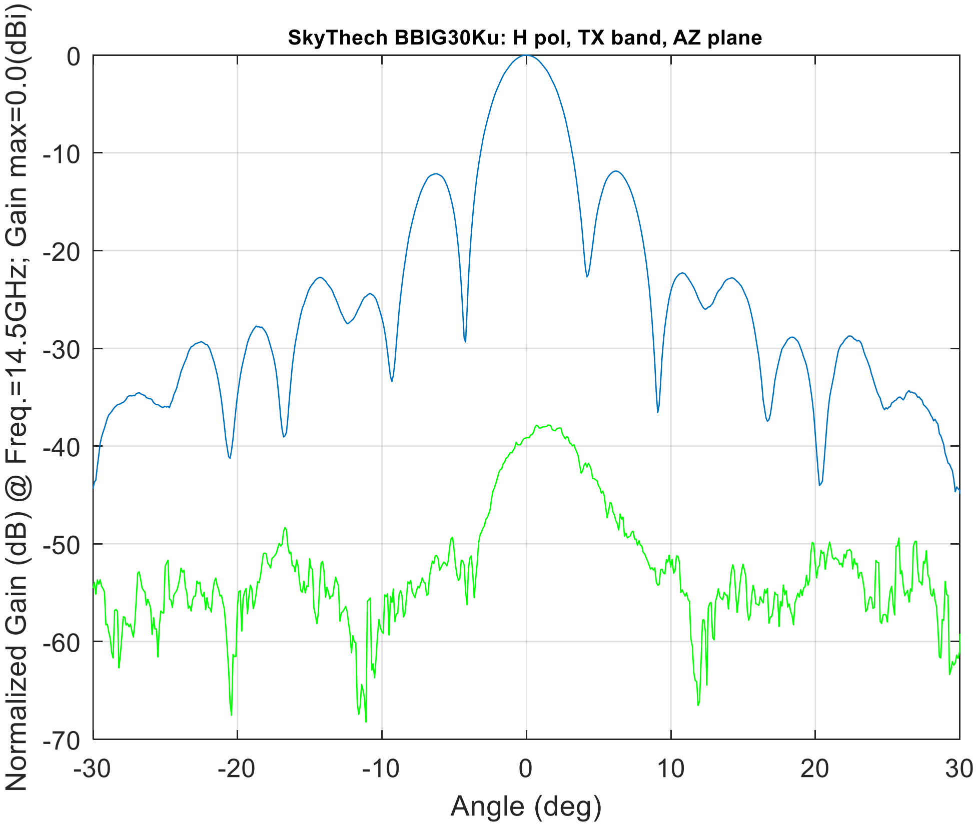

SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.125GHz; Gain max=0.0(dBi
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

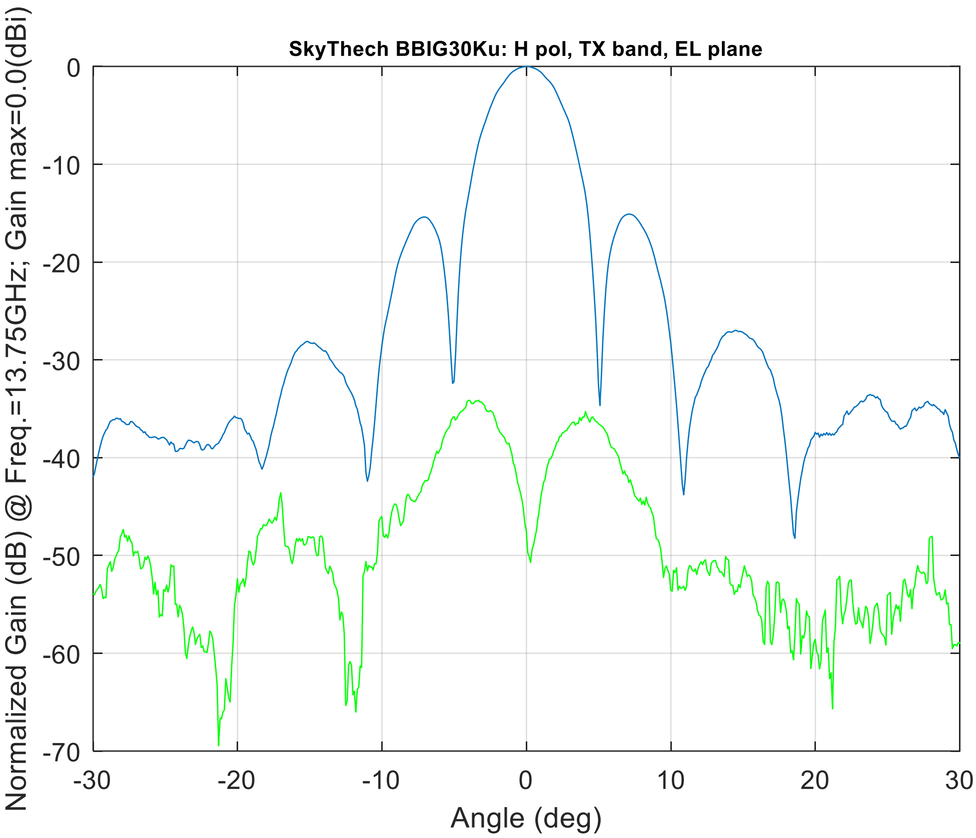

SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.125GHz; Gain max=0.0(dBi
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30


SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.25GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

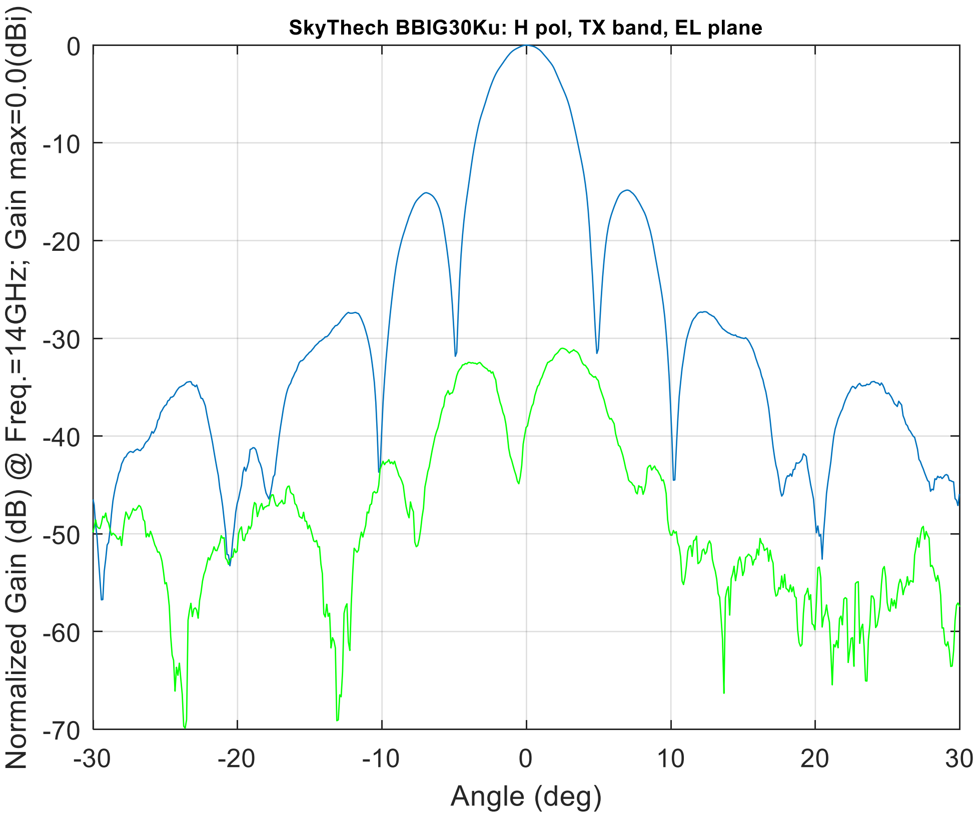

SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.25GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30


SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.5GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-150
-100
-50
0
50
100
150

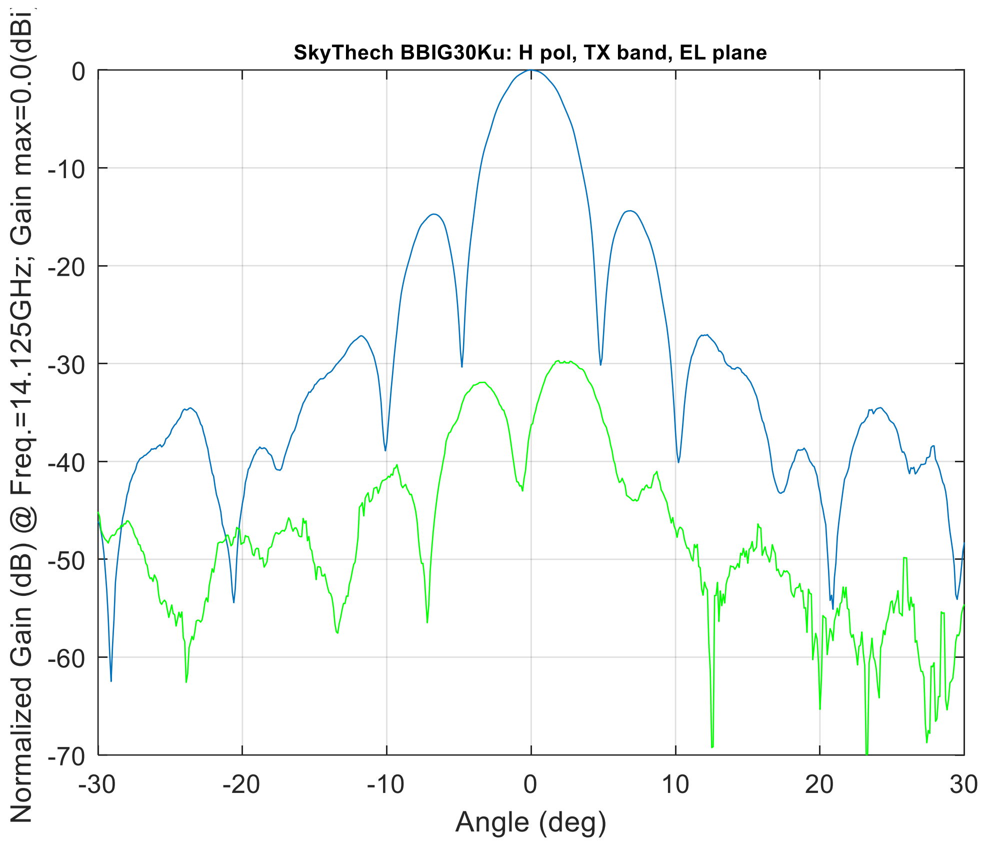

SkyThech BBIG30Ku: H pol, TX band, AZ plane
Normalized Gain (dB) @ Freq.=14.5GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30



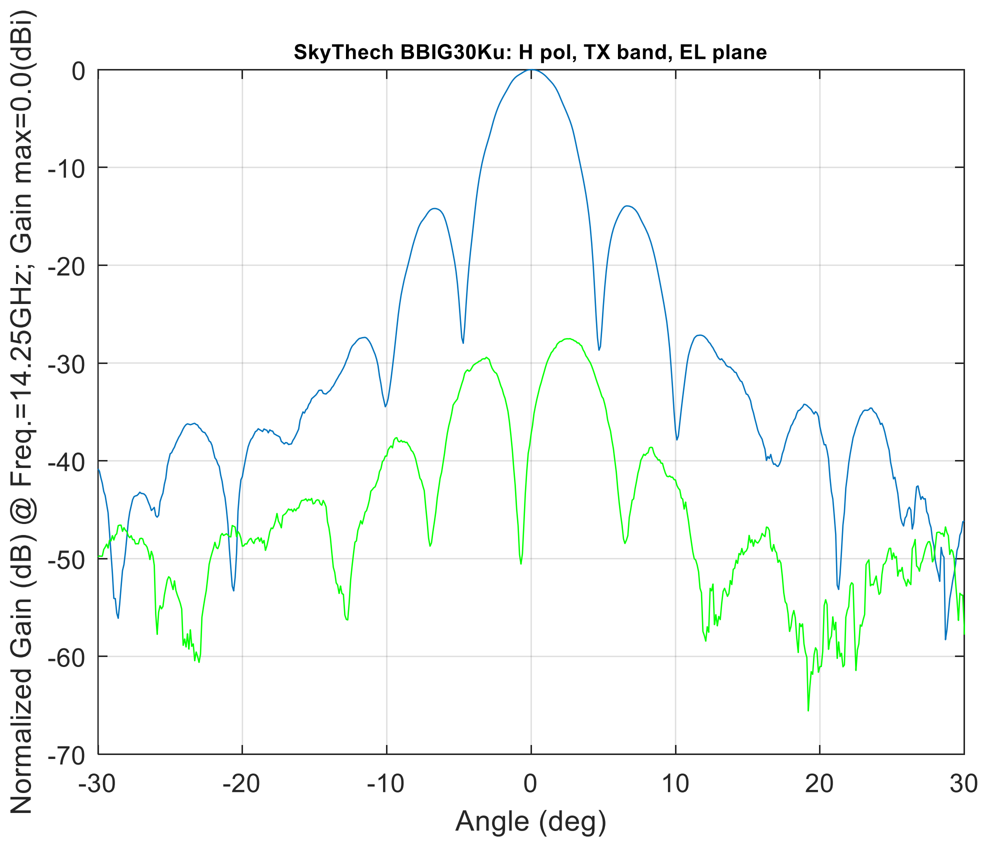
SkyThech BBIG30Ku: H pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=13.75GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)



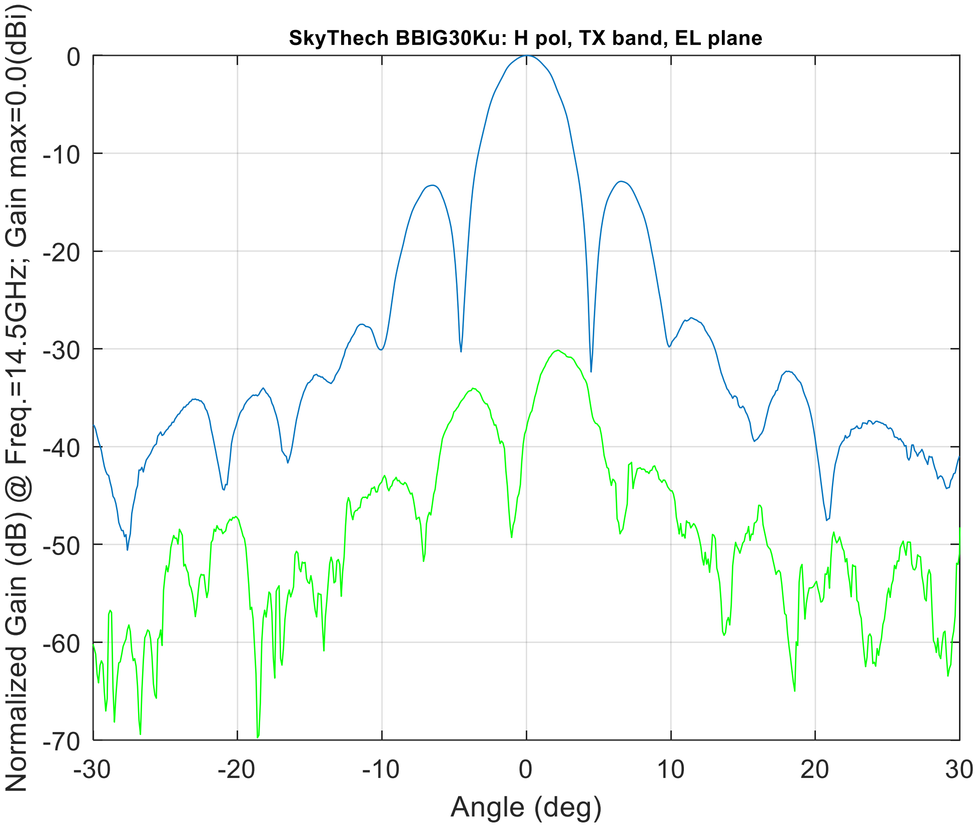
SkyThech BBIG30Ku: H pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)



SkyThech BBIG30Ku: H pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14.125GHz; Gain max=0.0(dBi
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)



SkyThech BBIG30Ku: H pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14.25GHz; Gain max=0.0(dBi)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30
Angle (deg)



SkyThech BBIG30Ku: H pol, TX band, EL plane
Normalized Gain (dB) @ Freq.=14.5GHz; Gain max=0.0(dBi)
Angle (deg)
0
-10
-20
-30
-40
-50
-60
-70
-30
-20
-10
0
10
20
30

CERTIFICATIONS

UltiSat Inc. ("UltiSat"), pursuant to Section 25.227 of the FCC's Rules, hereby certifies:

1. In accordance with Section 25.227(a)(15), as the operator of an ESAA system operating over international waters, UltiSat will operate consistent with Section 25.227(a)(1) of the Rules and has confirmed with its target space station operators that its existing and proposed operations are within coordinated parameters for adjacent satellites up to six degrees away (+/- 6°) on the geostationary arc.

2. In accordance with Section 25.227(b)(7), UltiSat certifies that its existing and proposed operations comply with the following requirements of Section 25.227:

   - Per Section 25.227(a)(6), for each ESAA transmitter, UltiSat will time annotate and maintain a record for a period of not less than one year of the vehicle location (i.e., latitude/longitude/altitude), transmit frequency, channel bandwidth and satellite used. Records will be recorded at time intervals no greater than one (1) minute while the ESAA is transmitting. UltiSat will make this data available in the requisite format within 24 hours of a request from the Commission, NTIA, or a frequency coordinator for purposes of resolving harmful interference events.
   - Per Section 25.227(a)(9), each ESAA terminal will automatically cease transmitting within 100 milliseconds upon loss of reception of the satellite downlink signal or when it detects that unintended satellite tracking has happened or is about to happen.
   - Per Section 25.227(a)(10), each ESAA terminal will be subject to the monitoring and control by an NCMC. Each terminal will be able to receive "enable transmission" and "disable transmission" commands from the NCMC and must automatically cease transmissions immediately on receiving any "parameter change command", which may cause harmful interference during the change, until it receives an "enable transmission" command from its NCMC. In addition, the NCMC will be able to monitor the operation of an ESAA terminal to determine if it is malfunctioning.
   - Per Section 25.227(a)(11), each ESAA terminal shall be self-monitoring and, should a fault which can cause harmful interference to FSS networks be detected, the terminal will automatically cease transmissions.

By:

/s/ David Bryant
David Bryant
Vice President
UltiSat Inc.

December 9, 2018