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

In the Matter of	)	
	)	
SES-17 S.à r.l.	)	File No. SAT-PPL-_____
	)	
Request for U.S.	)	
Market Access for SES-17	)	

PETITION

SES-17 S.à r.l. ("SES") hereby respectfully requests that the Commission authorize the Luxembourg-licensed SES-17 Ka-band spacecraft to serve the U.S. market from 67.1° W.L. At that location, the spacecraft will supplement the service being provided by the SES-10 Ku-band spacecraft at 66.9° W.L. Specifically, SES requests that the Commission:

1) add SES-17 to the Commission's Permitted Space Station List ("Permitted List") for fixed-satellite service ("FSS") in conventional Ka-band spectrum, 18.3-18.8 GHz; 19.7-20.2 GHz, 28.35-28.6 GHz, and 29.25-30 GHz, and for telemetry, tracking and control ("TT&C") operations in the following conventional Ku-band frequencies: telemetry carriers at 11704.5 MHz and 12195.5 MHz and command carriers at 14003.0 MHz, 14005.0 MHz, and 14497.0 MHz;

2) permit U.S. earth stations to communicate with SES-17 Ka-band capacity in the 17.3-18.3 GHz; 18.8-19.7 GHz; 27.5-28.35 GHz; and 28.6-29.25 GHz bands for FSS and for reception of a TT&C beacon at 19699.1 MHz.[1]

Grant of the requested authority is consistent with Commission precedent and will serve the public interest by allowing SES to expand its services at the nominal 67° W.L. orbital location.

[1] The satellite is also capable of operating in the 27.0-27.5 GHz band, but SES does not seek authority to provide service in the United States using these frequencies.

A completed FCC Form 312 is attached, along with technical materials on Schedule S and in narrative form pursuant to Section 25.114 of the Commission's rules. Construction of SES-17 began over a year ago, and launch of the spacecraft is currently scheduled to occur in 2021. SES seeks action on this petition consistent with that schedule.

I. BACKGROUND

SES-17 S.à r.l. is a Luxembourg subsidiary of SES S.A., which through its subsidiaries provides valuable satellite services across the United States, the Americas and around the globe. SES-17 represents the next step in SES's global network of high-throughput satellites to support high data rate fixed and mobile services. Designed and being manufactured by Thales Alenia Space, SES-17 will include a powerful Digital Transparent Processor, which will allow SES to offer customers extraordinary efficiency and unrivalled flexibility in bandwidth management capabilities. Equipped with 152 user spot beams, the fully digital satellite will provide mobility customers in particular with an unsurpassed ability to efficiently and flexibly modify their networks in real time in response to changing bandwidth demands. The satellite will also host larger Atlantic beams and Field of View beams to ensure constant connection for mobility customers travelling over the ocean.

The table below identifies the frequencies that will be used for each of the beam types.

Service	Earth-to-Space Frequencies	Space-to-Earth Frequencies
Gateway Beams	27.5-30.0 GHz	17.3-20.2 GHz
Service Spot Beams	27.5-30.0 GHz	17.8-20.2 GHz
Atlantic Beams	29.3-29.5 GHz	19.4-19.7 GHz
Field of View Beams	29.3-29.5 GHz	19.3-19.4 GHz

The SES-17 frequencies will operate under the following ITU filings submitted by the Grand Duchy of Luxembourg and The Netherlands: LUX-G8-47, LUX-G9-49, LUX-G11-49 (and LUX-G11-49-1), and NSS-83A.

II. AUTHORIZING SES-17 TO PROVIDE FSS IN THE U.S. IS CONSISTENT WITH COMMISSION POLICIES AND THE PUBLIC INTEREST

SES is a leading provider of satellite communications services in the United States and around the world. The application to serve the U.S. using the proposed SES-17 satellite reflects SES's continuing commitment to meeting the existing and future needs of customers. Granting U.S. market access for SES-17 will enable SES to introduce new services, with an emphasis on the growing aeronautical market, to U.S. customers from the 67.1° W.L. orbital location. Furthermore, grant of market access for SES-17 is consistent with the Commission's *DISCO II* policies.[2]

In the *DISCO II* proceeding, the Commission adopted a framework for determining whether to permit foreign-licensed satellites to serve the U.S. market, and these standards are codified in Section 25.137 of the Commission's Rules.[3] The Commission's policies are intended to ensure that entry by a foreign-licensed satellite will not distort competition in the United States.[4] The Commission also considers whether there are spectrum availability issues or concerns relating to national security, law enforcement, foreign policy, or trade that would present an obstacle to U.S. market access.[5] SES's market access requests for

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[2] *See Amendment of the Commission's Policies to Allow Non-U.S. Licensed Space Stations providing Domestic and International Service in the United States*, Report & Order, 12 FCC Rcd 24094 (1997) ("*DISCO II*").

[3] 47 C.F.R. § 25.137.

[4] *DISCO II* at ¶ 7.

[5] *See id.* at ¶ 178.

SES-17 – to add SES-17 to the Permitted List for FSS in the conventional Ka-band and for TT&C in the conventional Ku-band, and to authorize use of other spectrum available on the satellite for FSS including TT&C – fully comply with Commission requirements.

In *DISCO II*, the Commission adopted a presumption that, with respect to services covered by the WTO agreement, entry into the U.S. market by entities licensed by WTO member countries will promote competition in the U.S. market.[6] FSS operations except for DTH are covered by the WTO agreement.[7]

SES seeks authority to use SES-17 to provide FSS services to U.S. customers. Luxembourg, the licensing administration for SES-17, is a WTO-member country. Accordingly, the SES proposal to provide WTO-covered services is subject to the presumption in favor of entry described above.

Allowing SES to use SES-17 to offer FSS to, from, and within the U.S. will promote competition and is otherwise consistent with the *DISCO II* framework. Therefore, the Commission should add SES-17 to the Permitted List for FSS in the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz, and 29.25-30 GHz conventional Ka-band frequencies as well as for TT&C operations in the conventional Ku-band.

Furthermore, the Commission applies the same framework that governs requests for addition to the Permitted List to petitions seeking U.S. market access for bands other than the conventional Ku- and Ka-bands.[8] Accordingly, the Commission should also authorize SES-17 to offer FSS capacity in the United States using additional Ka-band spectrum: 17.3-18.3 GHz, 18.8-

[6] *Id.* at ¶ 39.

[7] *Id.* at ¶¶ 25 & 30.

[8] *Id.* at ¶ 192.

19.7 GHz, 27.5-28.35 GHz, and 28.6-29.25 GHz. Operations in these frequencies will adequately protect U.S.-authorized satellite and terrestrial systems from interference. In the Technical Appendix filed with this application, SES demonstrates that:

- SES-17 will comply with applicable Commission and International Telecommunication Union ("ITU") power flux density ("pfd") limits developed to ensure that satellite downlink transmissions do not adversely affect terrestrial services and other satellite earth stations communicating in the same spectrum in the uplink direction.

- SES will limit the SES-17 downlink equivalent isotropically radiated power ("EIRP") levels and comply with other Commission requirements to prevent unacceptable interference to adjacent satellites.

- SES has selected SES-17 gateway locations that are sufficiently separated from other authorized facilities, including other earth stations and licensed Local Multipoint Distribution Service ("LMDS") networks, to ensure that the gateways will not cause or receive harmful interference that disrupts reception. SES also recognizes that it will be unprotected from interference due to future authorized operations in spectrum where FSS systems are secondary.

- SES will coordinate with entities authorized to operate Ka-band non-geostationary orbit ("NGSO") FSS satellite systems as required to ensure that SES-17 does not cause harmful interference to such systems in NGSO-primary spectrum and will accept any interference caused by such systems in those bands.

- SES will coordinate SES-17's operations with entities authorized to operate NGSO mobile-satellite service ("MSS") systems as required to ensure compatibility.

- Licensing for SES-17 gateways in the U.S. will conform to the requirements of Section 25.136 regarding use of spectrum by future Upper Microwave Flexible Use Service ("UMFUS") networks.

Accordingly, grant of authority for SES-17 to serve the U.S. market is fully consistent with Commission policies and will not adversely affect other authorized users of the spectrum.

III. RULE WAIVERS ARE WARRANTED FOR SES-17

SES seeks waivers of Commission rules and policies in connection with the petition for SES-17 U.S. market access authority. Grant of these waivers is consistent with Commission precedent:

> The Commission may waive a rule for good cause shown. Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[9]

SES-17 substantially complies with the Commission's rules, but certain waivers are necessary in light of the frequencies used and the technical characteristics of the spacecraft. The Commission has granted similar waivers in other cases. As shown below, SES-17 will allow SES to initiate new services at the 67.1° W.L. orbital location, and grant of the requested waivers will therefore serve the public interest.

Section 2.106, Footnote NG166, and the Commission's Ka-band Plan: The Table of Allocations in Section 2.106 of the Commission's rules, the associated footnotes, and the designations in the Commission's Ka-band frequency plan[10] include limitations on the use of some of the frequency bands for which authority is sought in this Amendment. SES seeks waivers of these restrictions as discussed below.

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

[10] The Commission revised its Ka-band Plan in its decision updating the rules for NGSO FSS networks, and the current version of the Plan appears in Appendix B of that order. *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809, 7850-51 (2017).

Waivers of the Table of Allocations are generally granted "when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the nonconforming operator accepts any interference from authorized services."[11] The SES waiver requests meet this standard for each of the bands discussed below.

17.3-17.8 GHz: SES proposes to use the 17.3-17.8 GHz band for downlink transmissions to SES-17 gateway earth stations. This band is allocated for FSS, but only in the uplink direction, and is limited to use for broadcasting-satellite service ("BSS") feeder links. The 17.3-17.7 GHz band segment is allocated for BSS downlinks, and the 17.7-17.8 GHz band segment is solely allocated for terrestrial fixed service ("FS").

SES seeks waiver of Commission policies to permit FSS downlink operations on a protected basis in the 17.3-17.7 GHz frequencies. SES is contemporaneously filing a petition for rulemaking requesting changes to the U.S. Table of Allocations that would allow FSS operations in the 17.3-17.7 GHz frequencies as long as such operations comply with restrictions for the protection of BSS satellites and earth stations operating in this spectrum, and SES incorporates the petition by reference herein. The Technical Appendix demonstrates that FSS downlinks are compatible with the existing BSS allocations in the band and in fact will be less constraining on other BSS networks than conforming BSS operations would be. As a result, permitting protected FSS downlink operations will serve the public interest by permitting more robust use of scarce spectrum resources without adversely affecting incumbent authorized networks. For these reasons, pending action on the petition for rulemaking, SES asks that the Commission waive its rules to allow SES-17 to transmit to gateway earth stations in the 17.3-17.7 GHz frequencies without a requirement to modify its operations to accommodate future

[11] *The Boeing Company*, 16 FCC Rcd 22645 (IB & OET 2001) at 22651 & n.48 (citing cases).

BSS facilities and with protection from harmful interference caused by such future BSS deployments.

In the 17.7-17.8 GHz band segment, SES seeks waiver of the Table of Allocations and the Ka-band Plan to allow FSS downlink operations on an unprotected, non-harmful interference basis with respect to FS networks.[12] The Technical Appendix demonstrates that operations of SES-17 will comply with Commission pfd limits to protect terrestrial FS networks throughout the 17.7-19.7 GHz frequencies. SES will also accept any interference from existing and future FS transmissions in the 17.7-17.8 GHz frequencies.

19.4-19.6 GHz: SES proposes to use the 19.4-19.6 GHz band for downlink transmissions to SES-17 gateway earth stations and user terminals. Pursuant to the Table of Allocations, footnote NG166, and the Commission's Ka-band plan, these frequencies are available on a co-primary basis to terrestrial FS networks and NGSO MSS feeder links. SES seeks waiver of these limitations to permit non-conforming FSS downlink operations on an

[12] SES also seeks any necessary waiver of Section 25.140(b)(4) in connection with its planned operations in the 17.7-17.8 GHz band segment. That rule requires an interference analysis using the four-degree orbital spacing framework applicable to BSS operations if an applicant proposes a space station transmitting in the 17.3-17.8 GHz frequencies within four degrees of an orbital location at with the Commission has granted or is considering a satellite application in those frequencies. *See* 47 C.F.R. § 25.140(b)(4). The ViaSat-2 spacecraft at 69.9° W.L. has been authorized to serve the U.S. using the 17.7-17.8 GHz frequencies on a non-conforming basis for FSS, not BSS, operations. *See ViaSat, Inc.*, Call Sign S2902, File No. SAT-MOD-20160527-00053 ("ViaSat-2 Modification"), grant-stamped Jan. 12, 2017. As between adjacent FSS operations, the Commission considers compatibility based on a two-degree spacing framework, and ViaSat recognized this in its application by presenting an interference analysis assuming two-degree separation. *See* ViaSat-2 Modification, Exhibit A at 2-3, Supplemental Technical Annex at 4-5. Consistent with the approach taken by ViaSat, SES has provided a two-degree compatibility analysis for FSS operations in frequencies including the 17.7-17.8 GHz band segment. *See* Technical Appendix, Annex B. This showing conforms to the requirements of Section 25.140(a)(3)(vi) of the Commission's rules, 47 C.F.R. § 25.140(a)(3)(vi). Accordingly, the SES demonstration is consistent with the purpose of Section 25.140, and waiver to permit the analysis of interference using the two-degree FSS framework will serve the public interest.

unprotected, non-harmful interference basis. As noted above, the Technical Appendix demonstrates that operations of SES-17 will comply with Commission pfd limits to protect terrestrial FS networks throughout the 17.7-19.7 GHz frequencies. SES will also accept any interference from existing and future FS transmissions in the 19.4-19.6 GHz frequencies. SES will coordinate with authorized NGSO MSS networks and rely on geographic separation among earth stations and polarization isolation to protect those networks from harmful interference, and SES will accept harmful interference from existing and future NGSO MSS operations in this band segment.

29.1-29.25 GHz: SES proposes to use the 29.1-29.25 GHz band for uplink transmissions from SES-17 gateway earth stations and user terminals. Pursuant to the Table of Allocations, footnote NG166, and the Commission's Ka-band plan, these frequencies are available on a co-primary basis for MSS feeder links and LMDS. SES seeks waiver of these limitations to permit non-conforming FSS uplink operations on an unprotected, non-harmful interference basis. As discussed above, SES will coordinate with authorized NGSO MSS networks and rely on geographic separation among earth stations and polarization isolation to protect those networks from harmful interference, and SES will accept harmful interference from existing and future NGSO MSS operations in this band segment.

The SES gateway earth stations and any user terminals in the 29.1-29.25 GHz band will also be coordinated with LMDS operators. To protect LMDS operations from harmful interference, SES will rely on geographic isolation and is prepared to use other mitigation measures, including adjusting transmit elevation angles, frequency avoidance, uplink power adjustment, and earth station shielding. SES will also accept harmful interference from existing and future LMDS operations in this band segment.

Section 25.202(g): SES seeks any necessary waiver of Section 25.202(g) of the Commission's rules, which describes the conditions under which TT&C signals may be transmitted in frequencies that are not at the edge of the bands used for communications. As discussed above, SES seeks to perform SES-17 TT&C in conventional Ku-band frequencies but does not propose to use Ku-band frequencies for communications.

The Commission has explained that the purpose of its TT&C placement policy:

> is to simplify the coordination process for satellite systems, to provide an incentive for an operator to maximize the efficiency of its system's TT&C operations, and to minimize the constraints placed on other satellite operations.[13]

Permitting SES-17 to use Ku-band frequencies for TT&C fully complies with these objectives. As noted above, SES-17 will share the nominal 67° W.L. orbital location with another SES spacecraft, SES-10, which is authorized for Ku-band operations.[14] As a result, SES will have every incentive to use the Ku-band TT&C frequencies efficiently, and no other operator will be constrained in its ability to access Ku-band spectrum. Moreover, SES-17 TT&C operations will not cause more interference nor require more interference protection than operations of a typical two-degree compliant satellite and will conform to the off-axis EIRP limits applicable to Ku-band TT&C earth stations. As an ancillary benefit, use of Ku-band TT&C frequencies for SES-17, which relies on electric propulsion, will greatly increase the number of earth stations around the globe capable of supporting the lengthy orbit-raising process for the satellite – roughly seven and a half months from launch to on-station delivery. Under

[13] *Orbcomm License Corp*., 23 FCC Rcd 4804 at ¶ 20 (IB & OET 2008).

[14] *See New Skies Satellites B.V.*, Call Sign S2950, File No. SAT-PPL-20160117-00005, grant-stamped June 23, 2016, corrected June 30, 2016.

these circumstances, grant of any necessary Section 25.202(g) waiver will serve the public interest.

IV. CONCLUSION

For the foregoing reasons, SES respectfully requests that the Commission authorize SES-17 to serve the U.S. market to enable the delivery of state-of-the-art services to fixed and mobility customers from the nominal 67° W.L. orbital location.

Respectfully submitted,

SES-17 S.à r.l.

By: */s/ Petra A. Vorwig*

Petra A. Vorwig
Senior Legal & Regulatory Counsel
for SES-17 S.à r.l.
1129 20th Street N.W., Suite 1000
Washington, D.C. 20036

Of Counsel
Karis A. Hastings
SatCom Law LLC
1317 F Street, N.W., Suite 400
Washington, D.C. 20004
Tel: (202) 599-0975

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TECHNICAL APPENDIX

SES-17 AT 67.1° W.L.

1.0 Overall Description: §25.114(d)(1)

This technical appendix is submitted in support of the SES-17 S.à.r.l. (SES) petition for U.S. market access for the SES-17 spacecraft to be located at 67.1° W.L.[1] The SES-17 satellite is currently under construction by Thales Alenia Space, and is designed to operate in the Ka-band using both right- and left-hand circular polarizations (RHCP, LHCP). SES-17 will provide coverage of North, Central and South America as well as the Caribbean and the Atlantic Ocean using multiple user spot beams that will provide flexible high-throughput satellite (HTS) capability using Digital Transparent Processor (DTP) technology. The flexibility enabled by the DTP makes it possible to dedicate various amounts of bandwidth and RF power to each SES-17 beam within the frequency plan based on customer demand and business requirements. The DTP is capable of connecting one uplink and downlink beam or one uplink and multiple downlink beams via designated routing ports. In addition, SES-17 has the potential to implement gateway operations in certain user beams that have excess capacity. The satellite will serve a variety of broadband markets, including fixed data, aeronautical and maritime customers.

This application seeks authority for SES-17 to provide multi-beam coverage of North America, Central America, South America, the Caribbean, and the Atlantic Ocean in the following frequency ranges:

Direction	User	Gateway
Uplink (GHz)	27.5 – 30.0	27.5 – 30.0[2]
Downlink (GHz)	17.8 – 20.2	17.3 – 20.2

[1] The online Schedule S online does not allow the decimal place to be entered into the field for Orbital Longitude Information. As a result, the response to this field appears as 67° W.L. in Schedule S instead of the actual 67.1° W.L. center of the station-keeping box.

[2] The satellite will also have gateway uplink operations in the 27.0-27.5 GHz frequency band, but because these will occur outside of the United States, SES is not seeking authority to operate in this band segment as part of this application.

Specific information regarding the beam and channel plan is included in the accompanying Schedule S.

SES-17 will utilize 16 gateway beams, two of which are located in the United States over Laredo, Texas and Brewster, Washington. The gateway earth stations at these locations will be capable of communicating with the spacecraft in the 27.5-30.0 GHz and 17.3-20.2 GHz bands. SES-17 will provide coverage utilizing 152 user spot beams, as well as larger Atlantic beams and ten field-of-view beams, which can provide global coverage.

2.0 Schedule S: §25.114(c)

The Schedule S online information is submitted as part of this filing.

Due to the large numbers of identical fixed spot beams, SES is providing the predicted antenna gain contours and associated performance characteristics for one representative beam of each type, as indicated below:

Uplink Beams	Downlink Beams
NCU1	NCD1
NCU2	NCD2
NSU1	NSD1
NSU2	NSD2
SAU1	SAD1
SAU2	SAD2
TAU1	TAD1
TAU2	TAD2
FVU1	FVD1
FVU2	FVD2
VEU1	VED1
VEU2	VED2

Additionally, because the DTP will allow SES to vary the channel bandwidth in a frequency band, SES has specified the range of frequencies in that band over which the beam can operate for the applicable polarizations.

Annex A provides the maximum antenna boresight gain point latitude and longitudes, rounded to the nearest 0.1 degree, of each identical fixed spot beam within each beam group described in Schedule S as specified by Section 25.114(c)(4)(vii)(B).

3.0 Telemetry, Telecommand and Control (TT&C) frequencies and beams

The Telemetry, Telecommand and Control (TT&C) operations will be provided by earth stations located in the United States and Latin America. The TT&C frequencies are flexible with a tunable range from 11.70-12.45 GHz for Telemetry and 13.75-14.5 GHz for Telecommand operations. In practice, a single center frequency with a nominal operational bandwidth will be used, as indicated in the table below. SES will seek Commission authority if nominal operations utilize a different frequency range and bandwidth than those listed in this application. SES-17 TT&C operations will not cause more interference nor require more protection than operations of a typical two-degree compliant satellite and will comply with the off-axis EIRP limits applicable to Ku-band TT&C earth stations. SES on-station TT&C transmissions will occur in the Ku- and Ka-bands utilizing the following frequencies:

TT&C Frequency		
	Center Frequency (MHz)	Bandwidth (MHz)
TLM1	11704.5	0.3
TLM2	12195.5	0.3
CMD1	14003.0	0.9
CMD2	14005.0	0.9
CMD3	14497.0	0.9
Beacon	19699.1	0.3

4.0 Regulatory Considerations

4.1 17.3-17.8 GHz Band – Compatibility of SES-17 with space services

The 17.3-17.8 GHz band is allocated to the following space services: the fixed-satellite service (FSS) (Earth-to-space, limited to BSS feeder links) and the broadcasting-satellite service (BSS, by

definition space-to-Earth, limited to the 17.3-17.7 GHz band) on a primary basis in the U.S. Table of Allocations.

This application requests protected use of the 17.3-17.7 GHz downlink spectrum for SES-17 gateways.[3] Simultaneously with this application, SES is submitting a petition for rulemaking requesting that FSS be allowed protected access for downlink operations in this band. SES-17 transmissions in the United States will operate within the envelope of technical parameters allowed for BSS systems in the band, and thus will not cause more harmful interference to other uses of the band, nor seek greater protection from other uses of the band, than Ka-band BSS networks operating under the Commission's rules for 17/24 GHz BSS.[4]

As demonstrated below, SES-17 can operate in this downlink band in a way that protects co-primary users and does not constrain future development. Protected status is important for gateway functions that are critical to the overall services that SES-17 will provide in the United States.

There are three interference scenarios to address with respect to sharing with the space services in the band, as follows:

1. Compatibility of SES-17 with 17/24 GHz BSS systems - Transmissions from the SES-17 satellite will not cause unacceptable interference to, or unduly constrain, 17/24 GHz BSS systems.
2. Compatibility of SES-17 with direct broadcast satellite (DBS) space stations - Transmissions from the SES-17 satellite will not cause unacceptable interference to DBS receiving satellites or unduly constrain DBS satellite operations.
3. Compatibility of SES-17 with DBS feeder link earth stations – SES-17 receiving gateways will not receive unacceptable interference from existing DBS feeder link earth stations or unduly constrain deployment of new DBS feeder link earth stations.

Each of these interference cases is addressed in the following subsections.

[3] While SES requests authority to operate in 17.7-17.8 GHz, due to the additional terrestrial use of the band and associated Commission policies, SES does not seek protected access to this portion of the band. For completeness, SES addresses here sharing with the primary BSS feeder links in that portion of the band as well.

[4] Consistent with §25.210, SES-17 is designed to provide a cross-polarization isolation in the 17.3-17.7 GHz downlink band such that the ratio of the on axis co-polar gain to the cross-polar gain of the antenna in the assigned frequency band shall be at least 25 dB within its primary coverage area.

4.1.1 Compatibility of SES-17 with 17/24 GHz BSS Systems

SES-17 will operate at substantially lower EIRP levels than those allowed for 17/24 GHz BSS satellites in the 17.3-17.8 GHz band, as the frequencies will be used to provide gateway operations to large earth stations rather than to small BSS user terminals. As a result, SES-17's operations in the band will cause less interference to an adjacent 17/24 GHz BSS system than would another 17/24 GHz BSS satellite.

Similarly, because SES-17 will transmit to large gateway earth stations, the downlink operations will be less susceptible to interference from an adjacent BSS satellite.

Table 2 below provides various analyses of SES-17's compatibility with 17/24 GHz BSS systems in comparison to a situation involving two 17/24 GHz BSS systems.

Column 1 describes the baseline case of two adjacent 17/24 GHz BSS satellites. Column 2a describes the impact of SES-17's operations on an adjacent 17/24 GHz BSS satellite operating at the highest pfd level authorized under Section 25.208(w)(1) and (4): -115 dBW/m^2/MHz. Column 2b describes the impact of SES-17 on an adjacent 17/24 GHz BSS satellite operating at the lowest pfd level authorized under Section 25.208(w)(3): -121dBW/m^2/MHz. Columns 3a and 3b describe the impact on SES-17 of an adjacent 17/24 GHz BSS satellite two degrees away from SES-17, operating at the highest and lowest pfd levels authorized under Section 25.208(w).

Table 2. SES-17 C/I and BSS vs BSS C/I

	BSS as wanted signal			FSS as wanted signal	
	1	**2a**	**2b**	**3a**	**3b**
	BSS v BSS (victim)	**FSS vs BSS (victim), (highest 25.208(w) BSS pfd)**	**FSS vs BSS (victim), (lowest 25.208(w) BSS pfd)**	**BSS v FSS (victim), (highest 25.208(w) BSS pfd)**	**BSS v FSS (victim), (lowest 25.208(w) BSS pfd)**
Wanted Orbit location	-71.00	-71.00	-71.00	-67.10	-67.10
Interfering Orbit location	-67.10	-67.10	-67.10	-69.00	-69.00
Station-keeping tolerance (deg)	0.05	0.05	0.05	0.05	0.05
Topocentric orbital separation (deg)	4.3	4.3	4.3	2.1	2.1
Frequency (MHz)	17450	17450	17450	17450	17450
Antenna Size (m)	0.45	0.45	0.45	4.50	4.50
Peak satellite wanted EIRP density (dBW/Hz)	-13.0	-13.0	-19.0	-25.0	-25.0
Max gain	36.4	36.4	36.4	56.4	56.4
Interfering satellite peak EIRP density (dBW/Hz)	-13.0	-25.0	-25.0	-13.0	-19.0
C/I (dB)	**23.2**	**35.2**	**29.2**	**23.4**	**29.4**
Delta (compared to BSS v BSS)	**0.0**	**12.0**	**6.0**	**0.2**	**6.2**

The above calculations show that a 17/24 GHz BSS system adjacent to SES-17 will have a C/I that is 6 to 12 dB higher than if it were adjacent to another 17/24 GHz BSS system. Further, the C/I at an SES-17 gateway resulting from an adjacent 17/24 GHz BSS system two degrees away will be 0.2 to 6.2 dB higher than the C/I between two adjacent 17/24 GHz BSS systems with four degree orbital separation. As a result, it can be concluded that SES-17's use of the 17.3-17.8 GHz downlink band for gateway operations will not cause unacceptable interference to an adjacent 17/24 GHz BSS network, and SES-17 gateways will be able to successfully operate in the presence of a neighboring 17/24 GHz BSS satellite communicating with small earth station antennas.

In addition, the ViaSat-2 satellite at 69.9° W.L. has been granted U.S. market access for FSS operations in the 17.7-17.8 GHz band. SES certifies that it will comply with the default two-degree spacing pfd levels for the conventional Ka-band spectrum in Section 25.140(a)(3)(iii), thereby ensuring that SES can operate successfully with ViaSat-2 at a greater than two degree orbital separation. The two-degree compatibility analysis is presented in Annex B.

In summary, SES-17 will not cause more interference to an adjacent space station transmitting in the 17.3-17.8 GHz band than would a 17/24 GHz BSS space station operating in compliance with the requirements of the Part 25 rules.

4.1.2 Compatibility of SES-17 with DBS Space Stations

In order to ensure that SES-17's transmissions are compatible with receiving DBS satellites in the 17.3-17.8 GHz band, SES-17 has been designed to comply with the requirements of Section 25.264(b)(1). The information required under Section 25.264(a) and (b) is provided in Annex C. The closest satellite to SES-17 that uses frequencies in the 17.3-17.8 GHz range in the uplink direction is SES-10, SES's own satellite, which is authorized to serve the United States with uplinks in a portion of that spectrum. SES-10 will be separated from SES-17 by approximately 0.2 degrees, and SES will ensure that operations of its two spacecraft are compatible. Recommendation ITU-R BO.1835 finds that an orbital separation of at least 0.2 degrees is needed for two satellites to operate effectively in reverse transmission directions.[5] Considering this standard and input from parties, the FCC adopted a 0.2 degree minimum orbital separation for 17/24 GHz BSS satellites operating near DBS satellites receiving in the 17 GHz band.[6] As a result, SES does not anticipate any difficulty in managing potential interference between its SES-10 and SES-17 spacecraft.

The DBS satellites serving the United States that are closest to 67.1° W.L. are EchoStar 15 and 16 at 61.65° W.L., with an orbital separation from SES-17 of approximately 5.45 degrees and the NIMIQ 5 satellite at 72.7° W.L. with an orbital separation of approximately 5.6 degrees from SES-17. As previously noted, SES-17 is designed to comply with the requirements of §25.264(b) with respect to the orbital locations of licensed DBS systems serving the United States and thus is compatible with existing and potential new DBS spacecraft at the closest operational Plan locations of 61.65° and 72.7° W.L.

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[5] ITU, *Sharing between broadcasting-satellite service (BSS) networks using the Region 2 17.3-17.8 GHz BSS allocation and feeder links of BSS networks using the worldwide 17.3-17.8 GHz fixed-satellite service (FSS) (Earth-to-space) allocation*, Recommendation ITU-R BO.1835 (2008).

[6] *See Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band*, IB Dkt No. 06-123, Second Report and Order, 26 FCC Rcd 8927, 8942-45 (2011); 47 C.F.R. § 25.264(g).

4.1.3 Compatibility of SES-17 with DBS Feeder Link Earth Stations

SES has assessed the proximity of its planned gateway sites in Brewster, WA and Laredo, TX to licensed DBS feeder link sites. The closest DBS feeder link earth station to Brewster is about 170 kilometers away in Spokane, WA, and the closest to Laredo is about 266 kilometers away in New Braunfels, TX. In its ground-path proceeding, the Commission adopted use of the Appendix 7 methodology to determine the coordination area around new transmitting DBS feeder link earth stations where receiving Ka-band BSS earth stations might be affected.[7] SES has performed an Appendix 7 calculation using the ITU's Graphical Interface for Batch Calculations (GIBC) software to determine the maximum coordination area requirements around an earth station in this band. Appendix 7 §1.4.4 indicates that a receiving earth station operating in a bi-directional allocated frequency band will only require coordination with a transmitting earth station if it is located within the transmitting earth station's coordination area. The detailed results of the GIBC analysis, included in Annex D below, show that the DBS feeder link earth stations in Spokane, WA and New Braunfels, TX have a coordination distance of 96 and 100 km, respectively. This means that the Brewster and Laredo gateways are outside the coordination area for these two DBS feeder link sites and that coordination would not be required if new transmitting antennas were co-located at the existing DBS feeder link sites.

With respect to new DBS feeder link earth stations, the small number of SES-17 gateway sites will be much less constraining on new DBS feeder link earth stations than the ubiquitous 17/24 GHz BSS receive earth stations intended for use in this spectrum. As a result, SES-17 gateways will not materially limit the options for new DBS feeder link sites as compared to the current 17/24 GHz BSS allocation. The coordination process set forth in §25.203(m) would govern requests for new DBS feeder link sites at locations more than one kilometer from a currently-licensed DBS earth station.

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[7] *Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band*, IB Dkt No. 06-123, Third Report and Order, 32 FCC Rcd 3705, 3710-11 (2017); 47 C.F.R. § 25.203(m).

4.2 Compatibility of SES-17 with Terrestrial Systems in 17.7-18.3 GHz

The 17.7-18.3 GHz frequency band is allocated to the Fixed Service (FS) on a primary basis in the U.S. Table of Allocations. The 17.7-17.8 GHz frequency band is allocated to the FSS (Earth-to-space on a primary basis, and the 17.8-18.3 GHz frequency band is allocated to the FSS (space-to-Earth) on a primary basis in the U.S. Table of Allocations. The FCC's Ka-band plan limits the downlink non-Federal FSS allocation in the 17.8-18.3 GHz band to secondary status.[8]

This application requests authority to use the 17.7-18.3 GHz downlink spectrum for SES-17 gateway operations, and the 17.8-18.3 GHz downlink spectrum also for user operations.

SES-17 will comply with the pfd limits in Section 25.208(c), as shown in Annex B of this Technical Appendix. As a result, harmful interference will not be caused to terrestrial systems.

In addition, SES-17 network operations will not constrain future development of terrestrial systems in the band. Recognizing the FCC limitations on use of this band segment, SES will accept any interference from existing and future terrestrial stations operating in the 17.7-18.3 GHz frequencies. If any terrestrial interference prevents satisfactory operation of SES-17's gateway or user terminal links, then SES will discontinue use of that portion of the 17.7-18.3 GHz band at the affected gateway or user terminal(s). SES-17's gateway earth stations are planned to be located in relatively remote areas in Brewster, WA and Laredo, TX, and as a result, they are less likely to be affected by interference from FS operations. There is the possibility that SES or its SES-17 customers may also wish to implement gateway operations in certain user beams that have excess capacity. SES would consider nearby terrestrial deployments in planning any additional sites.

Finally, the flexibility offered by the DTP aboard the satellite will allow SES to change frequencies in the event a gateway or user terminal receives interference in this band. If no reasonable certainty can be gained for continued gateway operations, through coordination with nearby terrestrial links or other means, SES may determine that it is not feasible to use this frequency band for gateway operations. Interference to user terminals is easier to manage, as only certain user earth stations may be affected. Further, much of the planned operation on SES-17 is aeronautical, and when the

[8] *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters,* Report and Order and Further Notice of Proposed Rulemaking 32 FCC Rcd 7809, 7850-51 (2017) ("NGSO Order") at Appendix B.

terminals are operating at altitude, they are less susceptible to terrestrial interference than those located on the ground.

4.3 Compatibility of SES-17 with NGSO FSS in 18.8-19.3 GHz and 28.6-29.1 GHz

While the 28.6-29.1 GHz and 18.8-19.3 GHz bands are allocated internationally for GSO and NGSO use on a co-primary basis, these bands are allocated to NGSO FSS on a primary basis in the U.S. Table of Allocations. The U.S. Table allocates the 28.6-29.1 GHz band to GSO FSS on a secondary basis, and the Commission recently updated the Ka-band plan to specify that the 18.8-19.3 GHz band is available on a secondary basis to GSO FSS operations as well.[9]

SES-17's U.S. operations in this band will be consistent with the obligations of a secondary user and will not cause harmful interference to, nor seek protection from, authorized NGSO operations in this band.

The Commission has authorized Audacy, Karousel, LeoSat, WorldVu/OneWeb, Space Norway, and SpaceX NGSO systems (none of which have launched), Telesat Canada's NGSO system (for which a Phase 1 testing satellite has been launched) and the O3b system (which is in orbit and operating) to serve the U.S. market in the 28.6-29.1 GHz and 18.8-19.3 GHz bands. Other applications for NGSO systems in this band are pending before the Commission. SES has commenced discussions with OneWeb and Telesat to coordinate the use of Ka-band frequencies between each NGSO system and the entire SES GSO satellite fleet. SES will initiate discussions with Audacy, Karousel, LeoSat, Space Norway, and SpaceX to coordinate with those systems, and will coordinate with any NGSO systems authorized to use these bands to serve the U.S. in the future as well. SES is confident that these discussions will result in coordination agreements that include SES-17 access to the 18.8-19.3 GHz and 28.6-29.1 GHz bands.

With respect to O3b, SES completed the acquisition of 100% of O3b networks on August 1, 2016. The SES GSO and NGSO fleets are fully integrated, and SES will ensure that they operate without causing harmful interference into each other.

4.4 Compatibility of SES-17 with NGSO MSS in 19.4-19.6 GHz and 29.1-29.5 GHz

SES seeks authority to operate in the 19.4-19.6 GHz and 29.1-29.25 GHz bands on a non-conforming basis. The frequencies are allocated to NGSO MSS feeder links. Iridium is currently

[9] *See id.* at 7813-15, 7850.

the only licensee operating in these band segments and does so using one polarization. O3b has been authorized to use these bands and plans to have a spacecraft operating in the frequencies soon. SES also seeks authority to use 29.25-29.3 GHz, which has co-primary allocations for GSO FSS uplinks and NGSO MSS feeder links, on a conforming basis pursuant to Commission rules including the earth station coordination requirements of Section 25.258.

SES-17 will use these frequency bands for a limited number of gateway sites and for certain user beams. The locations of its two proposed gateway earth stations in Brewster, WA, and Laredo, TX, are sufficiently separated from existing Iridium feeder link sites located in Alaska, Arizona, California, Hawaii and Pennsylvania to ensure that the proposed SES-17 operations will not cause unacceptable interference to, nor receive unacceptable interference from, Iridium's operations. For the SES-17 user beams, SES could utilize beams in these bands with sufficient geographic separation from Iridium's feeder link sites and/or take advantage of polarization discrimination to ensure compatibility with Iridium's operations. SES will coordinate with Iridium regarding these matters. In summary, SES will conduct any necessary coordination of its proposed operations with Iridium in 19.4-19.6 GHz and 29.1-29.25 GHz, as well as in 29.25-29.3 GHz under Section 25.258 of the Commission's rules.

4.5 Earth Stations in the 27.5-28.35 GHz (§25.136) – Compatibility with Upper Microwave Flexible Use Service (UMFUS)

SES will seek authority to operate the gateways communicating with SES-17 on a protected basis pursuant to Section 25.136(a)(4). The information required to demonstrate compliance with Section 25.136 will be submitted with the gateway earth station applications. Applications for any other earth stations seeking to communicate with SES-17 on a protected basis in these frequencies will provide the information required under Section 25.136(a)(4).

4.6 Earth Stations in the 29.1-29.25 GHz – Compatibility with Local Multipoint Distribution Service (LMDS)

SES will seek authority to operate the gateways communicating with SES-17 on a non-conforming basis in the 29.1-29.25 GHz band, which has a primary allocation for terrestrial Local Multipoint Distribution Service (LMDS). The closest Basic Trading Area (BTA) with an active LMDS license to the SES-17 gateway location in Brewster, WA is in Seattle, and its border is a minimum of 89 km away. For the Laredo, TX gateway, the closest BTA with an active LMDS license is in San Antonio, TX, a minimum of 91 km away. SES will also seek authority to operate any user terminals communicating with SES-17 in the 29.1-29.25 GHz band on a non-conforming basis.

SES will coordinate its earth station locations with LMDS licensees and is prepared to take any necessary technical measures to avoid harmful interference, such as adjusting the transmit elevation angles, frequency avoidance, uplink power adjustment, earth station shielding, or some combination thereof. SES will also accept any interference resulting from LMDS transmissions in this band.

5.0 Interference Analysis and Certifications Pursuant to §25.140

SES certifies that the SES-17 downlink EIRP density in the conventional Ku-band will not exceed 14 dBW/4kHz[10] for digital transmissions and that associated uplink operations will not exceed applicable EIRP density envelopes in §25.218, §25.222(a)(1), §25.226(a)(1), or §25.227(a)(1) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of 67.1° W.L. and except as provided in §25.140(d).

SES further certifies that the SES-17 operations in the conventional Ka-band and 17.3-17.8 GHz band will not generate power flux-density at the Earth's surface in excess of −118 dBW/m^2/MHz and that associated uplink operation will not exceed applicable EIRP density envelopes in §25.138(a) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of 67.1° W.L. and except as provided in §25.140(d).

With respect to proposed operations in accordance with two-degree-compliance for a GSO FSS space station, in the 17.3-17.8 GHz, 17.8-18.3 GHz, 18.8-19.3 GHz, 19.3-19.7 GHz, 27.5-28.35 GHz, 28.6-29.1 GHz, and 29.1-29.25 GHz bands, see Annex B for analyses vis-à-vis other FSS systems pursuant to §25.140(a)(3)(vi). Additional analyses in Annex B also demonstrate compliance with the pfd limits in §25.208(d) for the 18.6-18.8 GHz band.

[10] There is a discrepancy between the 13 dBW/4kHz downlink EIRP density limit for operations in the conventional Ku-band that is discussed in the FCC's 2015 Second Report and Order in the Part 25 proceeding and the 14 dBW/4kHz limit specified in Section 25.140(a)(3)(ii). *See Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, 30 FCC Rcd 14713 (2015) at ¶¶ 112, 115. If the Commission determines that the lower limit identified in the Part 25 Order should apply, SES will adjust its operations accordingly.

SES also certifies that the power flux density on the Earth's surface of SES-17 transmissions in the 17.3-17.8 GHz band will not exceed the values specified in §25.208(c) and 25.208(w), as shown in Annex B. There are no space stations authorized to provide BSS within four degrees of SES-17. The Viasat-2 satellite has been authorized to provide FSS services on a non-conforming basis in 17.7-17.8 GHz at 69.9° W.L., which is more than two degrees away from SES-17. The analysis in Annex B shows that SES-17 can co-exist at two-degree spacing with other FSS systems in 17.3-17.8 GHz; furthermore, SES commits above to complying with the pfd limit in §25.140(a)(iii) that is generally applicable for Ka-band frequency ranges to ensure compatibility of GSO systems at two-degree spacing.

6.0 Mitigation of Orbital Debris: §25.114(d)(14)

6.1 Spacecraft Hardware Design

SES has assessed and limited the amount of debris that will be released in a planned manner during normal operations of SES-17. During the satellite ascent, after separation from the launcher, no debris will be generated. As with all recent SES satellite launches, all deployments will be conducted using pyrotechnic devices designed to retain all physical debris. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration.

SES has also assessed and limited the probability of the space station becoming a source of orbital debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. The design of SES's recent spacecraft locates all sources of stored energy within the body of the structure, which provides protection from small orbital debris. SES requires that spacecraft manufacturers assess the probability of micrometeorite damage that can cause any loss of functionality. This probability is then factored into the ultimate spacecraft probability of success. Any significant probability of damage would need to be mitigated in order for the spacecraft design to meet SES's required probability of success of the mission. SES has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft will not use any subsystems for end-of-life disposal that are not used for normal operations.

6.2 Minimizing Accidental Explosions

SES has assessed and limited the probability of accidental explosions during and after completion of mission operations. As part of the Safety Data Package submission for SES spacecraft, an extensive analysis is completed by the spacecraft manufacturer, reviewing each potential hazard relating to accidental explosions. A matrix is generated indicating the worst-case effect, the hazard cause, and the hazard controls available to minimize the severity and the probability of occurrence. Each subsystem is analyzed for potential hazards, and the Safety Design Package is provided for each phase of the program running from design phase, qualification, manufacturing and operational phase of the spacecraft. Also, the spacecraft manufacturer generates a Failure Mode Effects and Criticality Analysis for the spacecraft to identify all potential mission failures. The risk of accidental explosion is included as part of this analysis. This analysis indicates failure modes, possible causes, methods of detection, and compensating features of the spacecraft design.

The design of the SES-17 spacecraft is such that the risk of explosion is minimized both during and after mission operations. In designing and building the spacecraft, the manufacturer is taking steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. Burst tests are performed on all pressure vessels during qualification testing to demonstrate a margin of safety against burst. All pressures, including those of the batteries, will be monitored by telemetry. At the end of operational life, after the satellite has reached its final disposal orbit, all on-board sources of stored energy will be depleted or secured, excess propellant remaining in the chemical propulsion tanks will be vented, excess pressurant remaining in the nitrogen tanks will be vented, and the batteries will be discharged.

6.3 Safe Flight Profiles

SES has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Specifically, SES has assessed the possibility of collision with satellites located at, or reasonably expected to be located at, the requested orbital location or assigned in the vicinity of that location. Regarding avoidance of collisions with controlled objects, in general, if a geosynchronous satellite is controlled within its specified longitude and latitude station-keeping limits, collision with another controlled object (excluding where the satellite is collocated with another object) is the direct result of that object entering the allocated space.

SES-17 will be positioned at 67.1° W.L., and on-station operations require station-keeping within the +/- 0.1 degree N-S and +/- 0.05 degree E-W control box, thereby ensuring adequate collision avoidance distance from other satellites in geosynchronous orbit. In considering current and planned satellites that may have a station-keeping volume that overlaps the SES-17 satellite, SES has reviewed the FCC database for FCC licensed satellite networks and those that are currently under consideration by the FCC. In addition, networks for which a request for coordination has been published by the ITU within ±0.15 degrees of 67.1° W.L. have also been reviewed. Only those networks that either operate, or are planned to operate, and have an overlapping station-keeping volume with the SES-17 satellite, have been taken into account in the analysis. Based on these reviews, the only satellite operating at 67.1° W.L. is ASTRA 1H, which is controlled and operated by an affiliate of SES. If ASTRA 1H remains at this position when SES-17 is launched, SES will coordinate the operations of ASTRA 1H and SES-17 to ensure safe collocation. SES-10, which is also operated by an affiliate of SES, is located at 66.9° W.L., and its assigned station-keeping volume does not overlap with that requested for SES-17. There are no pending applications before the Commission requesting authorization to use an orbital location within ±0.15° of 67.1° W.L. Furthermore, SES is not aware of any other system with an overlapping station-keeping volume with SES-17 that is either in orbit or progressing towards launch. Based on the preceding, it is concluded that physical coordination of the SES-17 satellite with another party is not required at the present time.

SES uses the Space Data Center (SDC) system from the Space Data Association to monitor the risk of close approach of its satellites with other objects. Any close encounters (separation of less than 10 km) are flagged and investigated in more detail. If required, avoidance maneuvers are performed to eliminate the possibility of collisions. During any relocation, the moving spacecraft is maneuvered such that it is at least 30 km away from the synchronous radius at all times. In most cases, much larger deviation from the synchronous radius is used. In addition, the SDC system is used to ensure no close encounter occurs during the move. When de-orbit of a spacecraft is required, the initial phase is treated as a satellite move, and the same precautions are used to ensure collision avoidance.

6.4 Post-Mission Disposal

Post-mission disposal of the satellite from operational orbit will be accomplished by carrying out maneuvers to a higher orbit. The upper stage engine remains part of the satellite, and there is no

re-entry phase for either component. The fuel budget for elevating the satellite to a disposal orbit is included in the satellite design. SES plans to maneuver SES-17 to a disposal orbit with a minimum perigee of 255 km above the normal GSO operational orbit. This proposed disposal orbit altitude results from application of the IADC formula based on the following calculation:

Total Solar Pressure Area "A" = 100.0 m^2

"M" = Dry Mass of Satellite = 5060 kg

"CR" = Solar Pressure Radiation Coefficient = 1.00

Therefore the Minimum Disposal Orbit Perigee Altitude:

= 36,021 km + 1000 x CR x A / M

= 36,021 km + 1000 x 1.00 x 100.0 / 5060

= 36,043 km

= 255 km above GSO (35,786 km)

SES intends to reserve 3 kg of propellant in order to account for post-mission disposal of SES-17. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

ANNEX A – §25.114(c)(4)(vii)(B) Table of maximum antenna gain point(s)

	Downlink			Uplink	
Group ID	**Longitude**	**Latitude**		**Longitude**	**Latitude**
NC	-93.8	45.3		-93.8	45.3
	-87.6	44.9		-87.9	45.5
	-82.4	44.7		-82.4	44.7
	-77.0	44.5		-77.1	45.1
	-72.2	44.4		-72.2	44.4
	-94.0	40.6		-94.0	40.6
	-88.1	39.8		-88.3	40.3
	-83.5	40.1		-83.5	40.1
	-78.4	39.9		-78.9	39.9
	-74.0	39.8		-74.0	39.8
	-94.5	36.3		-94.5	36.3
	-89.0	35.6		-89.6	36.1
	-84.6	35.9		-84.6	35.9
	-80.1	35.6		-80.0	35.2
	-75.6	35.2		-75.6	35.7
	-95.4	32.9		-95.4	32.9
	-90.0	31.8		-90.2	32.2
	-85.8	32.0		-85.8	32.0
	-81.5	31.5		-81.6	31.9
	-77.2	31.8		-77.2	31.8
	-96.0	28.3		-96.2	28.8
	-91.5	28.2		-91.7	28.6
	-87.4	28.4		-87.0	28.4
	-82.9	27.9		-83.0	28.3
	-78.6	27.8		-79.0	28.2
	-97.2	25.3		-97.4	25.7
	-92.7	24.7		-93.3	25.1
	-88.8	25.3		-88.8	25.3
	-84.2	24.5		-84.7	24.8
	-80.5	24.8		-80.5	24.8
	-76.8	24.7		-76.4	25.1
	-98.8	21.5		-98.9	21.9
	-94.3	21.0		-94.8	21.4
	-89.4	20.9		-89.9	21.3

	-86.0	21.2		-86.1	21.5
	-81.9	21.1		-81.9	21.4
	-78.2	20.7		-78.2	21.0
	-74.3	21.0		-74.7	21.3
NS	-119.9	61.6		-119.7	61.6
	-103.8	61.5		-103.8	61.5
	-93.1	62.4		-94.9	67.3
	-83.3	62.7		-91.4	66.9
	-73.5	64.6		-69.7	68.7
	-120.6	55.3		-120.5	55.3
	-103.7	51.4		-104.7	54.9
	-95.4	51.4		-99.5	55.9
	-88.6	51.6		-92.5	54.6
	-81.6	51.9		-81.8	55.5
	-74.7	51.7		-76.7	55.3
	-68.0	52.3		-66.3	55.2
	-124.3	46.9		-136.2	50.0
	-112.9	46.8		-119.7	51.1
	-101.2	44.1		-106.0	47.3
	-119.8	40.6		-119.8	43.1
	-110.1	40.2		-114.7	41.1
	-101.2	39.1		-100.5	41.5
	-118.5	34.8		-121.6	36.0
	-108.6	34.5		-111.7	37.5
	-101.0	34.0		-104.3	36.0
	-117.2	29.5		-117.7	27.5
	-109.0	29.8		-112.8	30.1
	-102.2	29.5		-102.8	27.5
	-109.5	24.7		-111.5	27.1
	-102.0	24.3		-105.1	25.6
	-104.5	20.3		-104.7	18.1
	-81.4	-3.4		-80.4	-4.4
	-76.4	-3.7		-77.4	-4.4
	-79.1	-7.0		-80.2	-8.0
	-74.5	-7.7		-74.5	-9.0
	-77.6	-11.3		-76.3	-12.3
	-72.9	-11.0		-74.3	-11.6
	-75.7	-15.0		-76.5	-16.1
	-70.7	-15.0		-70.7	-15.7
	-36.2	-6.2		-35.4	-6.9

	-38.3	-9.9		-37.9	-9.9
	-40.6	-13.6		-40.6	-13.9
	-41.0	-18.5		-41.0	-18.5
	-44.2	-20.5		-44.1	-20.9
SA	-97.9	16.5		-99.8	19.0
	-90.9	15.9		-91.4	13.5
	-84.6	16.5		-86.1	19.4
	-79.3	16.4		-81.5	17.5
	-73.1	16.7		-73.4	16.4
	-66.6	16.0		-66.7	13.6
	-60.5	16.7		-61.2	16.4
	-95.4	11.2		-94.4	12.6
	-86.7	11.4		-87.6	9.1
	-80.3	11.3		-82.7	10.4
	-75.5	10.0		-76.6	11.0
	-68.6	11.6		-66.7	10.3
	-61.1	10.3		-63.7	9.3
	-84.9	5.7		-83.5	4.1
	-77.4	6.0		-78.4	4.7
	-72.5	4.7		-70.9	4.1
	-65.4	6.0		-66.0	4.4
	-59.5	6.0		-58.2	4.4
	-53.9	6.0		-53.6	3.7
	-80.4	0.8		-82.4	0.5
	-74.7	0.5		-76.1	-1.1
	-68.0	-0.5		-70.2	-0.2
	-62.5	0.8		-62.2	0.8
	-55.6	-0.2		-58.3	-0.5
	-50.6	0.8		-50.2	1.1
	-70.9	-4.4		-68.9	-5.4
	-67.0	-5.7		-64.7	-5.7
	-59.9	-4.4		-60.2	-5.7
	-52.2	-4.1		-52.5	-5.4
	-46.6	-4.1		-44.5	-4.1
	-39.6	-4.1		-39.9	-5.5
	-69.0	-10.0		-70.0	-11.6
	-62.1	-10.0		-61.4	-11.0
	-56.1	-9.7		-55.8	-9.7
	-49.5	-10.0		-48.8	-10.7
	-43.7	-10.4		-43.8	-12.5

	-65.7	-14.3		-66.3	-16.4
	-59.9	-15.7		-60.6	-16.0
	-53.0	-15.4		-53.3	-16.5
	-46.1	-15.9		-45.3	-16.2
	-69.8	-20.6		-70.5	-21.0
	-62.5	-19.5		-60.4	-20.6
	-54.6	-21.4		-54.1	-22.1
	-48.4	-20.8		-47.1	-21.6
	-71.7	-25.4		-72.9	-27.3
	-65.5	-25.4		-64.4	-28.1
	-59.0	-25.4		-59.5	-27.3
	-52.3	-27.5		-50.3	-27.5
	-68.9	-31.3		-67.0	-32.6
	-61.5	-31.7		-60.5	-33.9
	-54.8	-31.4		-52.6	-32.3
	-72.6	-39.3		-73.9	-38.9
	-65.2	-38.3		-66.1	-40.7
	-57.0	-38.9		-57.9	-38.9
	-69.5	-48.4		-69.0	-49.0
	-45.8	7.1		-46.2	5.1
	-64.9	67.2		-63.8	68.7
	-48.5	61.8		-35.8	67.6
	-36.4	62.8		-35.2	65.2
	-23.1	57.1		-25.3	59.3
	-22.3	53.6		-20.6	55.2
	-59.5	52.3		-60.0	53.0
	-51.3	48.1		-47.0	51.5
	-41.7	49.2		-41.7	49.2
	-32.3	45.3		-36.4	45.5
	-15.4	48.0		-18.2	44.3
	-68.7	44.2		-65.9	43.1
	-57.5	41.4		-56.4	41.9
	-69.4	35.6		-69.0	35.6
	-65.3	36.0		-62.4	36.1
	-74.7	28.4		-72.8	28.4
	-69.4	21.7		-70.2	23.9
	-14.2	41.6		1.2	45.3
	-13.6	35.4		-13.8	32.3
TA	-53.1	34.3		-58.9	34.1
	-35.5	30.7		-30.4	38.1

	-14.9	26.2		-0.5	34.1
	-65.6	23.7		-64.0	29.1
	-53.4	15.3		-46.9	15.4
	-37.8	13.5		-30.9	13.6
	-18.0	9.8		-4.9	10.8
	-38.1	-0.6		-37.2	5.3
VE	-64.2	-45.8		-102.8	11.7
	-30.1	-35.3		-103.2	-13.4
	-23.4	-11.7			
FV	-112.3	-8.7		-64.2	-45.8
	-106.1	-42.9		-30.1	-35.3
	-3.1	14.0		-23.4	-11.7
	-59.3	21.7			
	-102.9	64.5			
	-56.1	0.8			
	-53.4	-2.4			

ANNEX B - Interference Analysis and Certifications Pursuant to §25.140 and §25.208

In accordance with §25.140(a)(3)(vi), SES provides below a two-degree spacing analysis indicating compatibility for frequency bands with frequency ranges outside of conventional Ka-band operations, *i.e.*, 17.3-17.8, 17.8-18.3, 18.8-19.7, 27.5-28.35, 28.6-29.1, and 29.1-29.25 GHz.

As there is no previously authorized space station in these bands at an orbital location within two degrees of 67.1° W.L. nor any applications pending before the Commission seeking to use these bands for GSO operations within two degrees of 67.1° W.L., representative SES-17 parameters are used for both the victim and interfering satellite. These parameters are summarized in Table B.1.

Table B.1. Representative SES-17 Transmission Parameters

Carrier ID	Emission Designator	Bandwidth (MHz)	Uplink E/S Gain (dBi)	Uplink E/S EIRP/Carrier (dBW)	Downlink Satellite EIRP (dBW)	Downlink E/S Gain (dBi)
1	3M90G7W	3.9	45.5	50	47.3	70.3
2	3M90G7W	3.9	51.5	52	47.3	70.3
3	5M20G7W	5.2	39.4	45	47.3	70.3
4	3M90G7W	3.9	45.5	50	47.3	60.8
5	3M90G7W	3.9	51.5	52	47.3	60.8
6	5M20G7W	5.2	39.4	45	47.3	60.8
7	38M0G7W	38	60.8	63	48.8	39.6
8	38M0G7W	38	60.8	63	48.8	45.6
9	38M0G7W	38	60.8	63	48.8	51.6
10	54M0G7W	54	70.2	74	47.3	39.8
11	54M0G7W	54	70.2	74	47.3	45.8
12	54M0G7W	54	70.2	74	47.3	51.8
13	54M0G7W	54	70.2	74	53.3	39.8
14	54M0G7W	54	70.2	74	53.3	45.8
15	54M0G7W	54	70.2	74	53.3	51.8

Table B.2 gives a summary of the beam descriptions and associated frequencies for the SES-17 uplinks and downlinks used in the two-degree spacing analysis.

Table B.2. SES-17 Beam and Link Summary

SES-17 Beam Designation	Description and associated typical antennas
User Forward Link	Ka-band gateway uplink (transmit antenna size is 13.2 meters) and Ka-band user beam downlink (receive antenna sizes are 0.6 meters, 1.2 meters, and 2.4 meters)
User Return Link	Ka-band user beam uplink (transmit antenna sizes are 0.6 meters, 1.2 meters, and 2.4 meters) and Ka-band gateway downlink (receive antenna size is 13.2 meters)
Atlantic Forward Link	Ka-band gateway uplink (transmit antenna size is 4.5 meters) and Ka-band Atlantic downlink (receive antenna sizes are 0.6 meters, 1.2 meters, and 2.4 meters)
Atlantic Return Link	Ka-band Atlantic beam uplink (transmit antenna sizes are 0.6 meters, 1.2 meters, and 2.4 meters) and Ka-band gateway downlink (receive antenna size is 4.5 meters)
FoV Forward Link	Ka-band gateway uplink (transmit antenna size is 4.5 meters) and Ka-band FoV downlink (receive antenna sizes are 0.6 meters, 1.2 meters, and 2.4 meters)
FoV Return Link	Ka-band FoV beam uplink (transmit antenna sizes are is 0.6 meters, 1.2 meters, and 2.4 meters) and Ka-band gateway downlink (receive antenna size is 4.5 meters)
SES-17 Beams	**Associated Frequencies**
GW DL	17.3-20.2 GHz
GW UL	27.5-30.0 GHz
User DL	17.8-20.2 GHz
User UL	27.5-28.6 & 29.1-30.0 GHz
ATL DL	19.4-19.7 GHz
ATL UL	29.3-29.5 GHz
FoV DL	19.3-19.4 GHz
FoV UL	29.3-29.5 GHz

Tables B.3, B.4, B.5, and B.6 show the interference calculations and results of the overall C/I margin for the two-degree spacing analysis. These results indicate that SES-17 C/I margins are positive in all cases, indicating compliance**.**

The designation of the Gateway, User Spot, Atlantic or Field-of-View beams in the title of the link budget describes the satellite downlink EIRP for each beam type.

Table B.3. Representative SES-17 Ka-band Two-degree Spacing C/I analysis (Gateway beams)

		FORWARD				RETURN		
		aero	maritime	vsat		aero	maritime	vsat
Link Parameters	**Units**	**54M0G7W**	**54M0G7W**	**54M0G7W**		**5M20G7W**	**3M90G7W**	**3M90G7W**
Carrier bandwidth	MHz	54.0	54.0	54.0		5.2	3.9	3.9
Uplink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Uplink Frequency	GHz	28.977	28.977	28.977		18.527	18.527	18.527
Earth Station Diameter	m	13.20	13.20	13.20		0.60	1.20	2.40
Earth Station Gain	dBi	70.2	70.2	70.2		39.4	45.5	51.5
Earth station EIRP	dBW	74.00	74.00	74.00		45.0	50.0	52.0
Atmospheric Losses	dB	0.85	0.85	0.85		0.02	0.19	0.19
Free Space Loss	dB	-212.8	-212.8	-212.8		-208.9	-208.9	-208.9
Satellite G/T	dB/K	18.6	18.6	18.6		19.0	19.0	19.0
C/N Thermal Uplink	dB	30.2	30.2	30.2		16.5	22.6	24.6
C/I ASI	dB	29.2	29.2	29.2		10.4	16.6	18.6
C/(N+I) uplink	dB	26.7	26.7	26.7		9.5	15.7	17.7
Downlink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Downlink Frequency	GHz	19.227	19.227	19.227		29.527	29.527	29.527
Satellite EIRP per carrier	dBW	47.3	47.3	47.3		48.2	46.9	46.9
Atmospheric Losses	dB	0.36	0.36	0.36		0.38	0.38	0.38
Free Space Path Loss	dB	-209.2	-209.2	-209.2		-212.8	-212.8	-212.8
Earth Station Diameter	m	0.60	1.20	2.40		13.20	13.20	13.20
Earth Station Gain	dBi	39.8	45.8	51.8		70.3	70.3	70.3
System Noise Temperature	K	189	229	230		375	375	375
Earth Station G/T	dB/K	17.0	22.2	28.2		44.6	44.6	44.6
C/N Thermal Downlink	dB	6.0	11.2	17.2		41.1	41.1	41.1
C/I ASI	dB	9.8	15.8	21.9		51.4	51.4	51.4
C/(N+I) downlink	dB	4.5	10.0	16.0		40.7	40.7	40.7
Adjacent Satellite Interference:								
C/I up (single satellite)	dB	32.2	32.2	32.2		13.4	19.6	21.6
C/I dn (single satellite)	dB	12.8	18.8	24.9		54.4	54.4	54.4
Aggregate C/I up	dB	29.2	29.2	29.2		10.4	16.6	18.6
Aggregate C/I down	dB	9.8	15.8	21.9		51.4	51.4	51.4
Overall:								
C/(N+I) overall	dB	4.5	9.9	15.6		9.4	15.7	17.6
C/(N+I) required	dB	2.0	6.2	9.1		2.4	4.6	4.6
Margin	**dB**	**2.5**	**3.7**	**6.5**		**7.0**	**11.1**	**13.0**

Table B.4. Representative SES-17 Ka-band Two-degree Spacing C/I analysis (User Spot beams)

		FORWARD				RETURN		
		aero	maritime	vsat		aero	maritime	vsat
Link Parameters	**Units**	**54M0G7W**	**54M0G7W**	**54M0G7W**		**5M20G7W**	**3M90G7W**	**3M90G7W**
Carrier bandwidth	MHz	54.0	54.0	54.0		5.2	3.9	3.9
Uplink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Uplink Frequency	GHz	28.977	28.977	28.977		18.527	18.527	18.527
Earth Station Diameter	m	13.20	13.20	13.20		0.60	1.20	2.40
Earth Station Gain	dBi	70.2	70.2	70.2		39.4	45.5	51.5
Earth station EIRP	dBW	74.00	74.00	74.00		45.0	50.0	52.0
Atmospheric Losses	dB	0.85	0.85	0.85		0.02	0.19	0.19
Free Space Loss	dB	-212.8	-212.8	-212.8		-208.9	-208.9	-208.9
Satellite G/T	dB/K	18.6	18.6	18.6		19.0	19.0	19.0
C/N Thermal Uplink	dB	30.2	30.2	30.2		16.5	22.6	24.6
C/I ASI	dB	29.2	29.2	29.2		10.4	16.6	18.6
C/(N+I) uplink	dB	26.7	26.7	26.7		9.5	15.7	17.7
Downlink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Downlink Frequency	GHz	19.227	19.227	19.227		29.527	29.527	29.527
Satellite EIRP per carrier	dBW	53.3	53.3	53.3		48.2	46.9	46.9
Atmospheric Losses	dB	0.36	0.36	0.36		0.38	0.38	0.38
Free Space Path Loss	dB	-209.2	-209.2	-209.2		-212.8	-212.8	-212.8
Earth Station Diameter	m	0.60	1.20	2.40		13.20	13.20	13.20
Earth Station Gain	dBi	39.8	45.8	51.8		70.3	70.3	70.3
System Noise Temperature	K	189	229	230		375	375	375
Earth Station G/T	dB/K	17.0	22.2	28.2		44.6	44.6	44.6
C/N Thermal Downlink	dB	12.0	17.2	23.2		41.1	41.1	41.1
C/I ASI	dB	15.8	21.8	27.9		51.4	51.4	51.4
C/(N+I) downlink	dB	10.5	16.0	22.0		40.7	40.7	40.7
Adjacent Satellite Interference:								
C/I up (single satellite)	dB	32.2	32.2	32.2		13.4	19.6	21.6
C/I dn (single satellite)	dB	18.8	24.8	30.9		54.4	54.4	54.4
Aggregate C/I up	dB	29.2	29.2	29.2		10.4	16.6	18.6
Aggregate C/I down	dB	15.8	21.8	27.9		51.4	51.4	51.4
Overall:								
C/(N+I) overall	dB	10.4	15.6	20.7		9.4	15.7	17.6
C/(N+I) required	dB	2.0	6.2	9.1		2.4	4.6	4.6
Margin	**dB**	**8.4**	**9.4**	**11.6**		**7.0**	**11.1**	**13.0**

Table B.5. Representative SES-17 Ka-band Two-degree Spacing C/I analysis (Atlantic beams)

		FORWARD				RETURN		
		aero	maritime	vsat		aero	maritime	vsat
Link Parameters	**Units**	**54M0G7W**	**54M0G7W**	**54M0G7W**		**5M20G7W**	**3M90G7W**	**3M90G7W**
Carrier bandwidth	MHz	54.0	54.0	54.0		5.2	3.9	3.9
Uplink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Uplink Frequency	GHz	29.400	29.400	29.400		19.550	19.550	19.550
Earth Station Diameter	m	4.50	4.50	4.50		2.40	2.40	2.40
Earth Station Gain	dBi	61.0	61.0	61.0		52.0	52.0	52.0
Earth station EIRP	dBW	63.00	63.00	63.00		52.0	52.0	52.0
Atmospheric Losses	dB	0.39	0.39	0.39		0.02	0.19	0.19
Free Space Loss	dB	-212.9	-212.9	-212.9		-209.3	-209.3	-209.3
Satellite G/T	dB/K	18.6	18.6	18.6		5.6	5.6	5.6
C/N Thermal Uplink	dB	19.6	19.6	19.6		9.7	10.8	10.8
C/I ASI	dB	18.2	18.2	18.2		17.4	18.6	18.6
C/(N+I) uplink	dB	15.8	15.8	15.8		9.0	10.1	10.1
Downlink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Downlink Frequency	GHz	19.550	19.550	19.550		29.400	29.400	29.400
Satellite EIRP per carrier	dBW	48.0	48.0	48.0		47.2	45.9	45.9
Atmospheric Losses	dB	0.14	0.14	0.14		0.38	0.38	0.38
Free Space Path Loss	dB	-209.3	-209.3	-209.3		-212.9	-212.9	-212.9
Earth Station Diameter	m	0.60	1.20	2.40		4.50	4.50	4.50
Earth Station Gain	dBi	39.9	45.9	52.0		61.0	61.0	61.0
System Noise Temperature	K	196	236	238		279	279	279
Earth Station G/T	dB/K	17.0	22.2	28.2		36.5	36.5	36.5
C/N Thermal Downlink	dB	6.8	12.0	18.0		31.8	31.8	31.8
C/I ASI	dB	10.6	16.7	22.7		41.0	41.0	41.0
C/(N+I) downlink	dB	5.3	10.7	16.7		31.3	31.3	31.3
Adjacent Satellite Interference:								
C/I up (single satellite)	dB	21.2	21.2	21.2		20.4	21.6	21.6
C/I dn (single satellite)	dB	13.6	19.7	25.7		44.0	44.0	44.0
Aggregate C/I up	dB	18.2	18.2	18.2		17.4	18.6	18.6
Aggregate C/I down	dB	10.6	16.7	22.7		41.0	41.0	41.0
Overall:								
C/(N+I) overall	dB	4.9	9.6	13.2		9.0	10.1	10.1
C/(N+I) required	dB	2.0	6.2	9.1		2.4	4.6	4.6
Margin	**dB**	**2.9**	**3.4**	**4.1**		**6.6**	**5.5**	**5.5**

Table B.6. Representative SES-17 Ka-band Two-degree Spacing C/I analysis (Field-of-View (FoV) beams)

		FORWARD				RETURN		
		aero	maritime	vsat		aero	maritime	vsat
Link Parameters	**Units**	**38M0G7W**	**38M0G7W**	**38M0G7W**		**5M20G7W**	**3M90G7W**	**3M90G7W**
Carrier bandwidth	MHz	38.0	38.0	38.0		5.2	3.9	3.9
Uplink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Uplink Frequency	GHz	29.400	29.400	29.400		19.350	19.350	19.350
Earth Station Diameter	m	4.50	4.50	4.50		2.40	2.40	2.40
Earth Station Gain	dBi	61.0	61.0	61.0		51.9	51.9	51.9
Earth station EIRP	dBW	63.00	63.00	63.00		52.0	52.0	52.0
Atmospheric Losses	dB	0.39	0.39	0.39		0.02	0.19	0.19
Free Space Loss	dB	-212.9	-212.9	-212.9		-209.2	-209.2	-209.2
Satellite G/T	dB/K	18.6	18.6	18.6		2.5	2.5	2.5
C/N Thermal Uplink	dB	21.1	21.1	21.1		6.7	7.7	7.7
C/I ASI	dB	19.8	19.8	19.8		17.4	18.6	18.6
C/(N+I) uplink	dB	17.4	17.4	17.4		6.3	7.4	7.4
Downlink:		**Ka-band**	**Ka-band**	**Ka-band**		**Ka-band**	**Ka-band**	**Ka-band**
Downlink Frequency	GHz	19.350	19.350	19.350		29.400	29.400	29.400
Satellite EIRP per carrier	dBW	48.8	48.8	48.8		31.9	30.6	30.6
Atmospheric Losses	dB	0.14	0.14	0.14		0.38	0.38	0.38
Free Space Path Loss	dB	-209.2	-209.2	-209.2		-212.9	-212.9	-212.9
Earth Station Diameter	m	0.60	1.20	2.40		4.50	4.50	4.50
Earth Station Gain	dBi	39.8	45.8	51.9		61.0	61.0	61.0
System Noise Temperature	K	192	232	233		279	279	279
Earth Station G/T	dB/K	17.0	22.2	28.2		36.5	36.5	36.5
C/N Thermal Downlink	dB	9.2	14.4	20.4		16.5	16.5	16.5
C/I ASI	dB	12.9	18.9	24.9		25.7	25.7	25.7
C/(N+I) downlink	dB	7.7	13.1	19.1		16.0	16.0	16.0
Adjacent Satellite Interference:								
C/I up (single satellite)	dB	22.8	22.8	22.8		20.4	21.6	21.6
C/I dn (single satellite)	dB	15.9	21.9	27.9		28.7	28.7	28.7
Aggregate C/I up	dB	19.8	19.8	19.8		17.4	18.6	18.6
Aggregate C/I down	dB	12.9	18.9	24.9		25.7	25.7	25.7
Overall:								
C/(N+I) overall	dB	7.2	11.7	15.1		5.9	6.9	6.9
C/(N+I) required	dB	2.0	6.2	9.1		2.4	4.6	4.6
Margin	**dB**	**5.2**	**5.5**	**6.0**		**3.5**	**2.3**	**2.3**

Tables B.7 through B.22 present the calculations for the pfd limits defined in §25.140 and/or §25.208. The results indicate that the requirements are always met for all beams.

Table B.7. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for NCD1 representative User beam group

NCD1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	63.1	63.1	63.1	63.1	63.1	63.1
Gain roll-off at elevation angle, dBi	-20.0	-20.0	-20.0	-20.0	-20.0	0.0
EIRP at elevation angle, dBW	43.1	43.1	43.1	43.1	43.1	63.1
Carrier bandwidth, MHz	120.00	120.00	120.00	120.00	120.00	120.00
EIRP density at elevation angle dBW/1MHz	23.1	23.1	23.1	23.1	23.1	43.1
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **5.208(d)** to protect EESS in 18.6-18.8 GHz **dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz, **dBW/m2/1MHz**	-115.0	-112.5	-110.0	-107.5	-105.0	-105.0
pfd, dBW/m2/1MHz	**-140.2**	**-140.1**	**-140.0**	**-139.8**	**-139.7**	**-119.0**
Margin, dB, relative to 25.140 and 25.208(d)	22.2	22.1	22.0	21.8	21.7	1.0
Margin, dB, relative to 25.208(c)	25.2	27.6	30.0	32.3	34.7	14.0

Table B.8. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for NCD2 representative User beam group

NCD2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	62.6	62.6	62.6	62.6	62.6	62.6
Gain roll-off at elevation angle, dBi	-20.0	-20.0	-20.0	-20.0	-20.0	0.0
EIRP at elevation angle, dBW	42.6	42.6	42.6	42.6	42.6	62.6
Carrier bandwidth, MHz	98.00	98.00	98.00	98.00	98.00	98.00
EIRP density at elevation angle dBW/1MHz	23.48	23.48	23.48	23.48	23.48	43.48
Minimum spreading loss, dB/m2	-163.27	-163.15	-163.06	-162.94	-162.84	-162.07
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d)** to protect EESS in 18.6-18.8 GHz **dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz **dBW/m2/1MHz**	-115.0	-112.5	-110.0	-107.5	-105.0	-105.0
pfd, dBW/m2/1MHz	**-139.8**	**-139.7**	**-139.6**	**-139.5**	**-139.4**	**-118.6**
Margin, dB, relative to 25.140	21.8	21.7	21.6	21.5	21.4	0.6
Margin, dB, relative to 25.208(c)	24.8	27.2	29.6	32.0	34.4	13.6

Table B.9. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for NSD1 representative User beam group

NSD1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	61.1	61.1	61.1	61.1	61.1	61.1
Gain roll-off at elevation angle, dBi	-0.4	0.0	-0.3	-1.4	-4.0	-10.0
EIRP at elevation angle, dBW	60.7	61.1	60.8	59.7	57.1	51.1
Carrier bandwidth, MHz	64.00	64.00	64.00	64.00	64.00	64.00
EIRP density at elevation angle dBW/1MHz	43.4	43.8	43.5	42.4	39.8	33.8
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d)** to protect EESS in 18.6-18.8 GHz **dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-119.8**	**-119.3**	**-119.5**	**-120.5**	**-123.0**	**-128.2**
Margin, dB, relative to 25.140	1.8	1.3	1.5	2.5	5.0	10.2
Margin, dB, relative to 25.208(c)	4.8	6.8	9.5	13.0	18.0	23.2

Table B.10. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for NSD2 representative User beam group

NSD2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	61.0	61.0	61.0	61.0	61.0	61.0
Gain roll-off at elevation angle, dBi	-3.5	-2.0	-0.8	0.0	-1.0	-5.3
EIRP at elevation angle, dBW	57.5	59.0	60.2	61.0	60.0	55.7
Carrier bandwidth, MHz	64.00	64.00	64.00	64.00	64.00	64.00
EIRP density at elevation angle dBW/1MHz	40.3	41.7	42.9	43.7	42.7	38.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d)** to protect EESS in 18.6-18.8 GHz **dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-123.0**	**-121.4**	**-120.1**	**-119.2**	**-120.1**	**-123.6**
Margin, dB, relative to 25.140	5.0	3.4	2.1	1.2	2.1	5.6
Margin, dB, relative to 25.208(c)	8.0	8.9	10.1	11.7	15.1	18.6

Table B.11. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for SAD1 representative User beam group

SAD1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	60.3	60.3	60.3	60.3	60.3	60.3
Gain roll-off at elevation angle, dBi	-1.5	-1.1	0.0	-0.2	-1.1	-1.5
EIRP at elevation angle, dBW	58.8	59.2	60.3	60.2	59.2	58.8
Carrier bandwidth, MHz	54.00	54.00	54.00	54.00	54.00	54.00
EIRP density at elevation angle dBW/1MHz	42.3	42.6	43.8	43.6	42.7	42.3
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 GHz **25.208(d)** to protect EESS in 18.6-18.8 GHz **dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-121.0**	**-120.5**	**-119.3**	**-119.3**	**-120.2**	**-119.8**
Margin, dB, relative to 25.140	3.0	2.5	1.3	1.3	2.2	1.8
Margin, dB, relative to 25.208(c)	6.0	8.0	9.3	11.8	15.2	14.8

Table B.12. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for SAD2 representative User beam group

SAD2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	60.7	60.7	60.7	60.7	60.7	60.7
Gain roll-off at elevation angle, dBi	-1.0	-0.7	0.0	-0.1	-0.8	-1.7
EIRP at elevation angle, dBW	59.7	60.0	60.7	60.6	60.0	59.0
Carrier bandwidth, MHz	54.00	54.00	54.00	54.00	54.00	54.00
EIRP density at elevation angle dBW/1MHz	43.2	43.5	44.2	44.1	43.4	42.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d)** to protect EESS in 18.6-18.8 GHz **dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-120.1**	**-119.6**	**-118.9**	**-118.8**	**-119.4**	**-119.6**
Margin, dB, relative to 25.140	2.1	1.6	0.9	0.8	1.4	1.6
Margin, dB, relative to 25.208	5.1	7.1	8.9	11.3	14.4	14.6

Table B.13. Maximum PFD values and margins relative to permissible limits of §25.208 for TAD1 representative User beam group

TAD1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	49.5	49.5	49.5	49.5	49.5	49.5
Gain roll-off at elevation angle, dBi	-1.3	-1.8	-1.4	-0.8	-0.1	0.0
EIRP at elevation angle, dBW	48.2	47.7	48.1	48.7	49.4	49.5
Carrier bandwidth, MHz	9.00	9.00	9.00	9.00	9.00	9.00
EIRP density at elevation angle dBW/1MHz	39.4	38.9	39.3	39.9	40.6	40.7
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208 (c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-123.9**	**-124.2**	**-123.7**	**-123.0**	**-122.2**	**-121.3**
Margin, dB, relative to 25.208 (c)	8.9	11.7	13.7	15.5	17.2	16.3

Table B.14. Maximum PFD values and margins relative to permissible limits of §25.208 for TAD2 representative User beam group

TAD2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	50.0	50.0	50.0	50.0	50.0	50.0
Gain roll-off at elevation angle, dBi	-4.1	-3.7	-2.9	-1.9	-1.3	0.0
EIRP at elevation angle, dBW	45.9	46.3	47.1	48.1	48.8	50.0
Carrier bandwidth, MHz	9.00	9.00	9.00	9.00	9.00	9.00
EIRP density at elevation angle dBW/1MHz	37.1	37.5	38.4	39.3	40.0	41.2
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208 (c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-126.2**	**-125.6**	**-124.7**	**-123.6**	**-122.8**	**-120.8**
Margin, dB, relative to 25.208 (c)	11.2	13.1	14.7	16.1	17.8	15.8

Table B.15. Maximum PFD values and margins relative to permissible limits of §25.208 for FVD1 representative User beam group

FVD1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	47.0	47.0	47.0	47.0	47.0	47.0
Gain roll-off at elevation angle, dBi	-0.6	-0.3	0.0	-0.3	-0.7	-1.2
EIRP at elevation angle, dBW	46.4	46.7	47.0	46.7	46.3	45.8
Carrier bandwidth, MHz	5.00	5.00	5.00	5.00	5.00	5.00
EIRP density at elevation angle dBW/1MHz	40.2	40.5	40.8	40.5	40.1	39.6
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208 (c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-123.1**	**-122.7**	**-122.3**	**-122.4**	**-122.7**	**-122.5**
Margin, dB, relative to 25.208	8.1	10.2	12.3	14.9	17.7	17.5

Table B.16. Maximum PFD values and margins relative to permissible limits of §25.208 for FVD2 representative User beam group

FVD2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	47.0	47.0	47.0	47.0	47.0	47.0
Gain roll-off at elevation angle, dBi	-2.1	-1.9	-1.5	-1.0	-0.3	0.0
EIRP at elevation angle, dBW	44.9	45.1	45.5	46.0	46.7	47.0
Carrier bandwidth, MHz	5.00	5.00	5.00	5.00	5.00	5.00
EIRP density at elevation angle dBW/1MHz	38.7	38.9	39.3	39.8	40.5	40.8
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208 (c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-124.6**	**-124.3**	**-123.8**	**-123.1**	**-122.3**	**-121.3**
Margin, dB, relative to 25.208 (c)	9.6	11.8	13.8	15.6	17.3	16.3

Table B.17. Maximum PFD values and margins relative to permissible limits of §25.208 for VED1 representative User beam group

VED1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	44.0	44.0	44.0	44.0	44.0	44.0
Gain roll-off at elevation angle, dBi	-1.0	-0.9	-0.8	-0.6	-0.5	0.0
EIRP at elevation angle, dBW	43.0	43.1	43.2	43.4	43.5	44.0
Carrier bandwidth, MHz	2.40	2.40	2.40	2.40	2.40	2.40
EIRP density at elevation angle dBW/1MHz	40.0	40.0	40.2	40.3	40.5	41.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208 (c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-123.3**	**-123.1**	**-122.9**	**-122.6**	**-122.3**	**-121.1**
Margin, dB, relative to 25.208 (c)	8.3	10.6	12.9	15.1	17.3	16.1

Table B.18. Maximum PFD values and margins relative to permissible limits of §25.208 for VED2 representative User beam group

VED2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	44.0	44.0	44.0	44.0	44.0	44.0
Gain roll-off at elevation angle, dBi	-1.2	-1.1	-1.1	-0.9	-0.7	0.0
EIRP at elevation angle, dBW	42.8	42.9	43.0	43.1	43.3	44.0
Carrier bandwidth, MHz	2.40	2.40	2.40	2.40	2.40	2.40
EIRP density at elevation angle dBW/1MHz	39.7	39.8	39.9	40.1	40.3	41.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208 (c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-123.5**	**-123.3**	**-123.1**	**-122.8**	**-122.5**	**-121.1**
Margin, dB, relative to 25.208	8.5	10.8	13.1	15.3	17.5	16.1

Table B.19. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for GWD1 beam

GWD1						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	62.0	62.0	62.0	62.0	62.0	62.0
Gain roll-off at elevation angle, dBi	-2.6	-1.5	-0.8	-0.5	0.0	-8.0
EIRP at elevation angle, dBW	59.4	60.5	61.2	61.5	62.0	54.0
Carrier bandwidth, MHz	500.00	500.00	500.00	500.00	500.00	500.00
EIRP density at elevation angle dBW/1MHz	33.2	34.3	35.0	35.3	35.8	27.8
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d) to protect EESS) dBW/m2/1MHz**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
25.208(w) 17.3-17.7 MHz **dBW/m2/MHz, (3) In the region of the contiguous United States, located west of 100 West Longitude**	-121.0	-121.0	-121.0	-121.0	-121.0	-121.0
pfd, dBW/m2/1MHz	**-130.1**	**-128.9**	**-128.1**	**-127.6**	**-127.0**	**-134.3**
Margin, dB, relative to 25.140(a)(3)(iii)	12.1	10.9	10.1	9.6	9.0	16.3
Margin, dB, relative to 25.208(c)	15.1	16.4	18.1	20.1	22.0	29.3
Margin, dB, relative to 25.208(w)	9.1	7.9	7.1	6.6	6.0	13.3

Table B.20. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for GWD2 beam

GWD2						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	61.6	61.6	61.6	61.6	61.6	61.6
Gain roll-off at elevation angle, dBi	-2.8	-1.6	-0.5	0.0	-2.0	-8.0
EIRP at elevation angle, dBW	58.8	60.0	61.1	61.6	59.6	53.6
Carrier bandwidth, MHz	500.00	500.00	500.00	500.00	500.00	500.00
EIRP density at elevation angle dBW/1MHz	32.6	33.8	34.9	35.4	33.4	27.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d) to protect EESS) dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 dBW/m2/1MHz	-115	-112.5	-110	-107.5	-105	-105
25.208(w) 17.3-17.7 MHz **dBW/m2/MHz, (3) In the region of the contiguous United States, located west of 100 West Longitude**	-121.0	-121.0	-121.0	-121.0	-121.0	-121.0
pfd, dBW/m2/1MHz	**-130.7**	**-129.4**	**-128.1**	**-127.5**	**-129.4**	**-134.7**
Margin, dB, relative to 25.140(a)(3)(iii)	12.7	11.4	10.1	9.5	11.4	16.7
Margin, dB, relative to 25.208 (c)	15.7	16.9	18.1	20.0	24.4	29.7
Margin, dB, relative to 25.208 (w)	9.7	8.4	7.1	6.5	8.4	13.7

Table B.21. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for GWD3 beam

GWD3						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	61.9	61.9	61.9	61.9	61.9	61.9
Gain roll-off at elevation angle, dBi	-20.0	-20.0	-20.0	-20.0	-20.0	0.0
EIRP at elevation angle, dBW	41.9	41.9	41.9	41.9	41.9	61.9
Carrier bandwidth, MHz	500.00	500.00	500.00	500.00	500.00	500.00
EIRP density at elevation angle dBW/1MHz	15.7	15.7	15.7	15.7	15.7	35.7
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.140(a)(3)(iii) 18.3-18.8, 19.7-20.2 **25.208(d) to protect EESS) dBW/m2/MHz for all angles**	-118.0	-118.0	-118.0	-118.0	-118.0	-118.0
25.208(c) GSO space station pfd limit 17.7-19.7 GHz **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
25.208(w) 17.3-17.7 MHz **dBW/m2/MHz, (1) In the region of the contiguous United States, located south of 38° North Latitude and east of 100 West Longitude**	-115.0	-115.0	-115.0	-115.0	-115.0	-115.0
pfd, dBW/m2/1MHz	**-147.6**	**-147.5**	**-147.4**	**-147.2**	**-147.1**	**-126.4**
Margin, dB, relative to 25.140(a)(3)(iii)	29.6	29.5	29.4	29.2	29.1	8.4
Margin, dB, relative to 25.208 (c)	32.6	35.0	37.4	39.7	42.1	21.4
Margin, dB, relative to 25.208 (w)	32.6	32.5	32.4	32.2	32.1	11.4

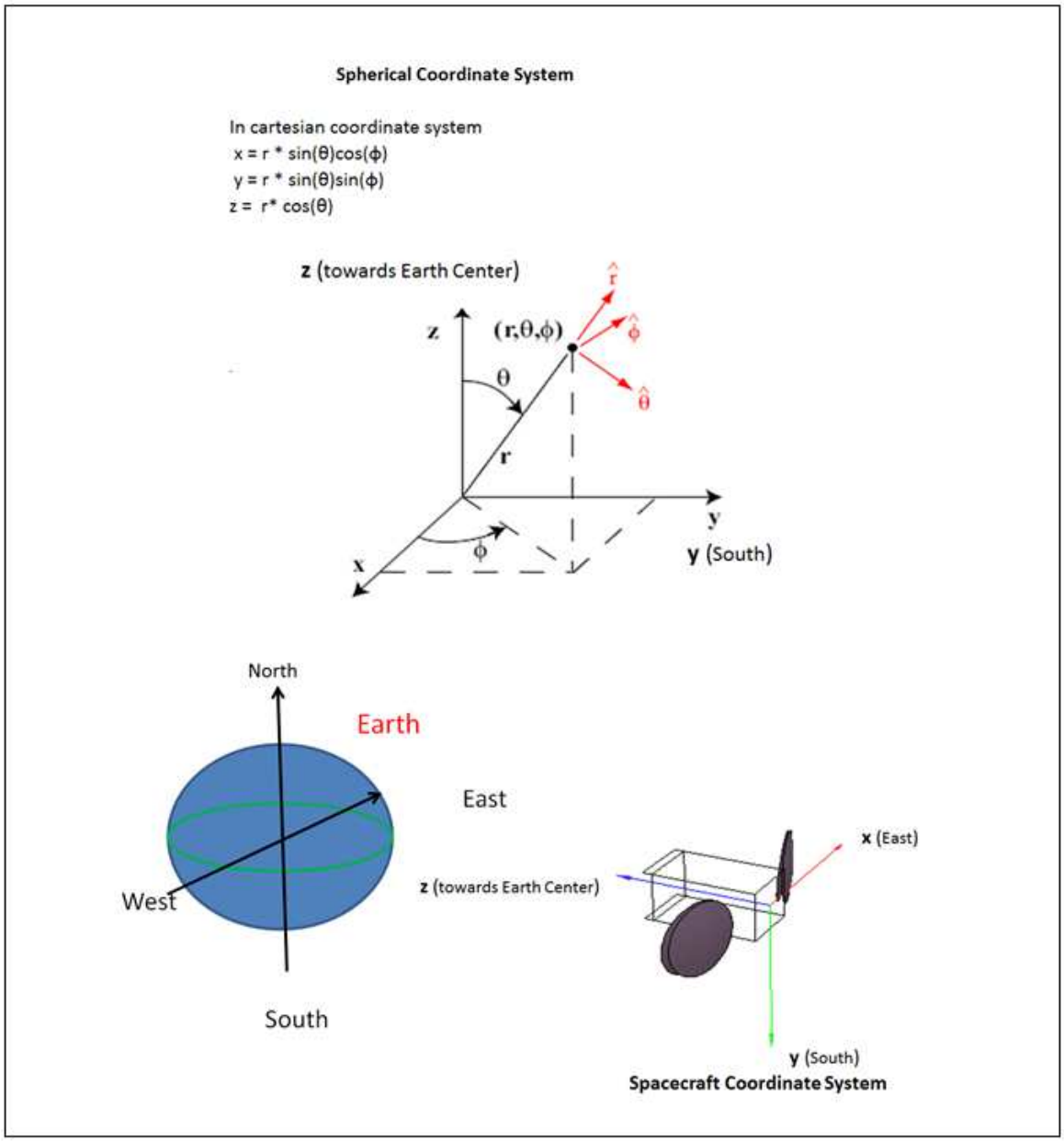
Table B.22. Maximum PFD values and margins relative to permissible limits of §25.140 and §25.208 for Beacon

Ka-band Beacon						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	21.4	21.4	21.4	21.4	21.4	21.4
EIRP at elevation angle, dBW	21.4	21.4	21.4	21.4	21.4	21.4
Carrier bandwidth, MHz	0.30	0.30	0.30	0.30	0.30	0.30
EIRP density at elevation angle dBW/1MHz	27.4	27.4	27.4	27.4	27.4	27.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208(c) GSO space station pfd limit 17.7-19.7 **dBW/m2/1MHz**	-115	-112.5	-110	-107.5	-105	-105
pfd, dBW/m2/1MHz	**-135.9**	**-135.7**	**-135.6**	**-135.5**	**-135.4**	**-134.6**
Margin, dB, relative to 25.208(c)	20.9	23.2	25.6	28.0	30.4	29.6

ANNEX C - §25.264(a) & (b) Requirements to facilitate reverse-band operation in the 17.3-17.8 GHz band of 17/24 GHz BSS and DBS space stations

This Annex provides the predicted transmitting antenna off-axis gain information specified in Section 25.264(a) of the Commission's rules for the frequency band 17.3-17.8 GHz (space-to-Earth). The reference coordinate system is depicted in Figure C.1.

Figure C.1. Reference Coordinate System for 25.264(a)



The figures in ATTACHMENT A - Beam Patterns provide the off-axis gain for the frequency range 17.3-17.8 GHz as required in §25.264(a).

The analysis below presents the pfd calculations as required by rule 25.264(b). This calculation considers the aggregate pfd from all SES-17 beams in the 17.3-17.8 GHz band. The neighboring DBS satellites to SES-17 at the nominal location of 67.1° W.L. are EchoStar 15/16 and NIMIQ 5 respectively located at the 61.7° and 72.7° W.L. orbital locations. From the antenna data above, the highest value in the +X and -X direction in respect to the off-axis gain for all beams is 0 dB. This value is used to calculate the aggregate pfd for 16 beams and presents a worst-case scenario. The associated EIRP densities are calculated accordingly and are shown in Table C.1 to determine the worst case aggregate pfd levels generated by SES-17 at the DBS satellite orbital locations.

Given the large margin for the requested cases, SES also considered the case of a satellite located at 67.3° W.L., which is 0.2° away from 67.1° W.L. in the -X direction (this direction has the worst case EIRP density). At 0.2° away, the spreading loss decreases to 114.3 dB and the resulting aggregate pfd at the victim orbital location is −124.0 dBW/m^2/100 kHz, which is still 7 dB below the 25.264(b) requirement of -117 dBW/m^2/100 kHz

Table C.1. §25.264(b) pfd analysis

		interferer	victim(s)		
Victim Satellites		SES-17	EchoStar 15/16	NIMIQ 5	hypothetical (0.2°)
Orbital Location	(° W.L.)	67.1	61.7	72.7	67.3
Geocentric orbital separation	(°)	N/A	5.5	-5.6	-0.2
Separation Distance	km	N/A	4010.7	-4121.0	-147.2
Path Loss	dB/m2	N/A	143.1	143.3	114.3
Off-axis angle (from SES-17 to victim)	(°)	N/A	87.3	-87.2	-87.2
Directivity/off-axis gain	dBi	40.0	-19.0	0.0	0.0
EIRPSD	dBW/100kHz	18.3	-40.7	-21.7	-21.7
25.264(b) requirments	dBW/m2/100 kHz	N/A	-117.0	-117.0	-117.0
AGGREGATE pfd, dBW/m2/100 kHz (16 beams)	dBW/m2/100 kHz	N/A	-171.7	-153.0	-124.0
Margin, dB, relative to 25.264(b)		**N/A**	**54.7**	**36.0**	**7.0**

ANNEX D - Compatibility of SES-17 with DBS Feeder Link Earth stations: Appendix 7 GIBC Results

Annex D provides the Appendix 7 analysis as described in section §4.1.3. As mentioned in that section, GIBC can be used to determine the coordination area required for two earth stations operating in the opposite transmission directions. The assumptions used in the analysis as well as the results are presented below.

Table D.1. Transmitting Earth Station Parameters

Parameters for Appendix 7 Analysis

Nearest Transmitting DBS Feeder Link Earth Station - Spokane, WA

Distance: 172 km from SES-17 Brewster receive earth station

Call Sign	Location	Longitude	Latitude	Satellite Location (°E)	Earth Station antenn gain (dBi)	Frequency Range (GHz)	Power Density Max (dBW/Hz)	Antenna Pattern
E070275	Spokane, WA	117°33'5" W	47°35'34" N	-72.7	62.9	17.3-17.8	-36	ITU-R S.465

Horizon Elevation parameters

Row	Azimuth (°)	Minimum elevation angle (°)	Distacnce (km)
1	0	5	0.5
2	90	5	0.5
3	180	5	0.5
4	270	5	0.5
5	360	5	0.5

Nearest Transmitting DBS Feeder Link Earth Station - New Braunfels, TX

Distance: 266 km from SES-17 Laredo receive Earth station

Call Sign	Location	Longitude	Latitude	Satellite Location (°E)	Earth Station antenn gain (dBi)	Frequency Range (GHz)	Power Density Max (dBW/Hz)	Antenna Pattern
E060004	New Braunfels, TX	98°3'48" W	29°43'36" N	-110	65	17.3-17.8	-36	ITU-R S.465

Horizon Elevation parameters

Row	Azimuth (°)	Minimum elevation angle (°)	Distacnce (km)
1	0	5	0.5
2	90	5	0.5
3	180	5	0.5
4	270	5	0.5
5	360	5	0.5

Table D.2. Receiving Earth Station Parameters
(derived from Appendix 7 Table 9b of ITU Radio Regulations contained in §25.203(m))

Space service designation in which the transmitting earth station operates	Fixed-satellite		
Frequency bands (GHz)	17.3-17.8		
Space service designation in which the receiving earth station operates	Broadcasting-satellite		
Orbit	GSO		
Modulation at receiving earth station	N (digital)		
Receiving earth station interference parameters and criteria:			
p_0 (%)	0.015		
n	2		
p (%)	0.015		
N_i(dB)	1		
M_s (dB)	In the area specified in 47 CFR §25.209(w)(1) and (4)	In the area specified in 47 CFR §25.209(w)(2)	In the area specified in 47 CFR §25.209(w)(3).
	4.8	3.0	1.8.
W(dB)	4		
Receiving earth station parameters:			
G_m (dBi)	36		
G_r	0		
ε_{min}	20°		
T_e (K)	150		
Reference bandwidth:			
B (Hz)	10^6		
Permissible interference power: $P_r(p)$ (dBW) in B	−146.8	−149.8	−152.8.

Figure D.1. GIBC Spokane, WA results
(nearest DBS site to SES-17 gateway in Brewster, WA)

Diagram 2: 3.1_TABLE9. TRANSMITTING GSO ES in FIXED-SATELLITE SERVICE W.R.T. RECEIVING GSO ES in FIXED-SATELLITE AND METEREOLOGICAL-SATELLITE SERVICES.

Notice ID: 9
Administration/Geographical area: USA/USA
Satellite orbital position: -72.70
Frequency band: 17700.0000-17800.0000 MHz

Earth station name: SPOKANE
Earth station position: 117W330547N3534
Satellite name: ECHOSTAR

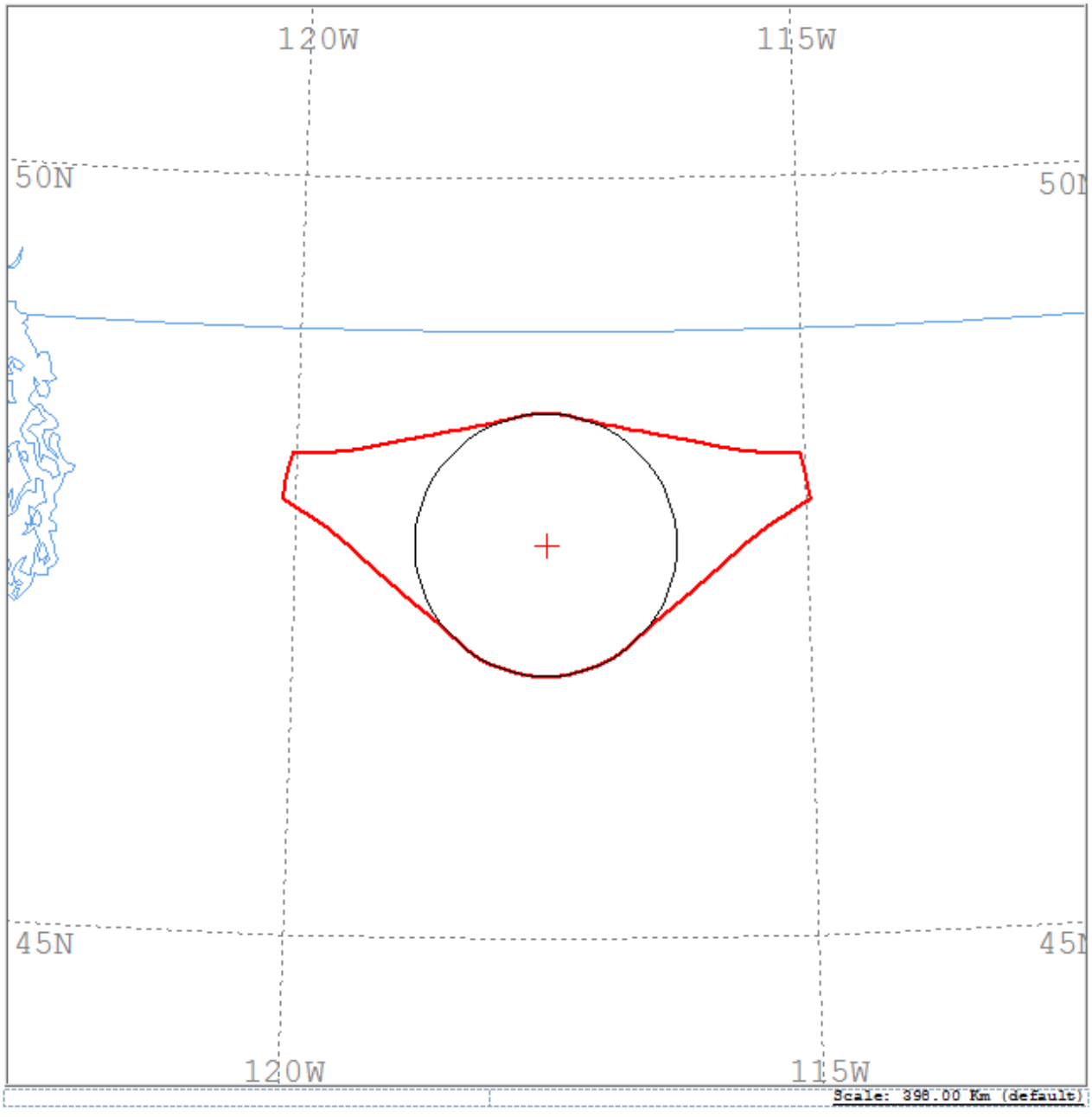


Figure D.1. above shows that the total coordination distance in all directions for Main Mode 1 is 96 km.

Main Mode 1 indicates the required distance within which the transmitting DBS feeder link earth station located in Spokane, WA would need to coordinate. The SES-17 gateway station in Brewster, WA is located outside of this required coordination area.

Main Mode 2 uses a propagation model which includes bi-directional rain scatter and indicates further distances towards all horizons as a default, including pointing in directions where SES-17 will not operate. Because of those reasons Main Mode 2 is ignored.

Figure D.2. GIBC New Braunfels, TX Results
(nearest DBS site to SES-17 gateway in Laredo, TX)

Diagram 2: 3.1_TABLE9. TRANSMITTING GSO ES in FIXED-SATELLITE SERVICE W.R.T. RECEIVING GSO ES in FIXED-SATELLITE AND METEREOLOGICAL-SATELLITE SERVICES.

Notice ID: 11
Administration/Geographical area: USA/USA
Satellite orbital position: -110.00
Frequency band: 17700.0000-17800.0000 MHz

Earth station name: NEW BRAUNSFELS
Earth station position: 099W034829N4336
Satellite name: ECHOSTAR

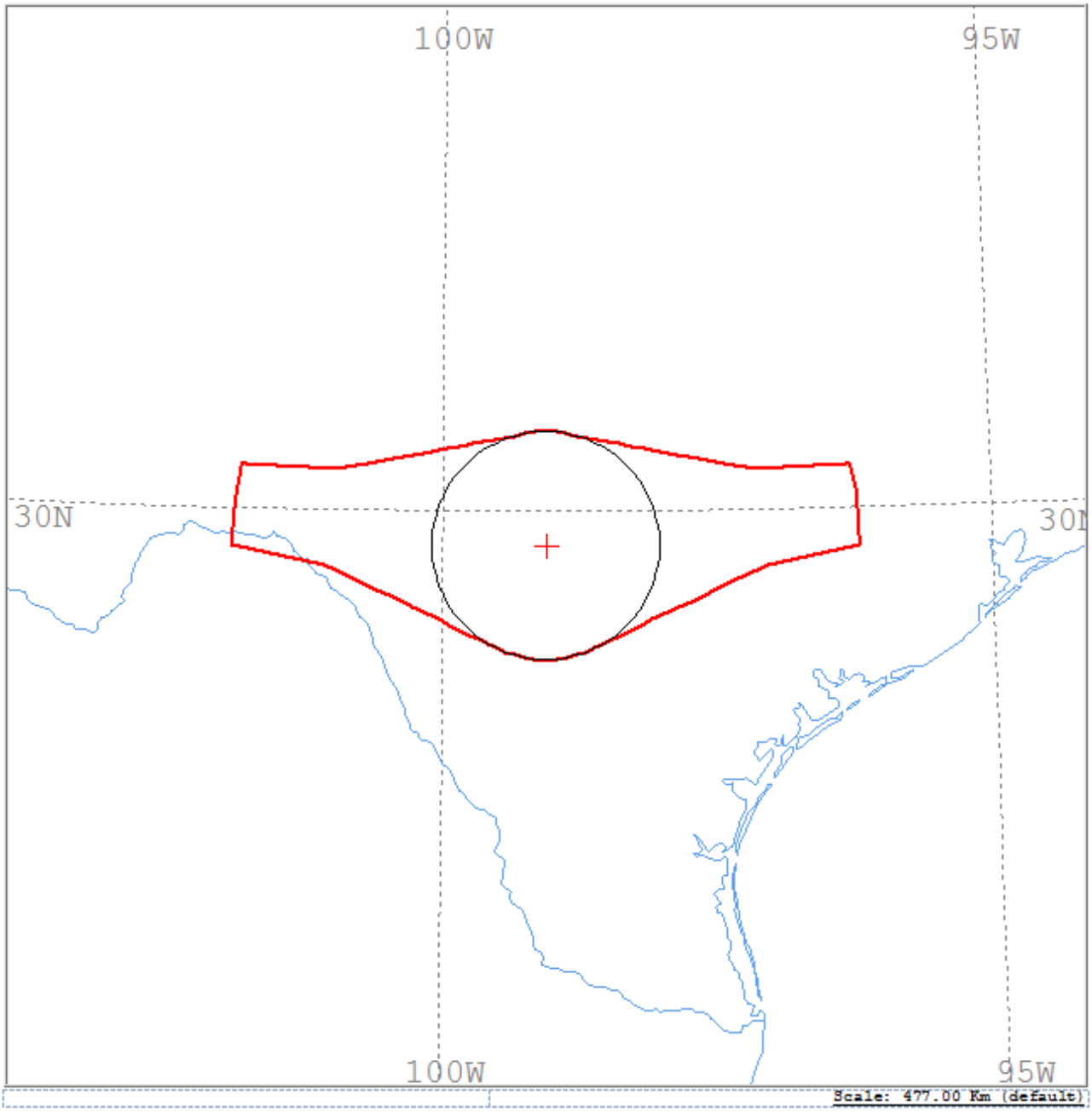


Figure D.2. above shows that the total coordination distance in all directions for Main Mode 1 is 100 km.

Main Mode 1 indicates the required distance within which the transmitting DBS feeder link earth station located in New Braunfels, TX would need to coordinate. The SES-17 gateway station in Laredo, TX is located outside of this required coordination area.

Main Mode 2 uses a propagation model which includes bi-directional rain scatter and indicates further distances towards all horizons as a default, including pointing in directions where SES-17 will not operate. Because of those reasons Main Mode 2 is ignored.

DECLARATION

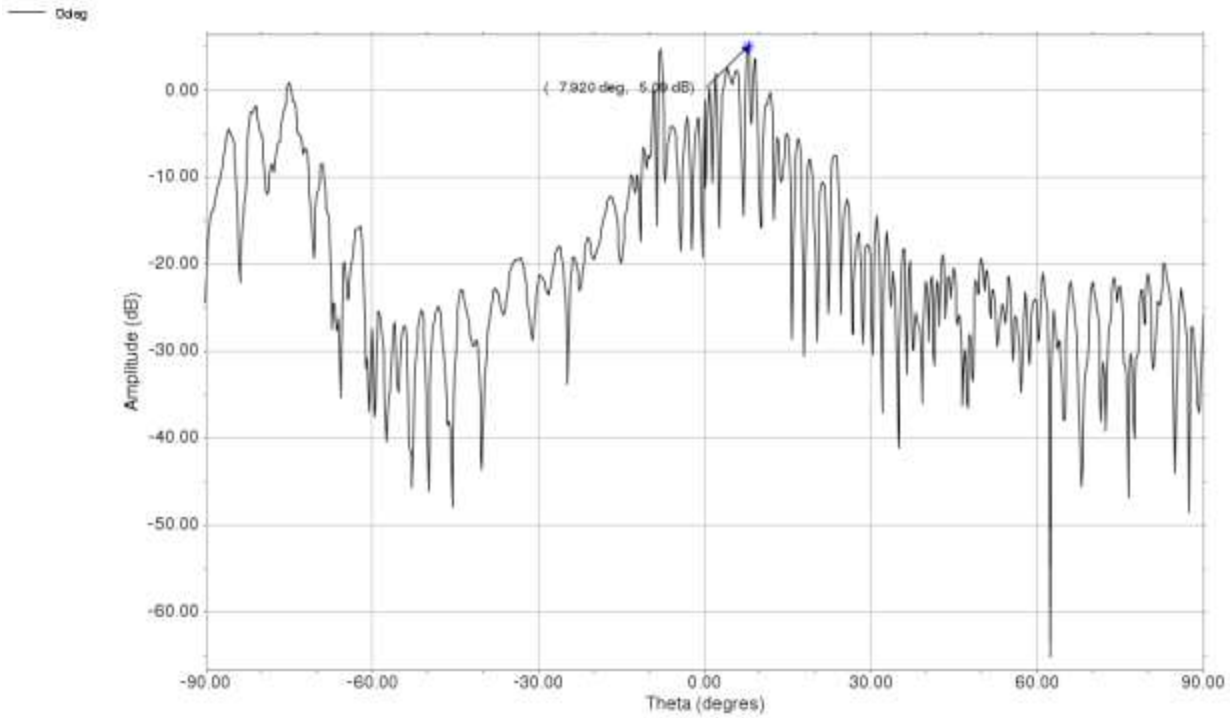
I, Ryan Henry, hereby certify under penalty of perjury that I am the technically qualified person responsible for preparation of the technical information contained in the foregoing exhibit; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical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

/s/ Ryan Henry
Ryan Henry
Senior Manager, Spectrum Management & Development
SES

Dated: March 5, 2019

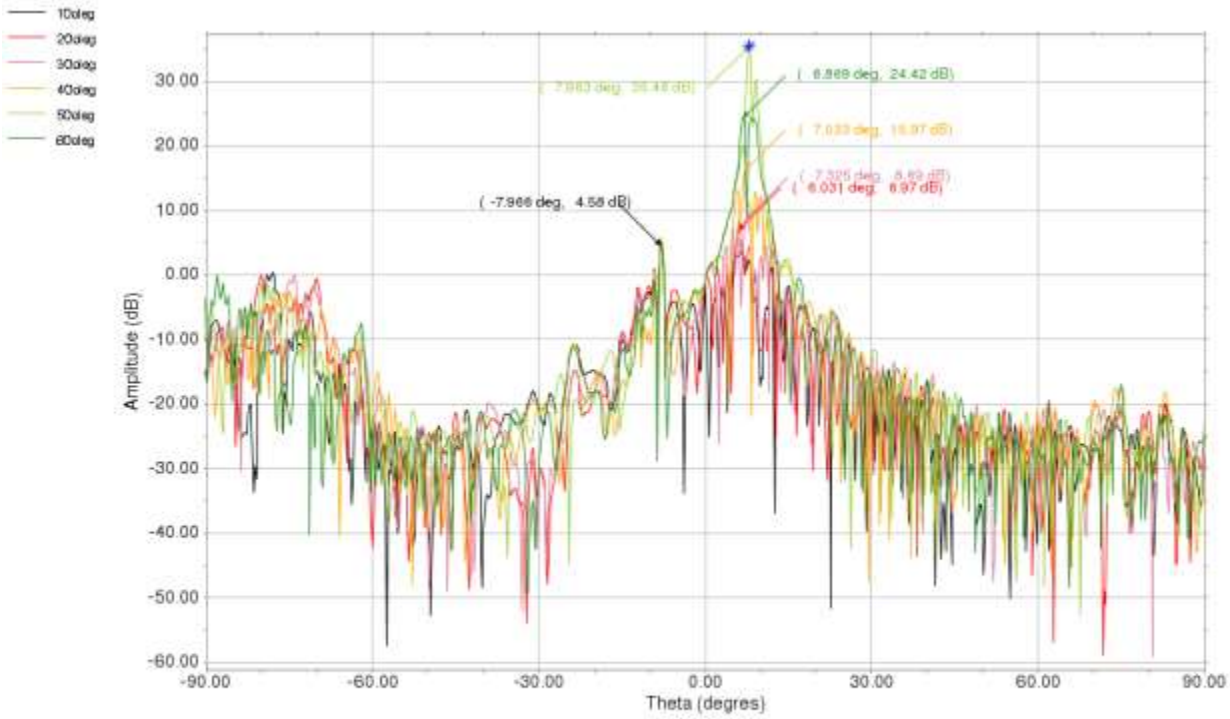
ATTACHMENT A - Beam Patterns

The figures below provide the off-axis gain for the frequency range 17.3-17.8 GHz as required in §25.264(a).



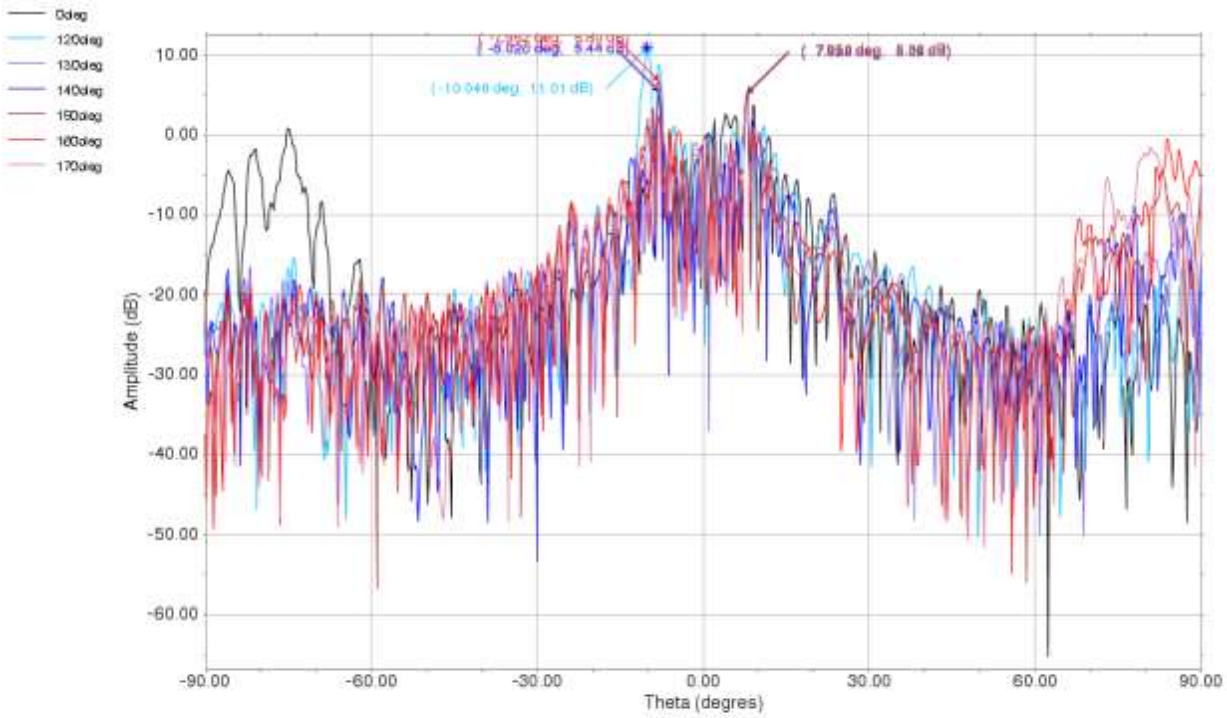
BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :35.49 dB **CX max :13.28 dB**



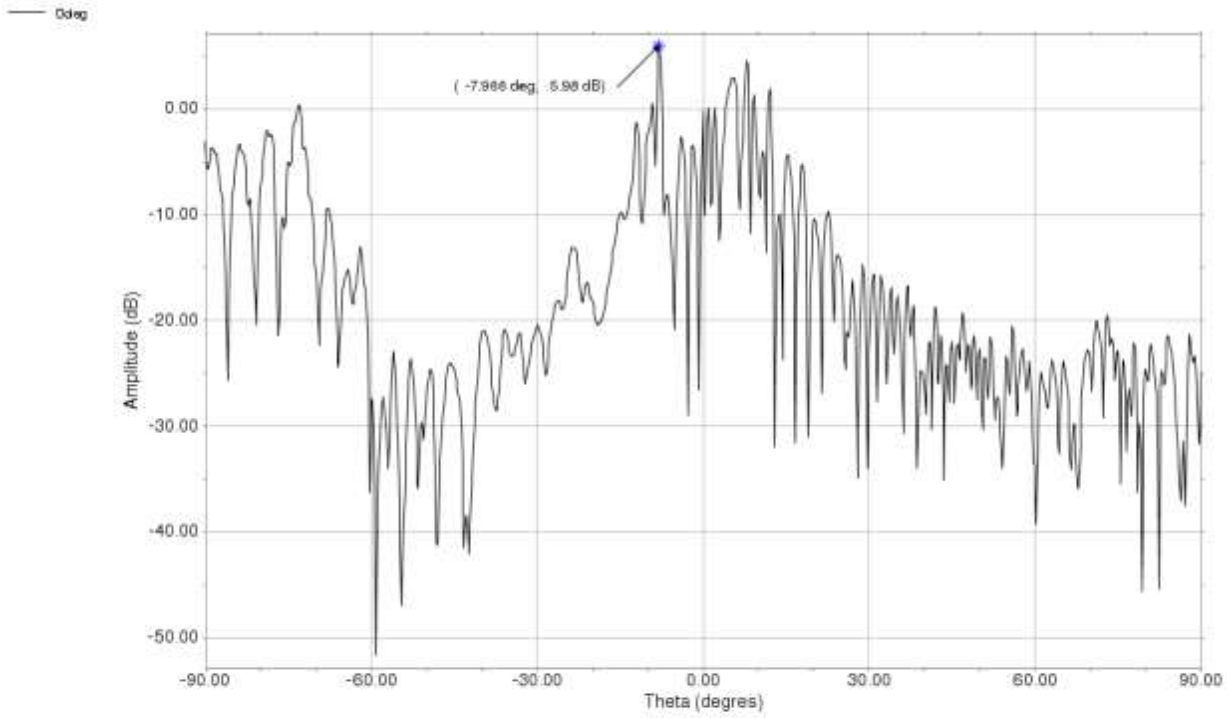
BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :35.49 dB **CX max :13.28 dB**



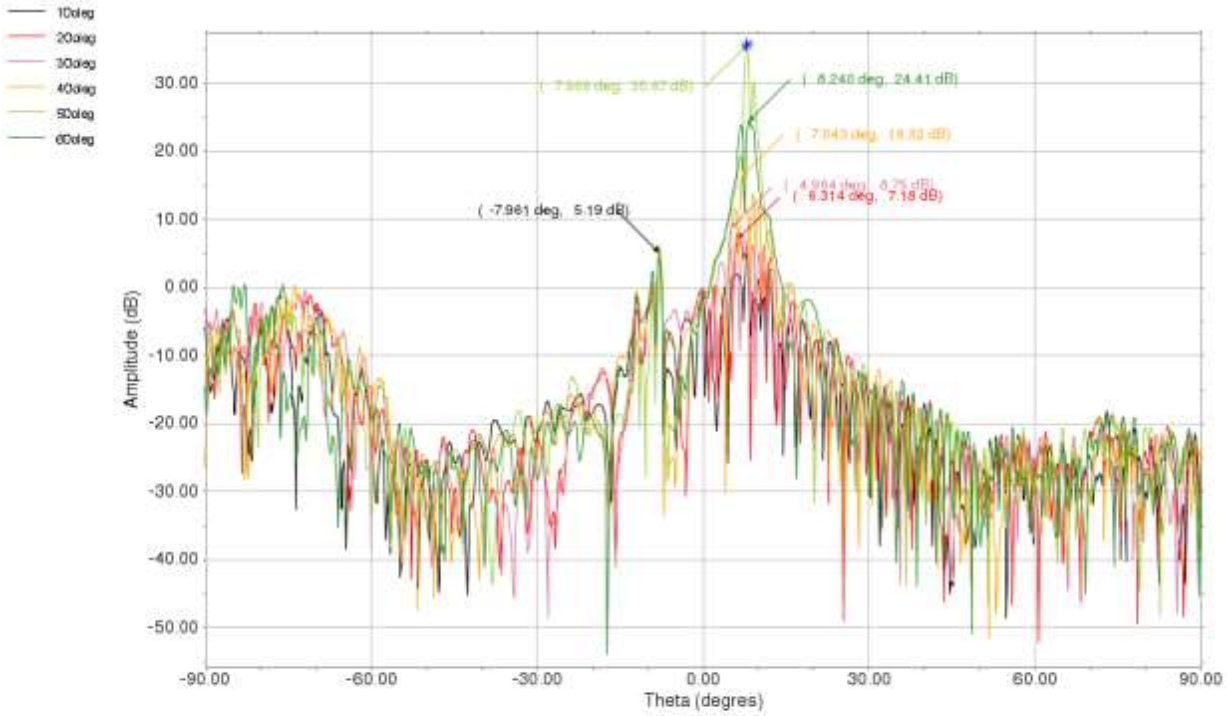
BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :35.49 dB **CX max :13.28 dB**



BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

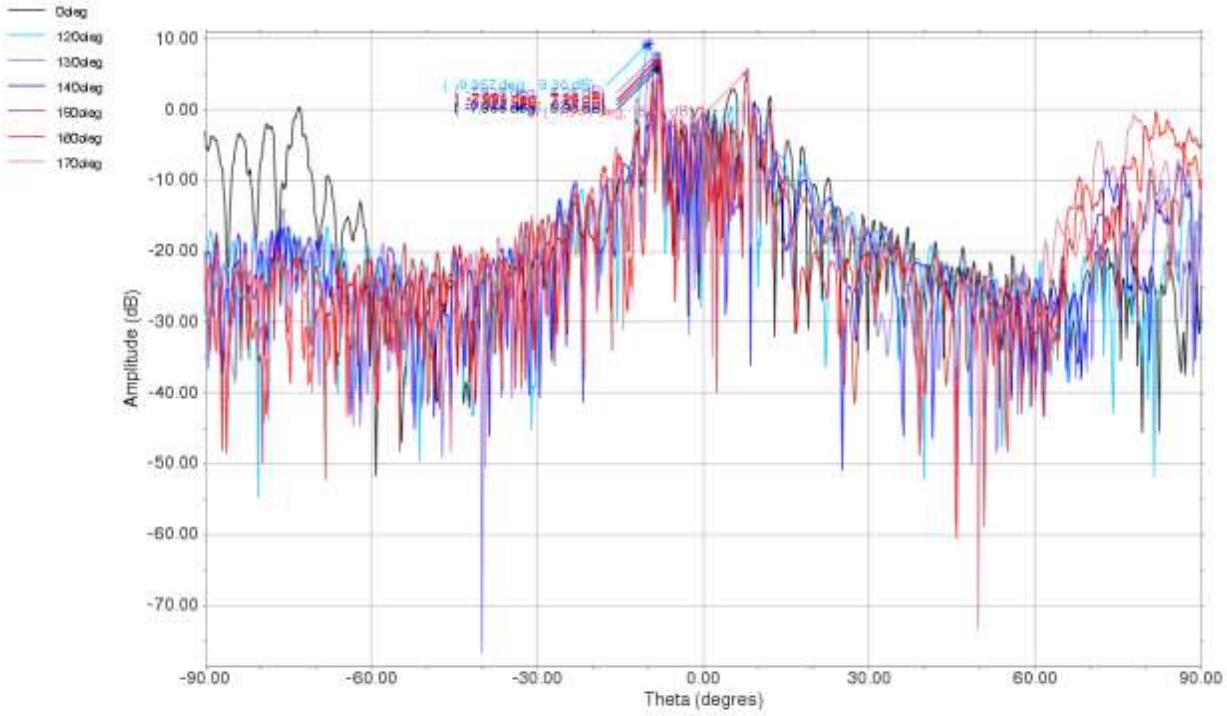
CO max :35.69 dB **CX max :9.73 dB**



BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :35.69 dB

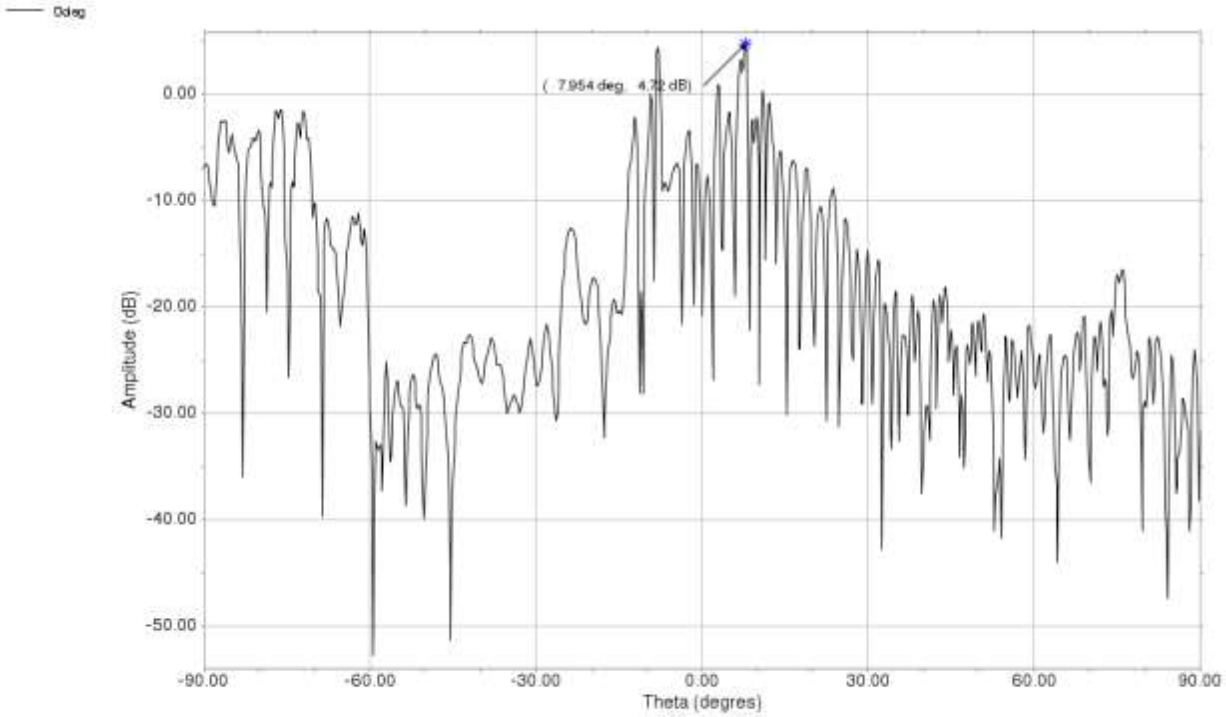
CX max :9.73 dB



BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

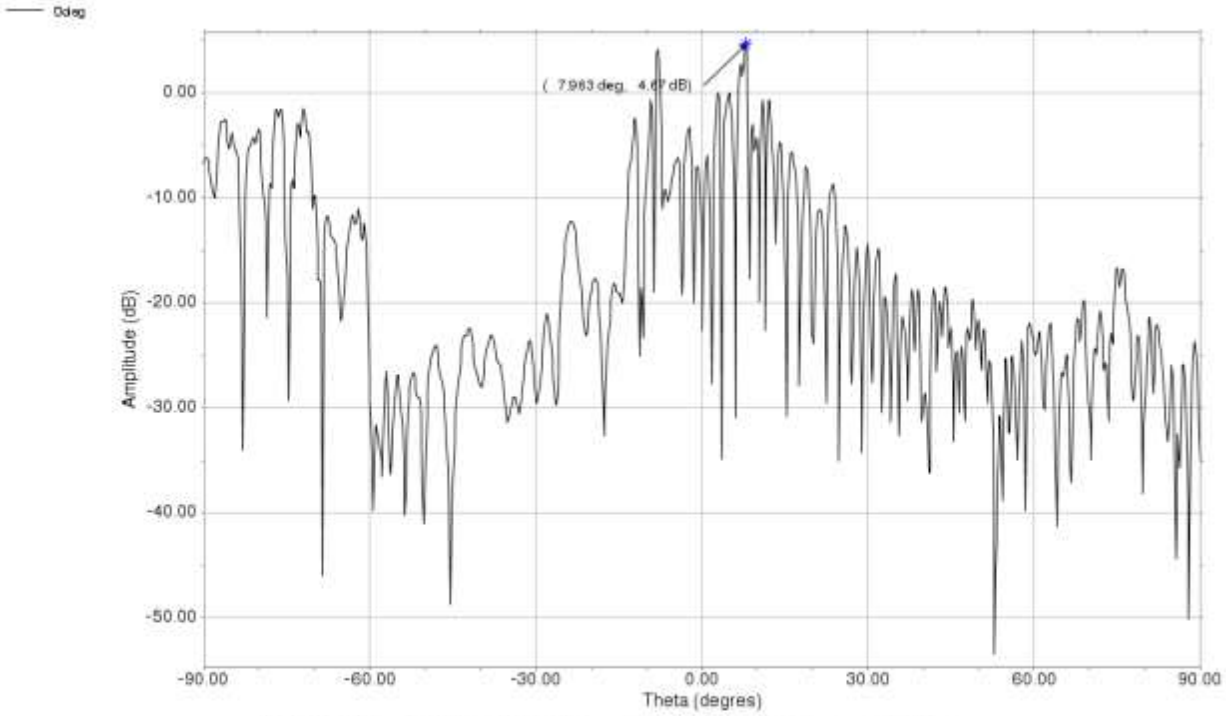
CO max :35.69 dB

CX max :9.73 dB



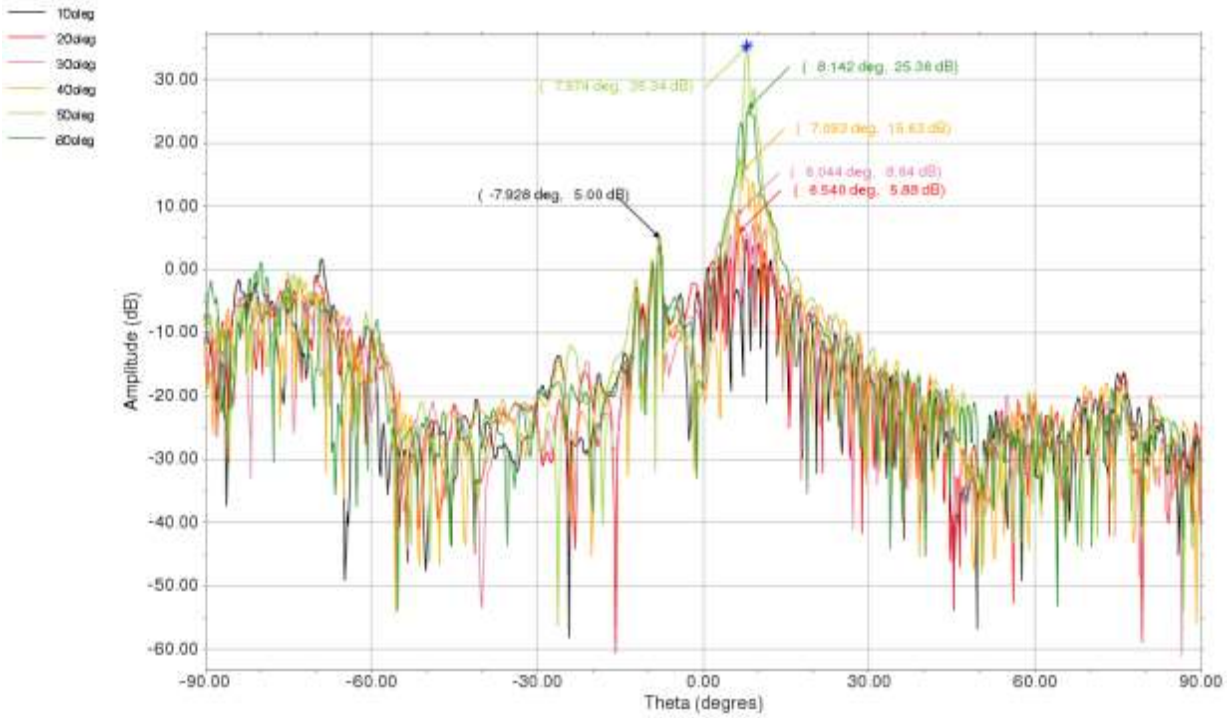
BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :35.35 dB **CX max :6.57 dB**



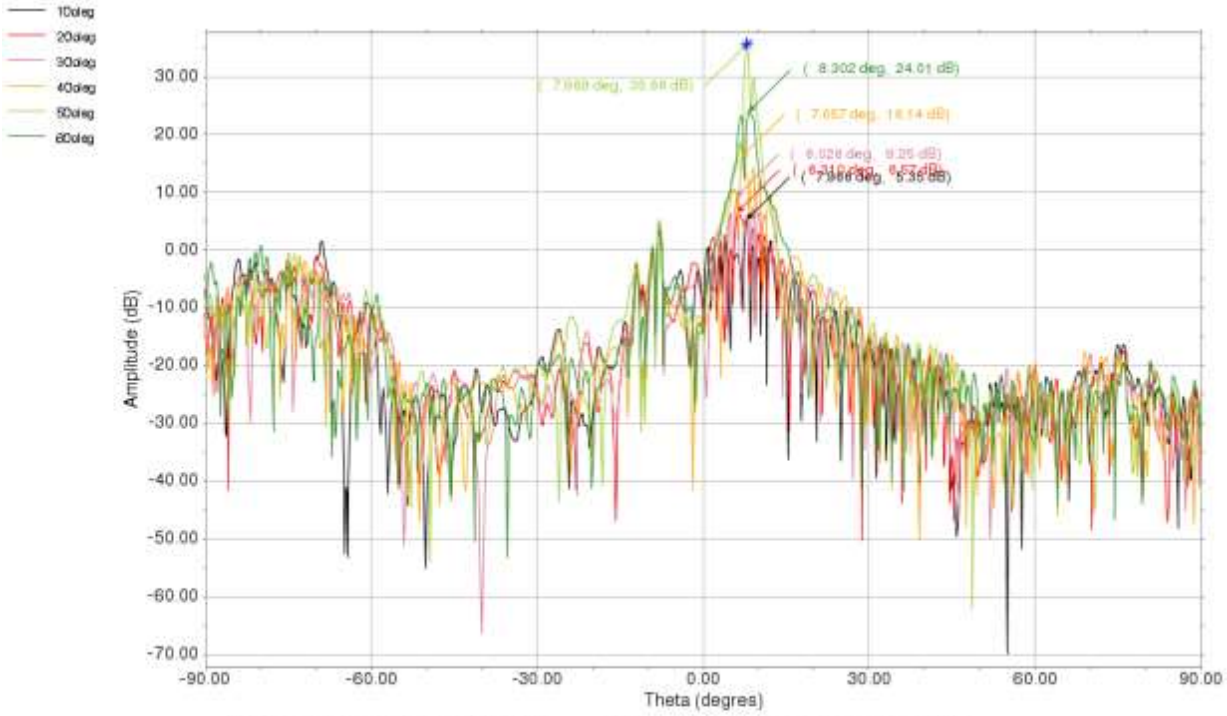
BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :35.68 dB **CX max :10.22 dB**



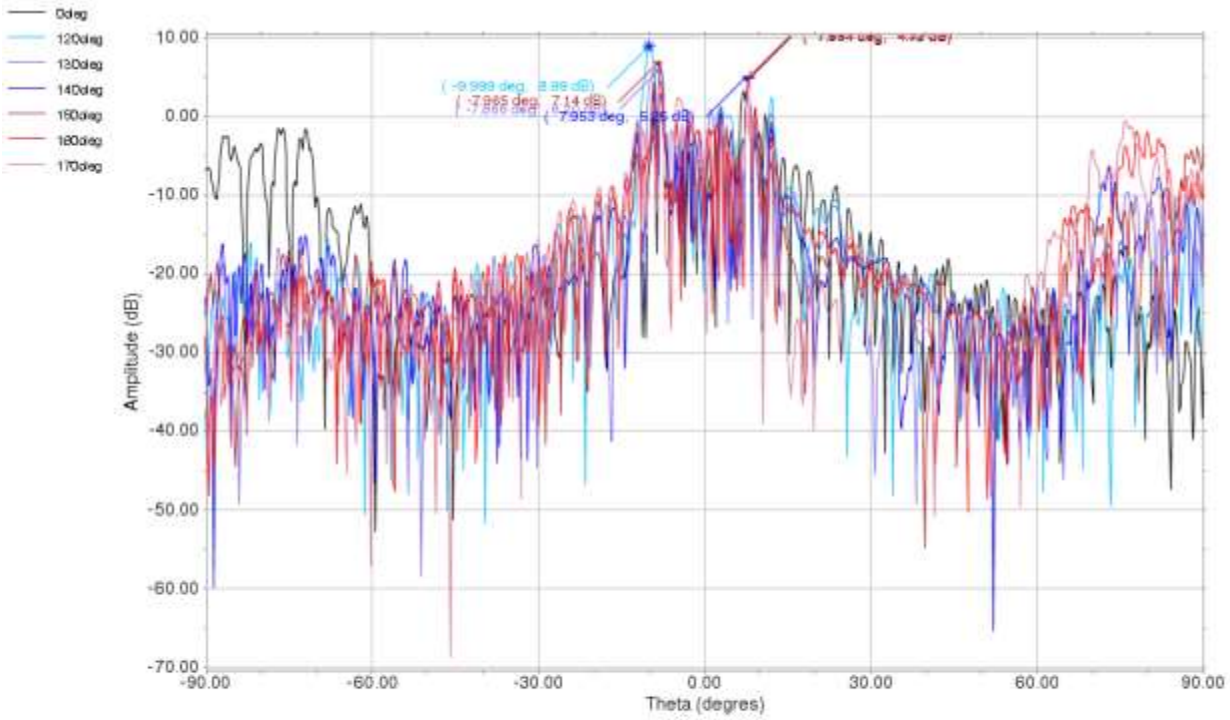
BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :35.35 dB **CX max :6.57 dB**



BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

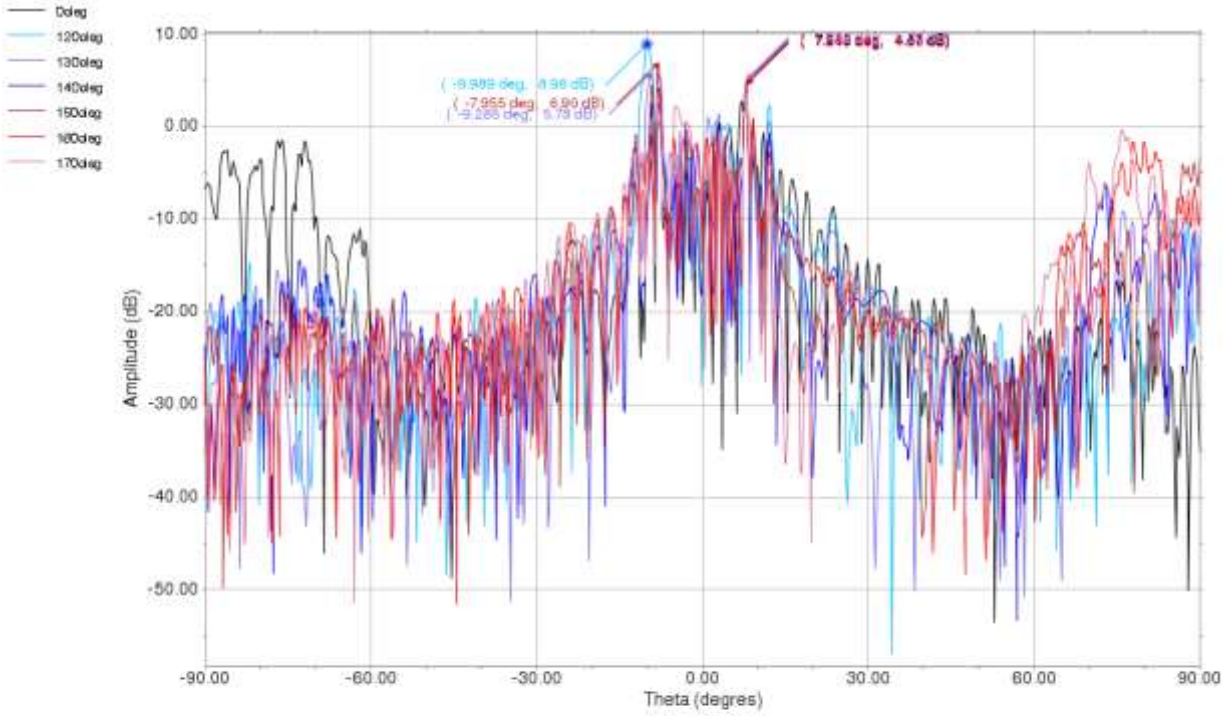
CO max :35.68 dB **CX max :10.22 dB**



BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :35.35 dB

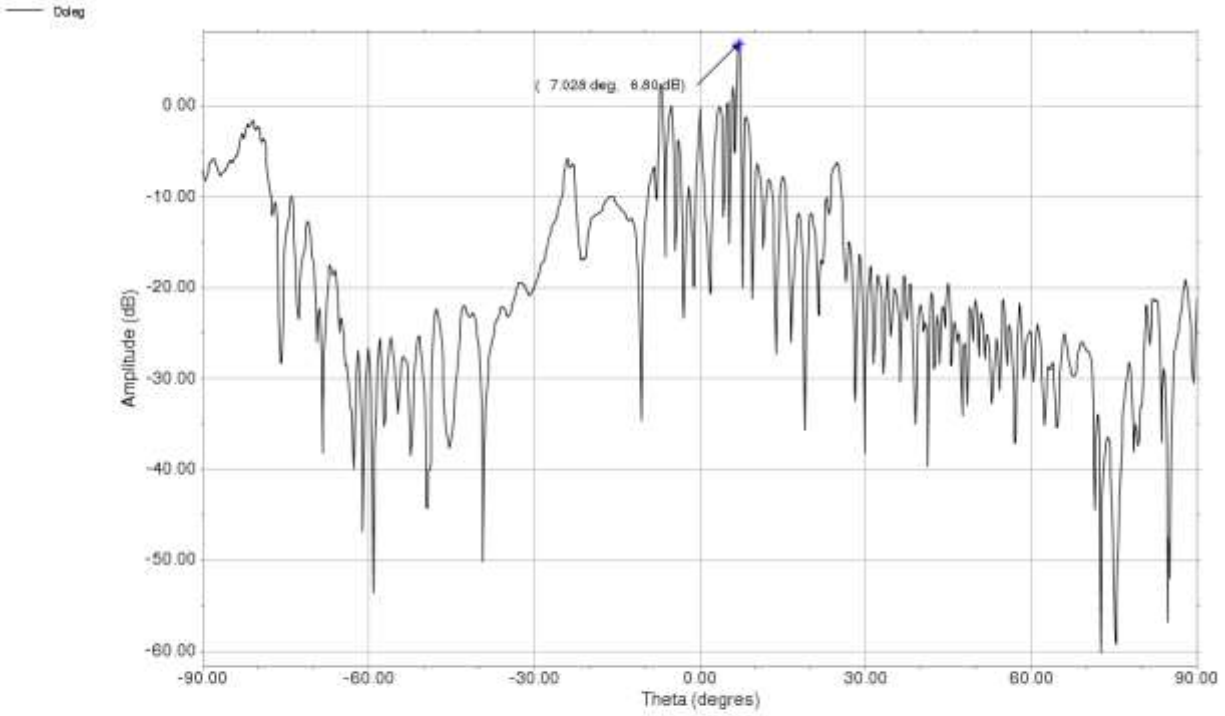
CX max :6.57 dB



BEAM GW No1 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

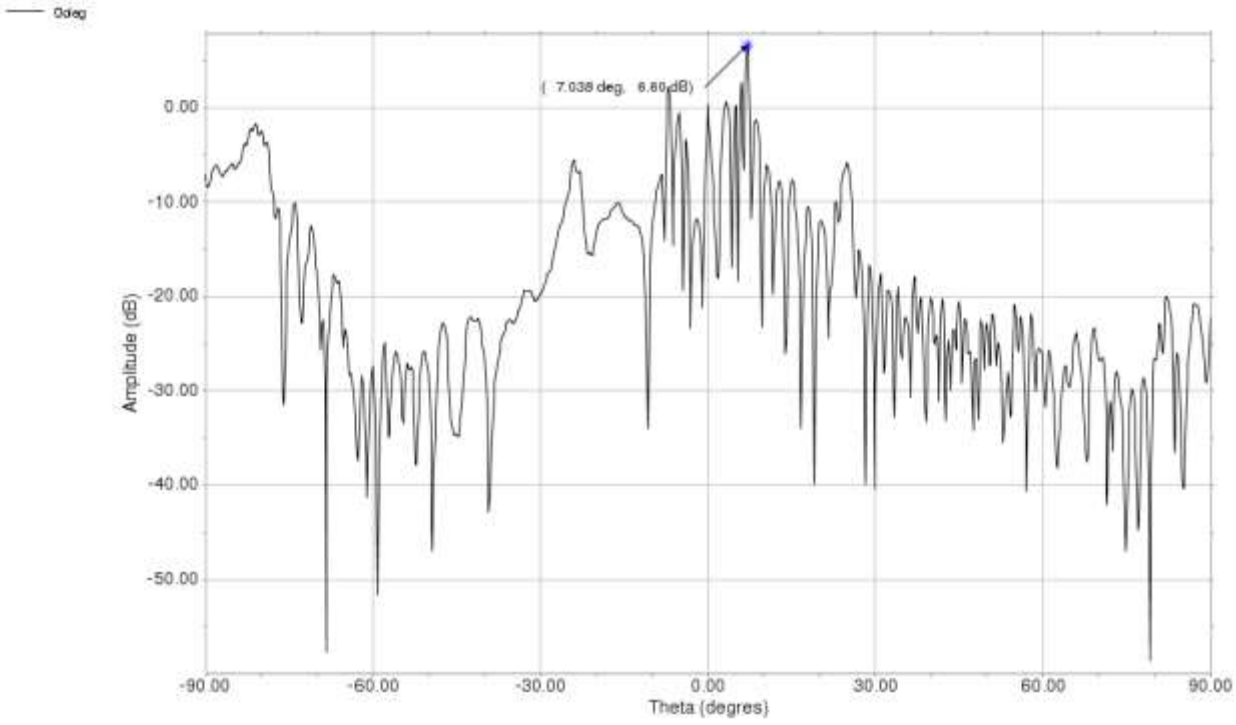
CO max :35.68 dB

CX max :10.22 dB



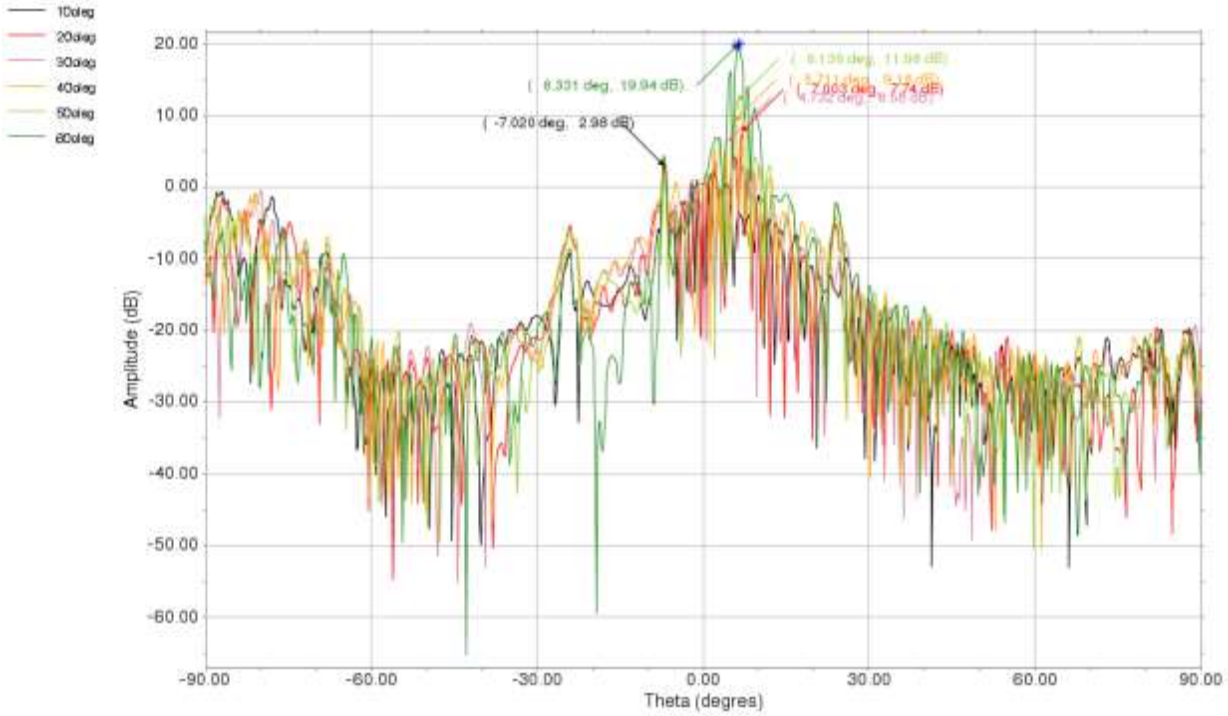
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :33.68 dB **CX max :13.41 dB**



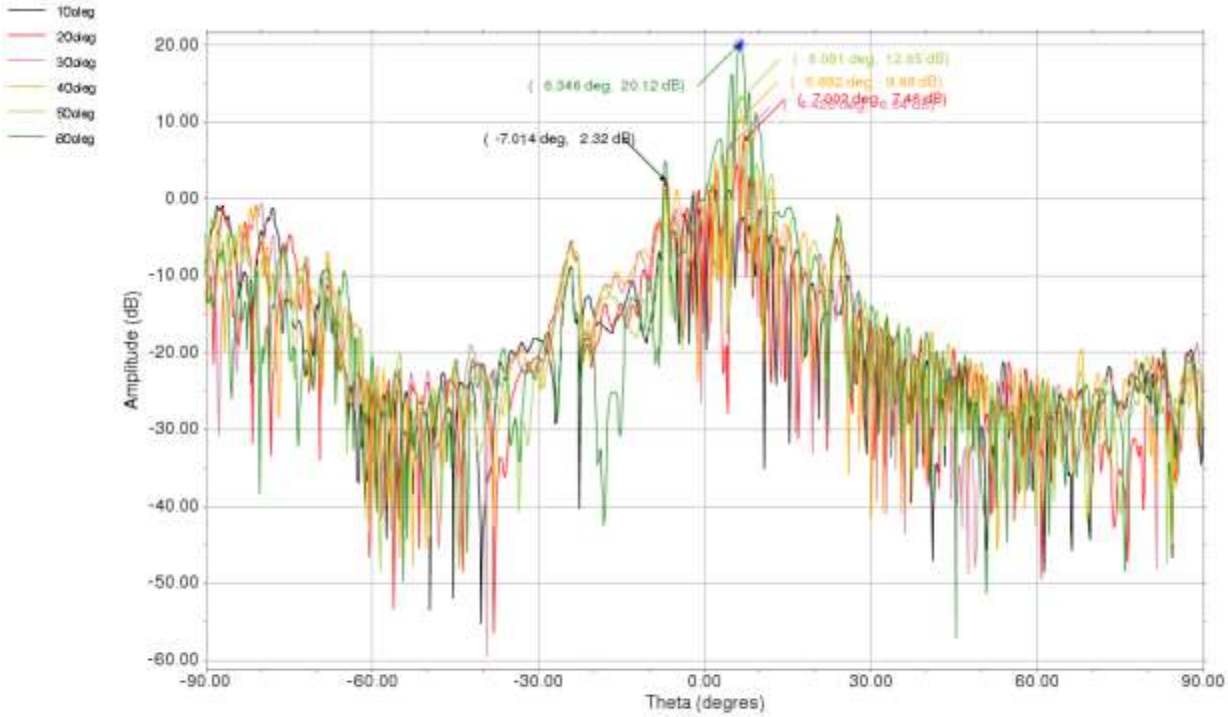
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :34.53 dB **CX max :14.62 dB**



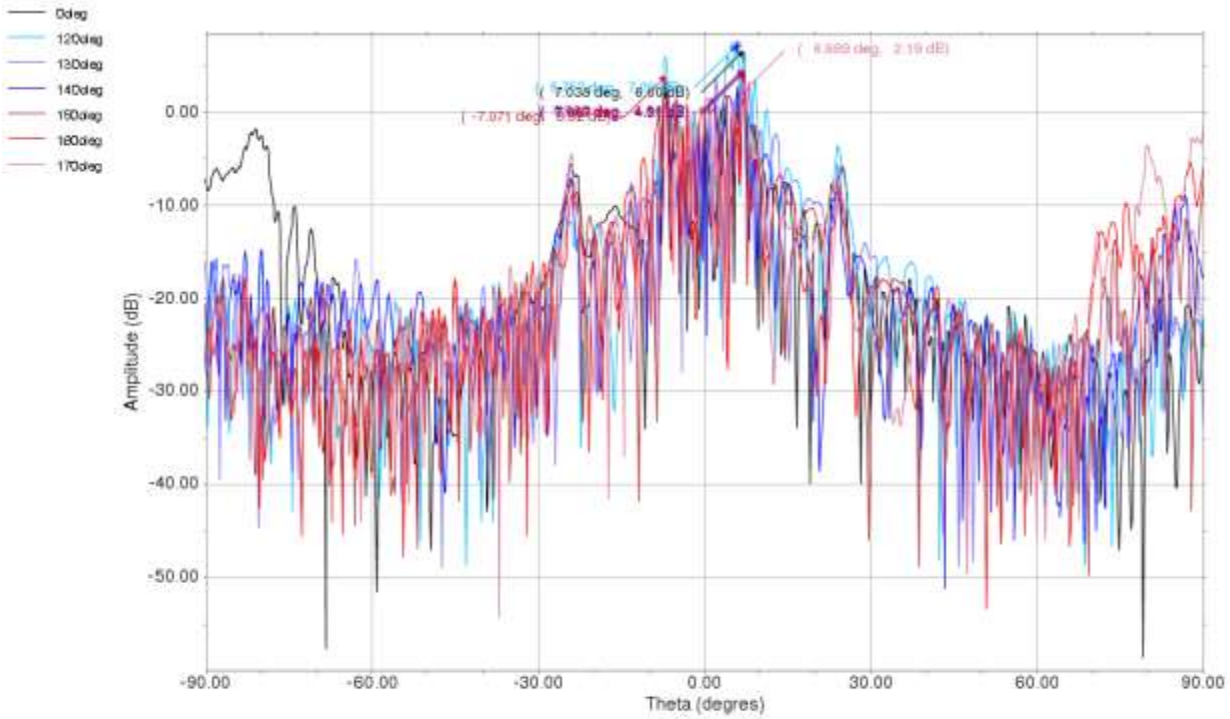
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :34.53 dB **CX max :14.62 dB**



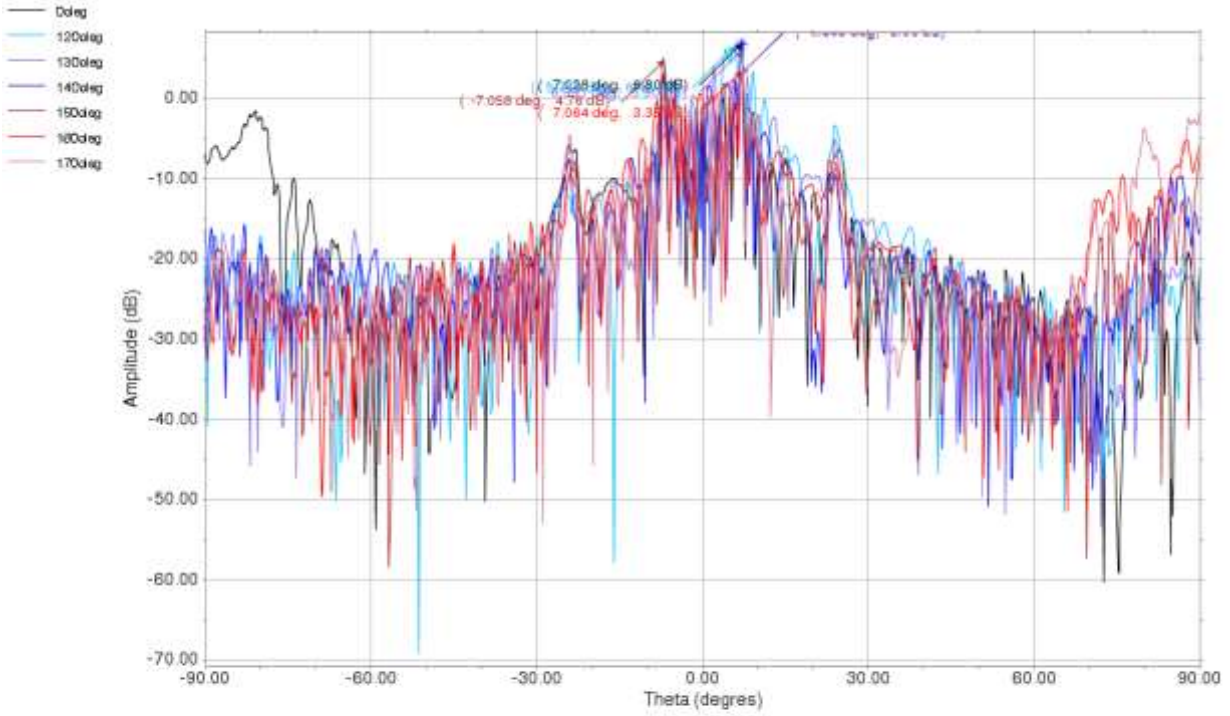
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :33.68 dB **CX max :13.41 dB**



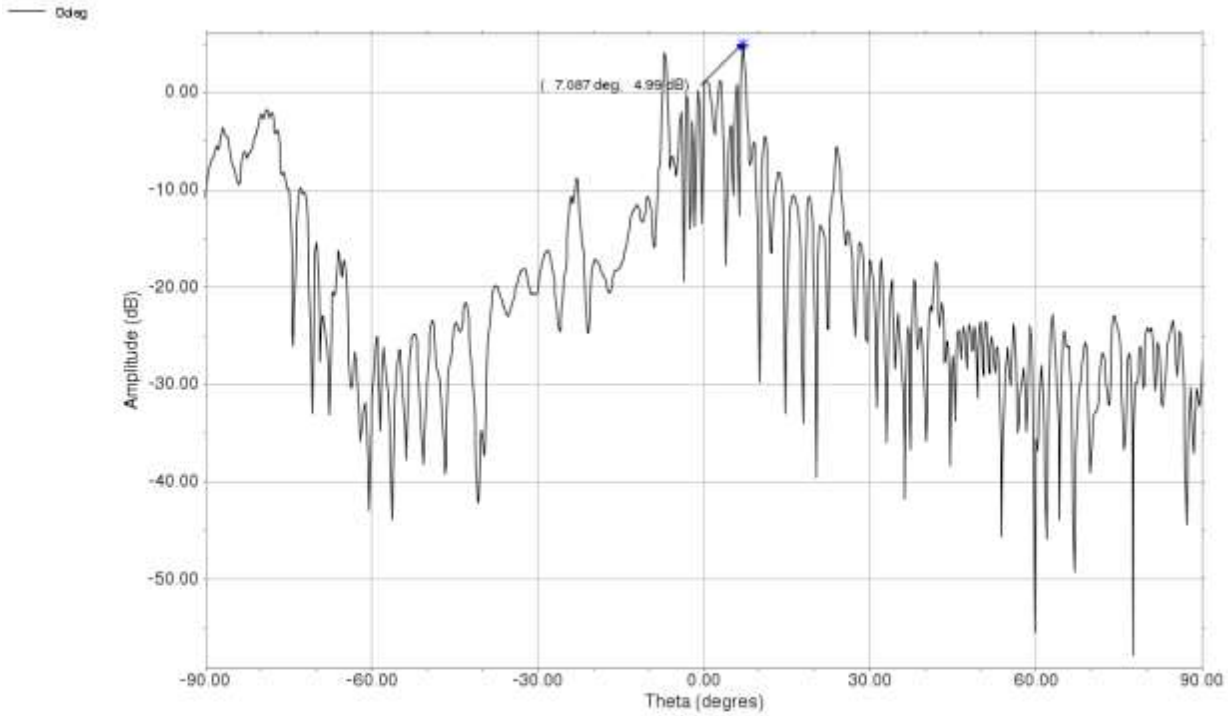
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :34.53 dB **CX max :14.62 dB**



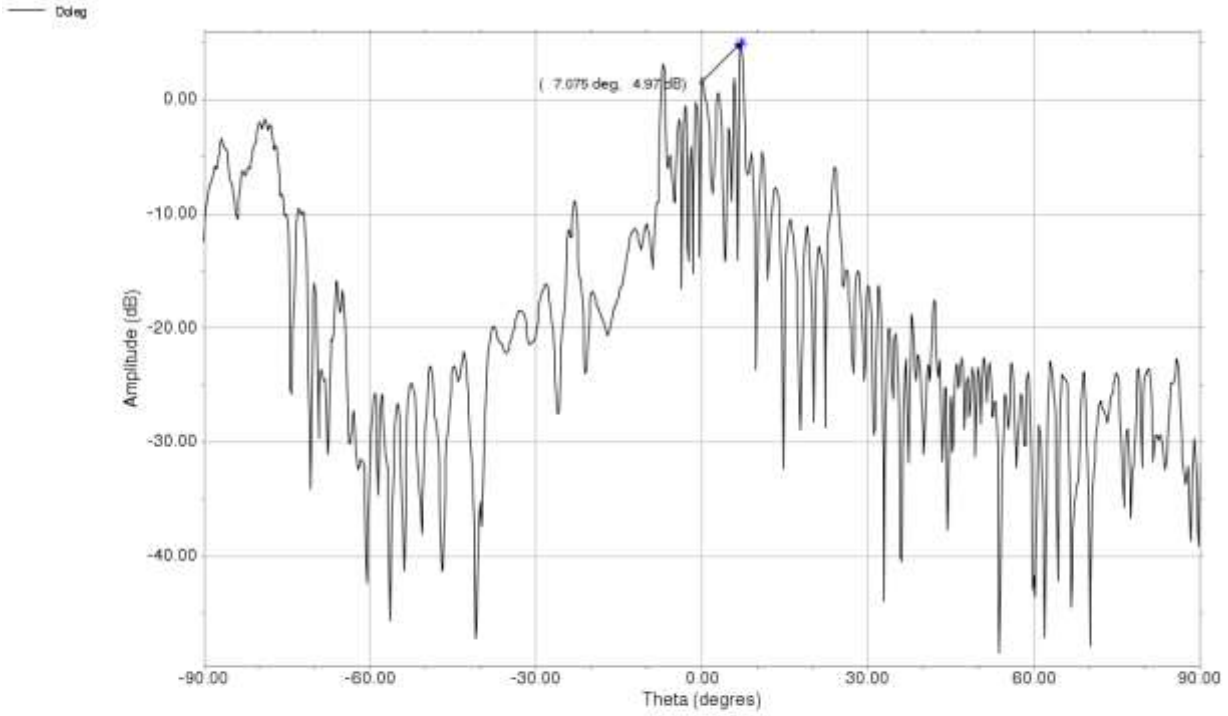
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :33.68 dB **CX max :13.41 dB**



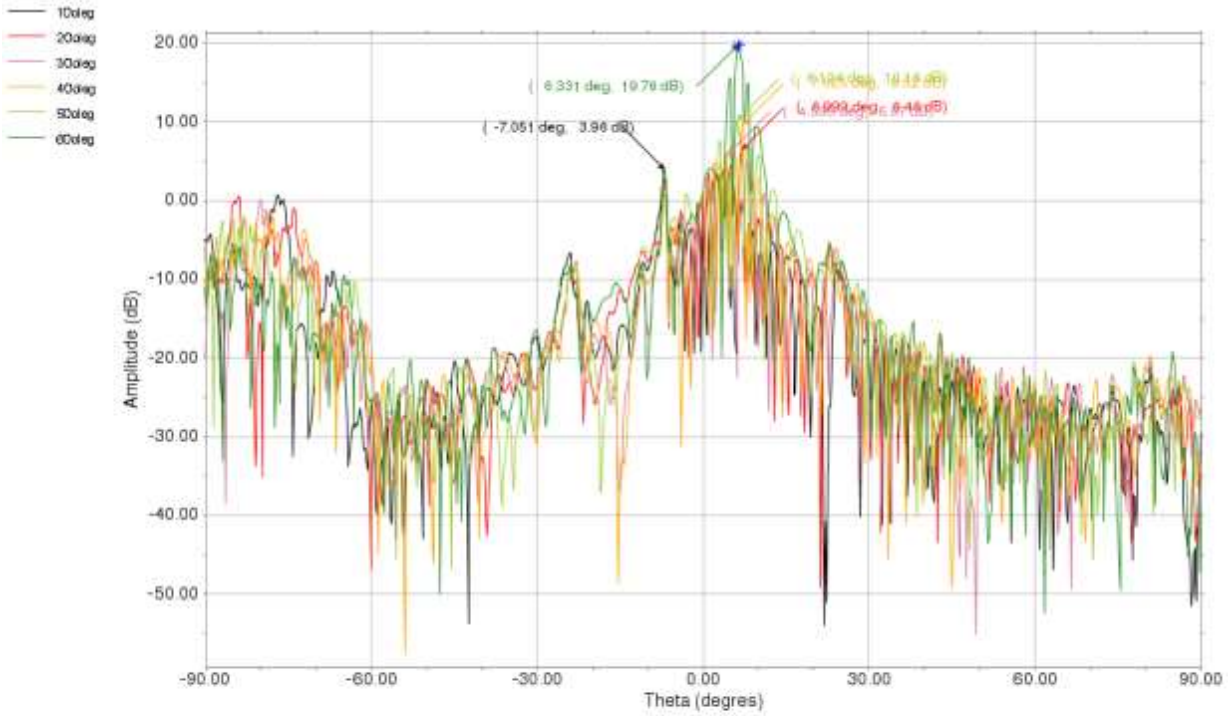
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

CO max :34.60 dB **CX max :11.16 dB**



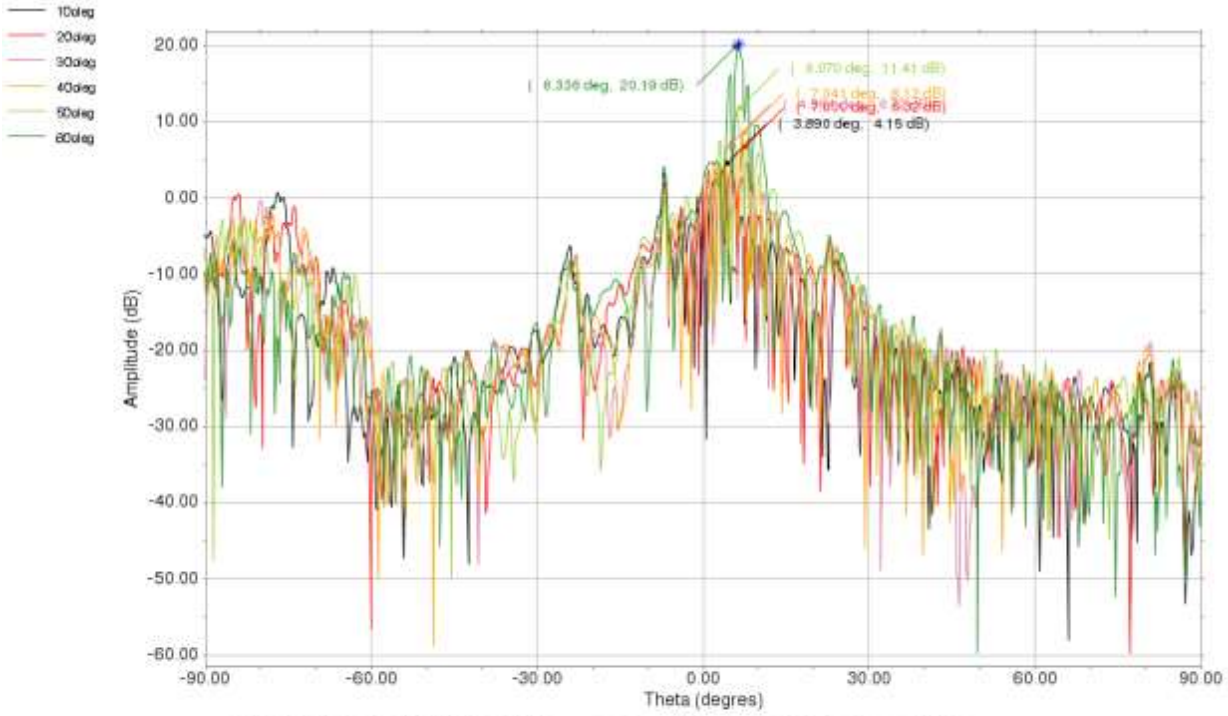
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :33.79 dB **CX max :10.65 dB**



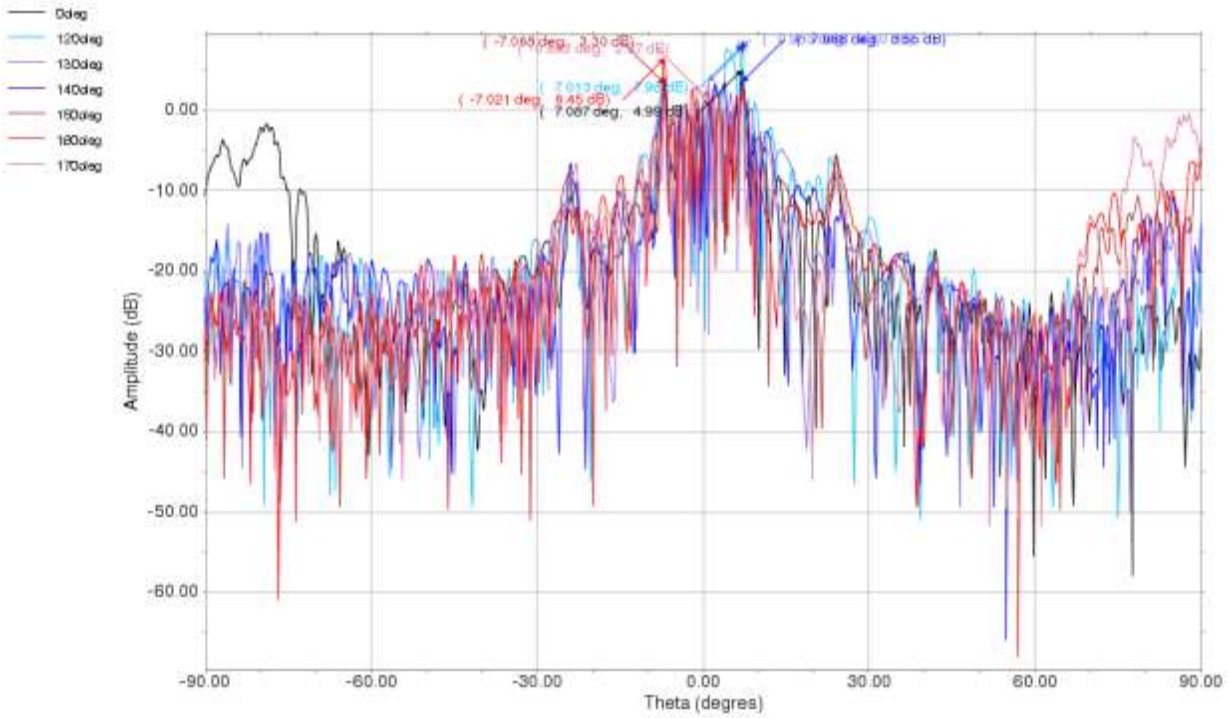
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :34.60 dB **CX max :11.16 dB**



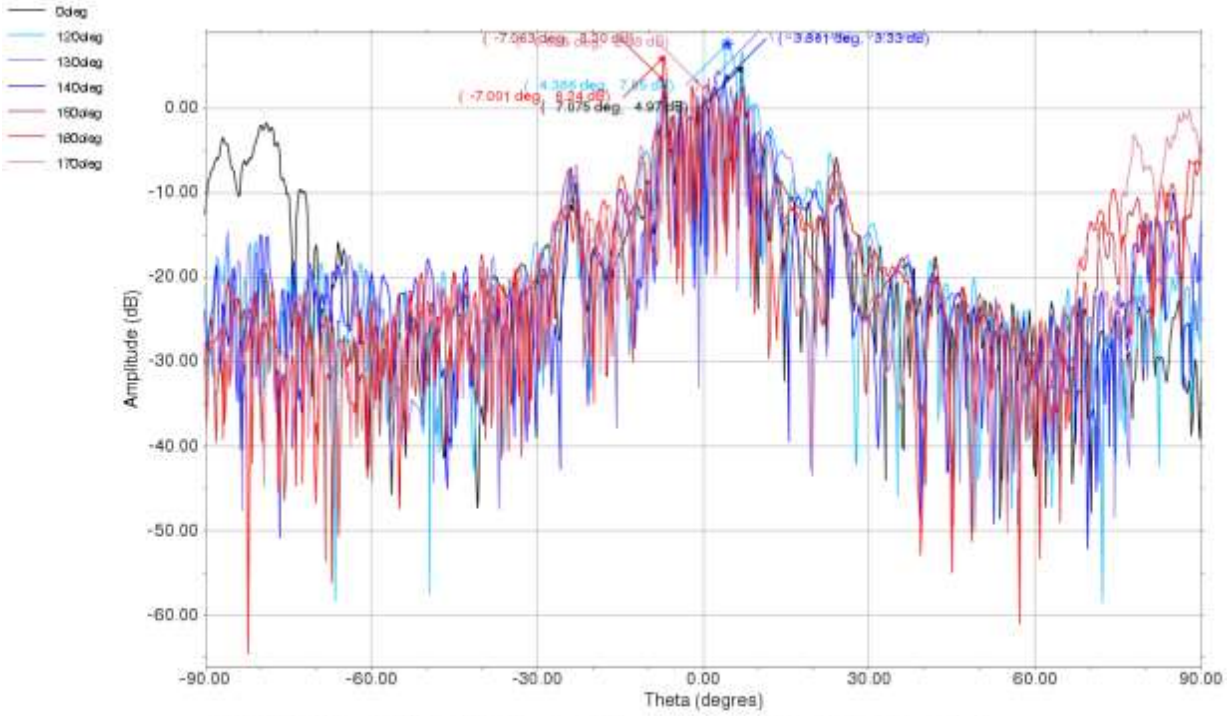
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :33.79 dB **CX max :10.65 dB**



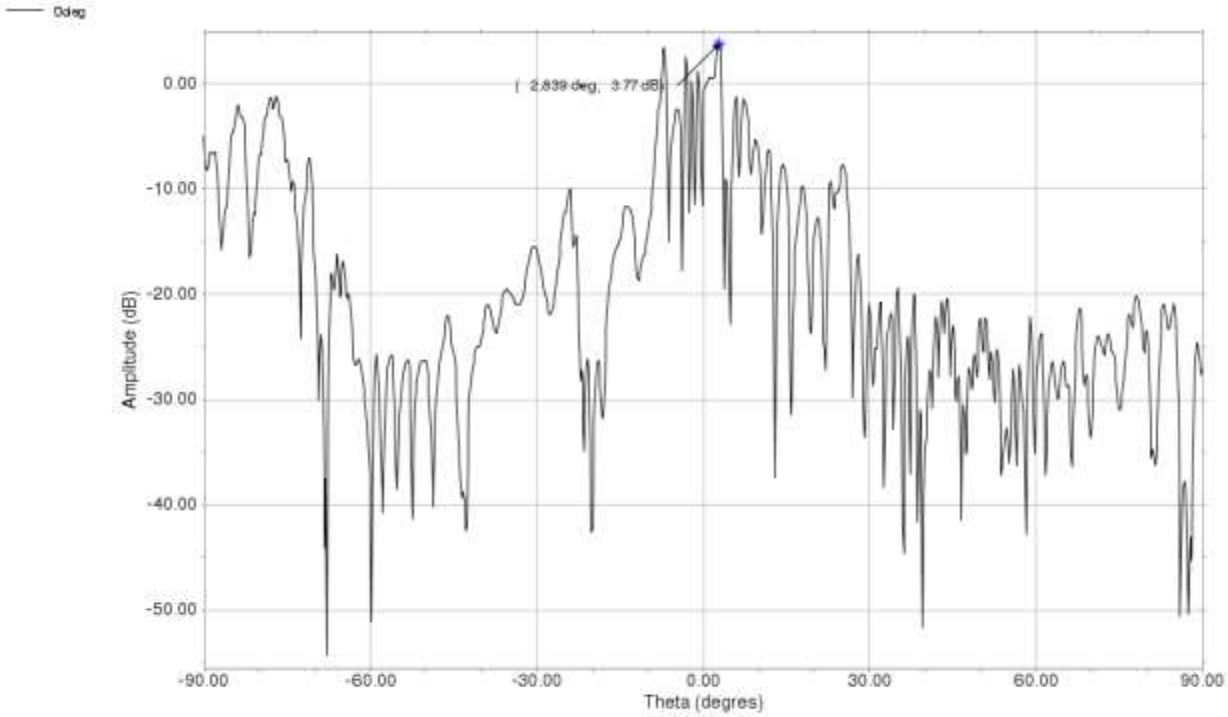
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :34.60 dB **CX max :11.16 dB**



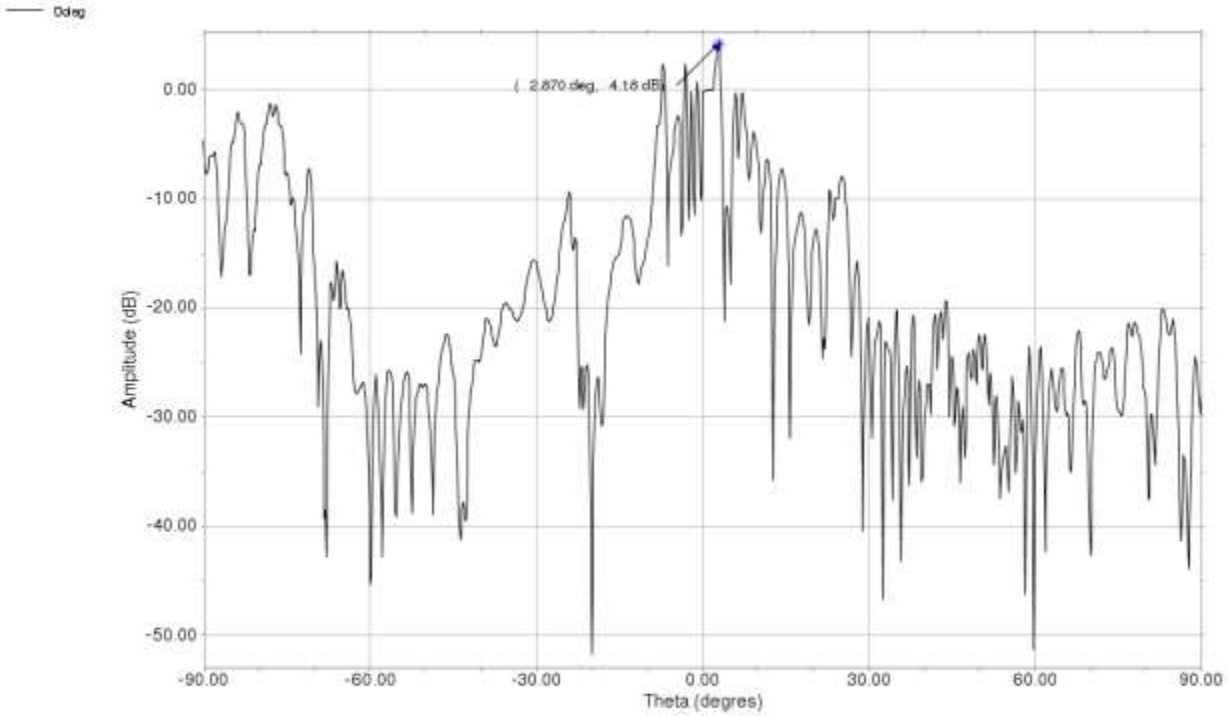
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :33.79 dB **CX max :10.65 dB**



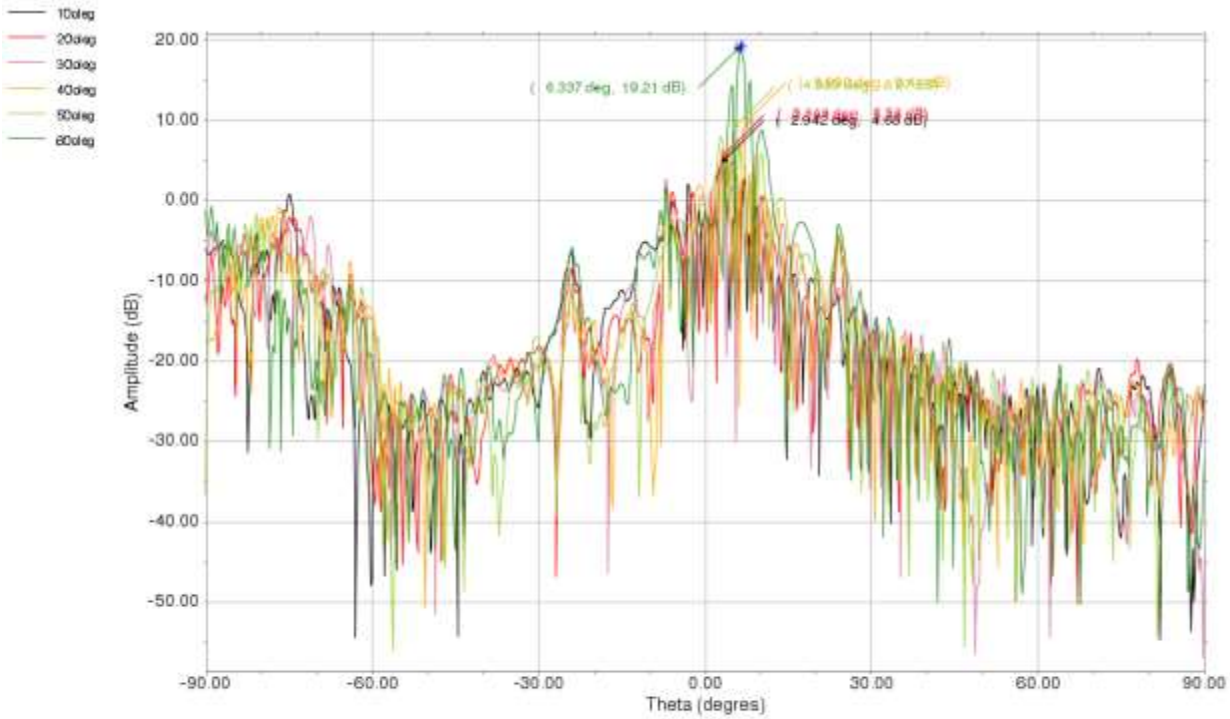
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :34.30 dB **CX max :12.05 dB**



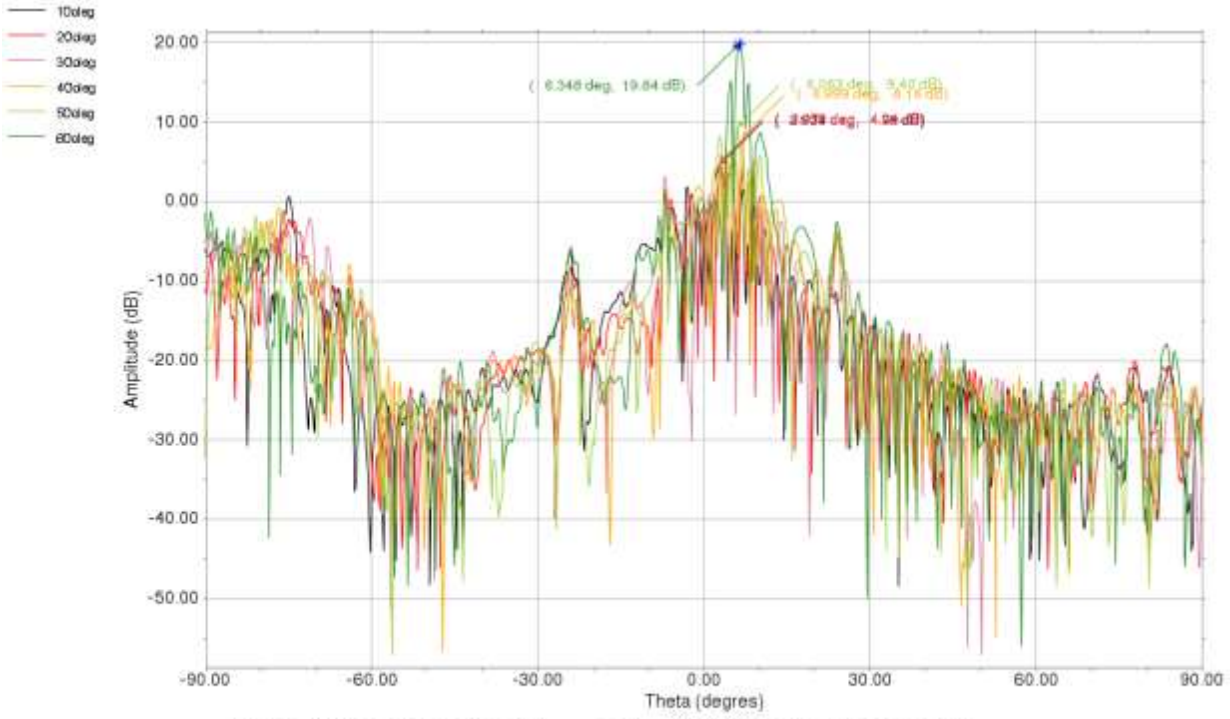
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :33.55 dB **CX max :12.18 dB**



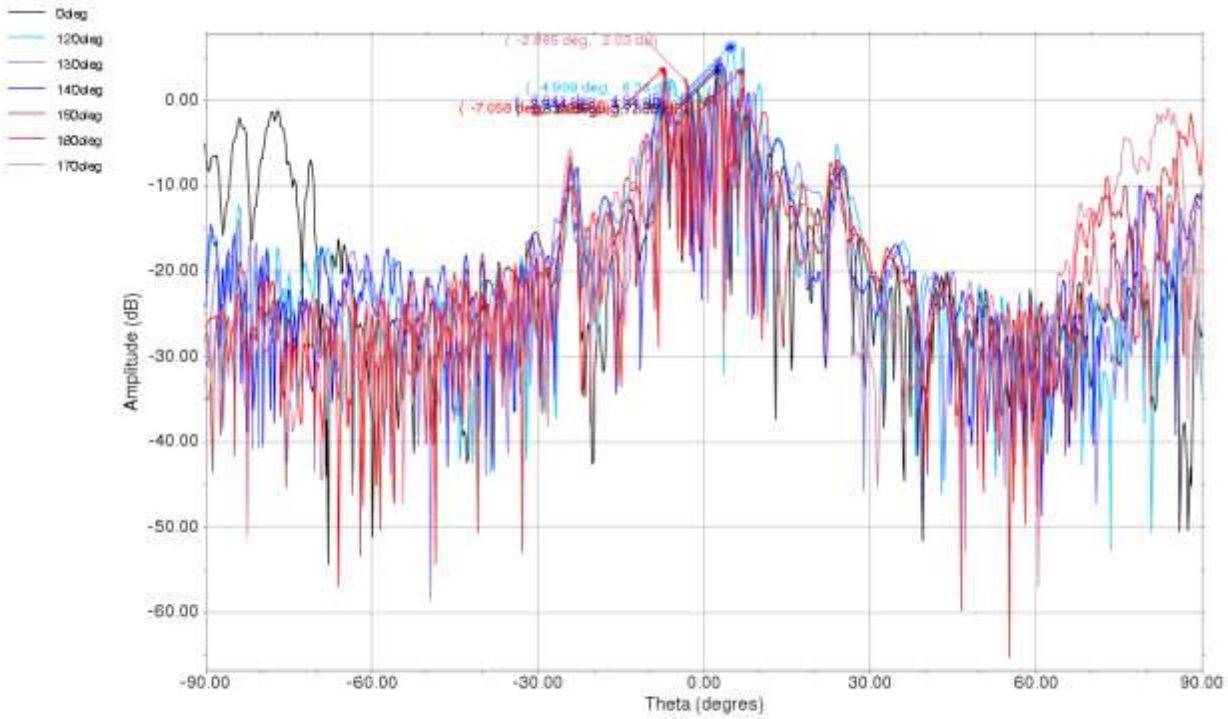
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :34.30 dB **CX max :12.05 dB**



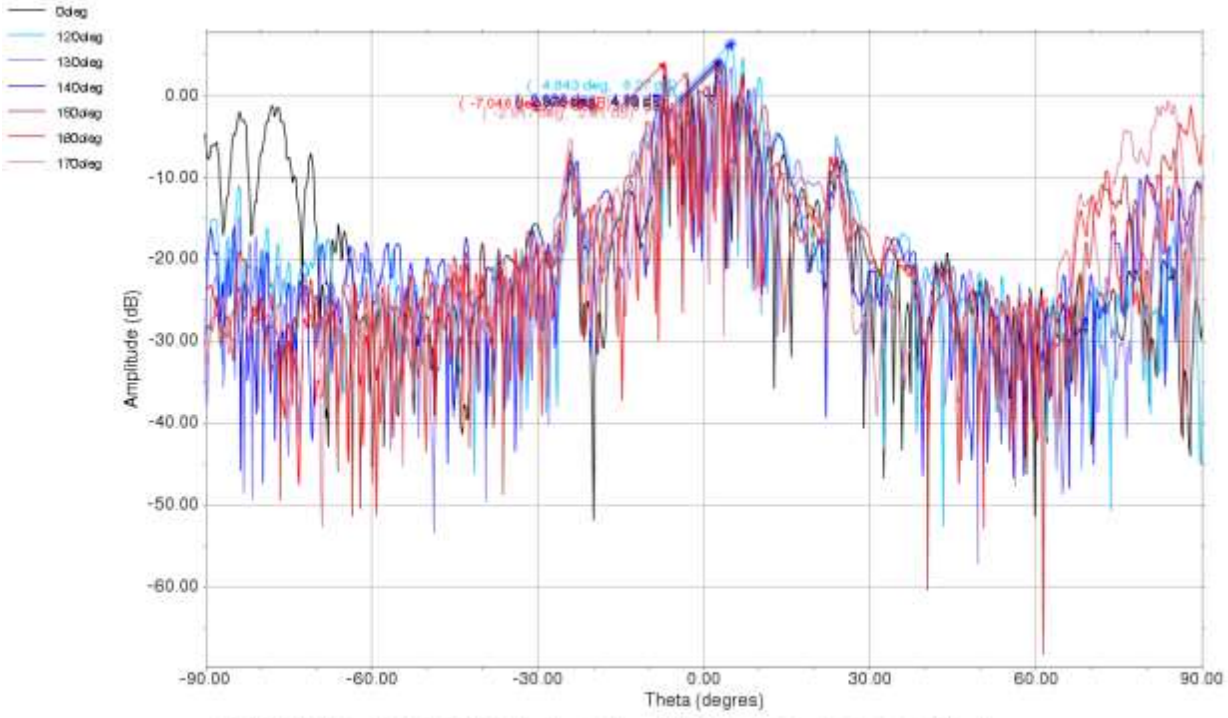
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :33.55 dB **CX max :12.18 dB**



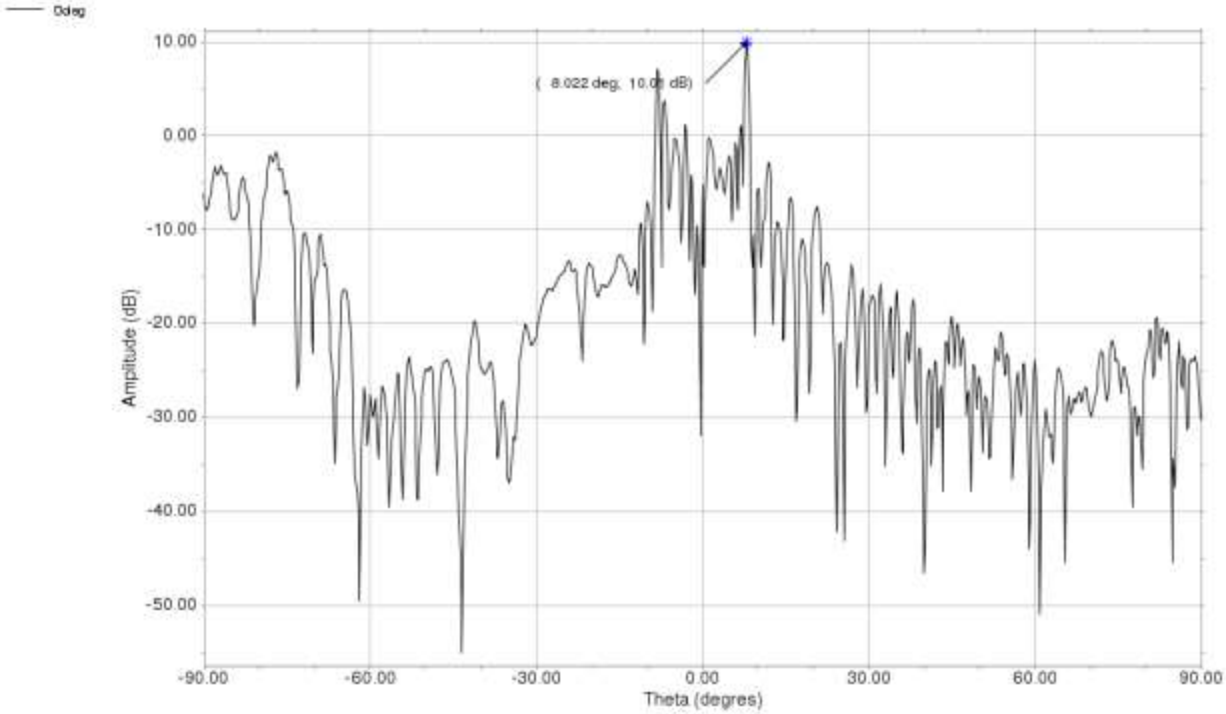
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :34.30 dB **CX max :12.05 dB**



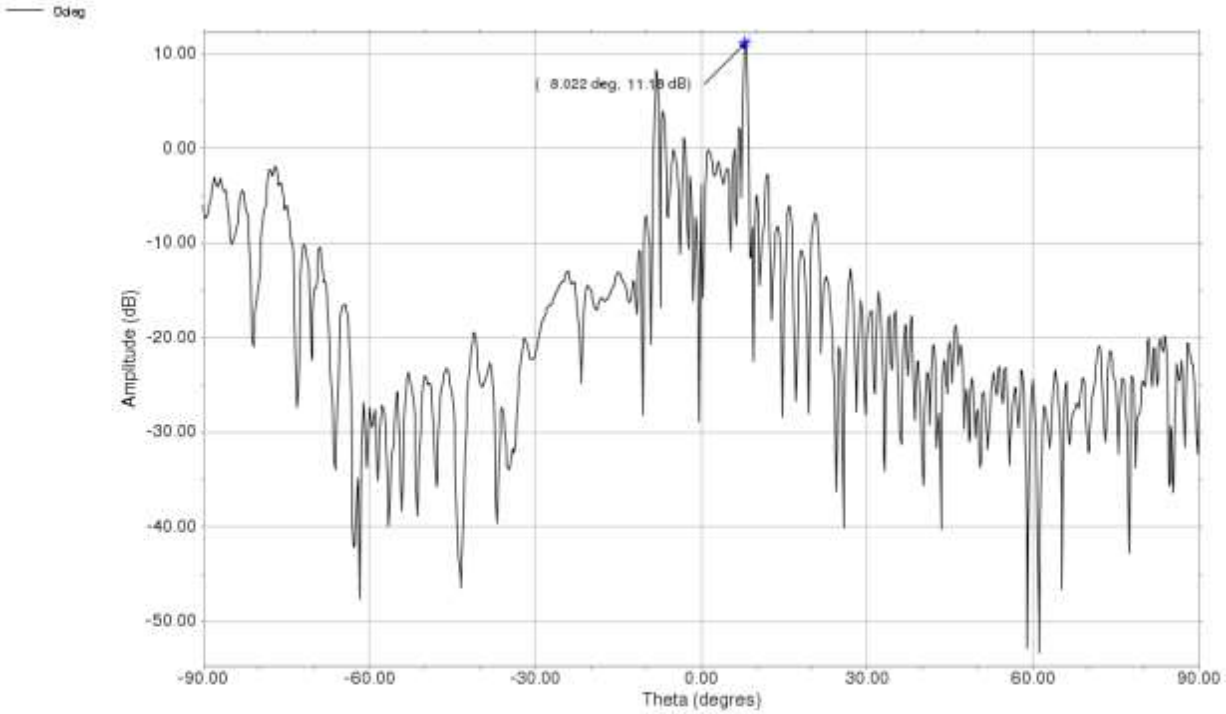
BEAM GW No2 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :33.55 dB **CX max :12.18 dB**



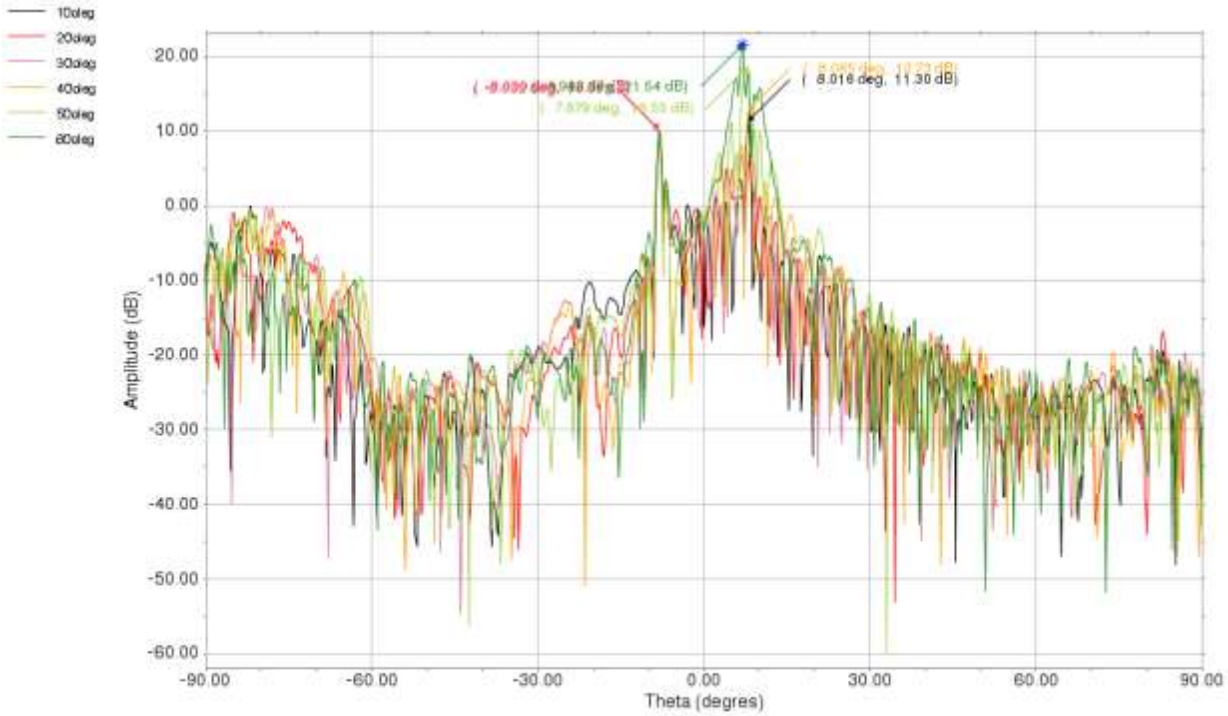
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :39.71 dB **CX max :13.71 dB**



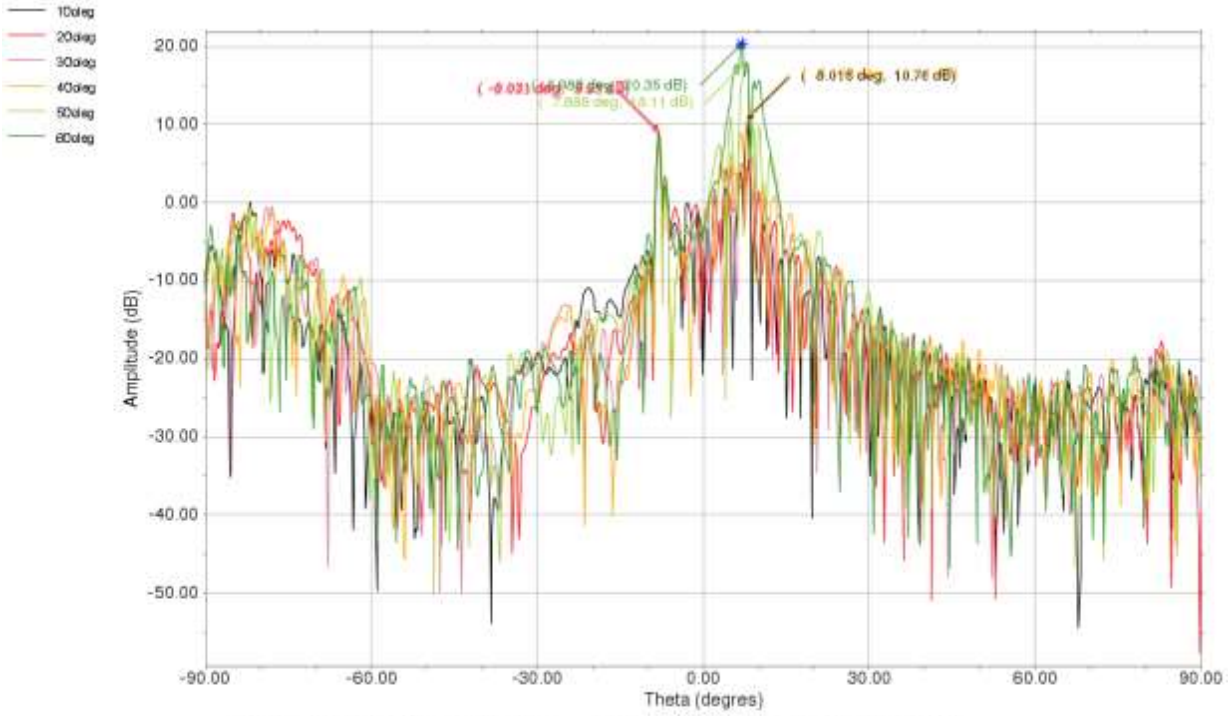
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :40.70 dB **CX max :13.73 dB**



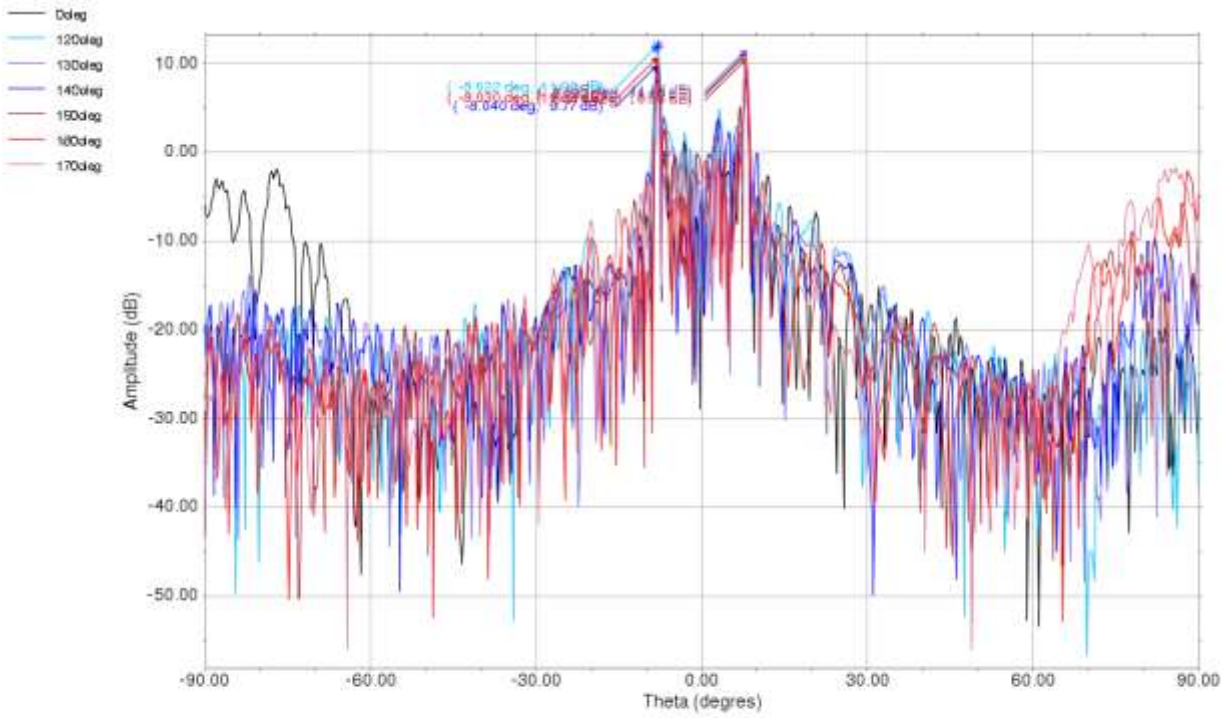
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :40.70 dB **CX max :13.73 dB**



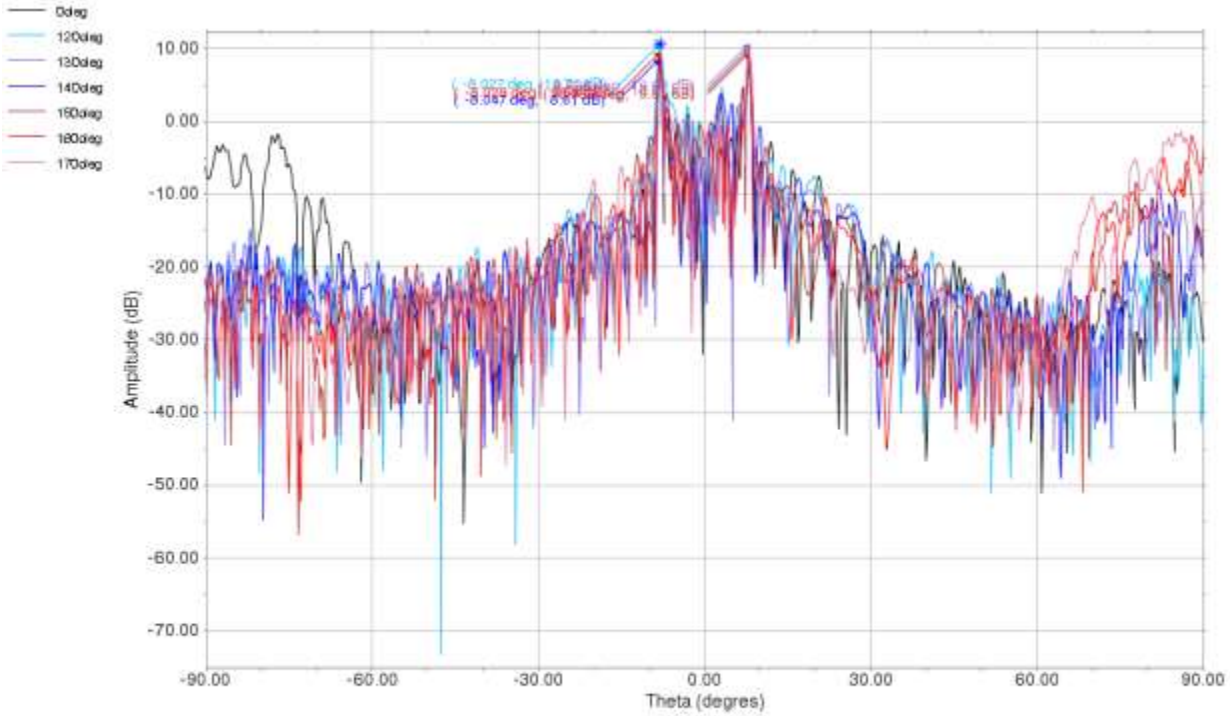
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :39.71 dB **CX max :13.71 dB**



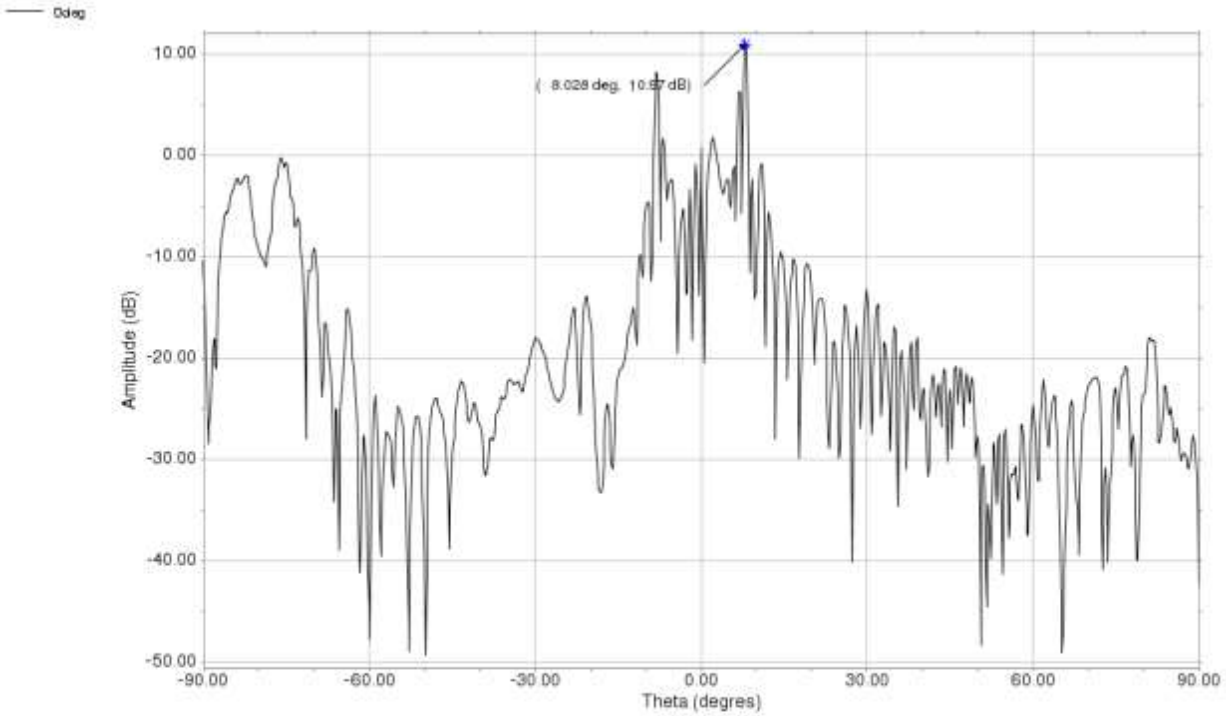
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :40.79 dB **CX max :13.73 dB**



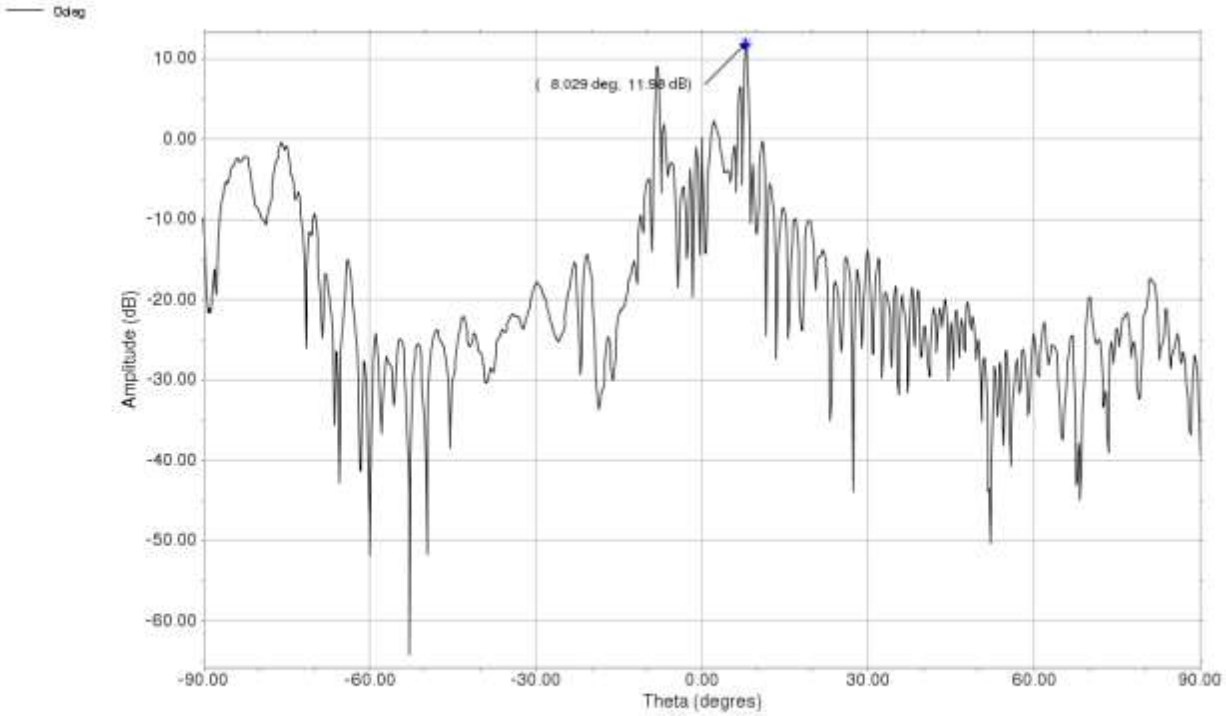
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :39.71 dB **CX max :13.71 dB**



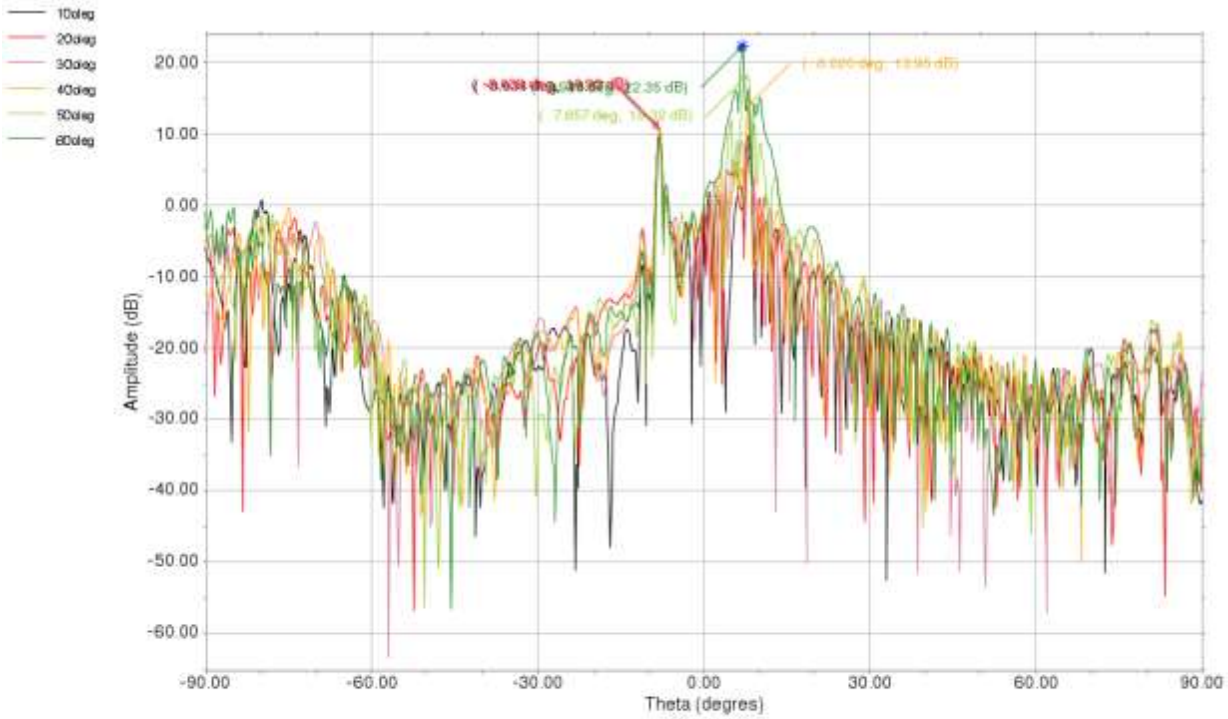
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :39.80 dB **CX max :12.12 dB**



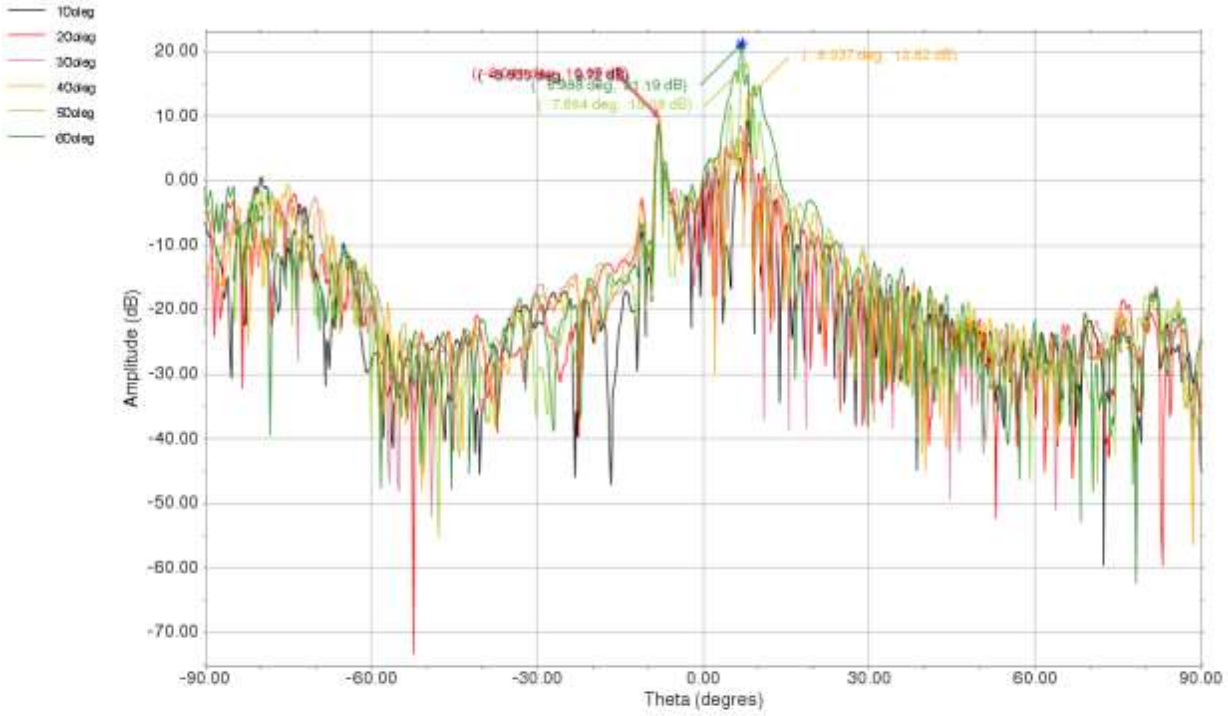
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

CO max :40.78 dB **CX max :9.75 dB**



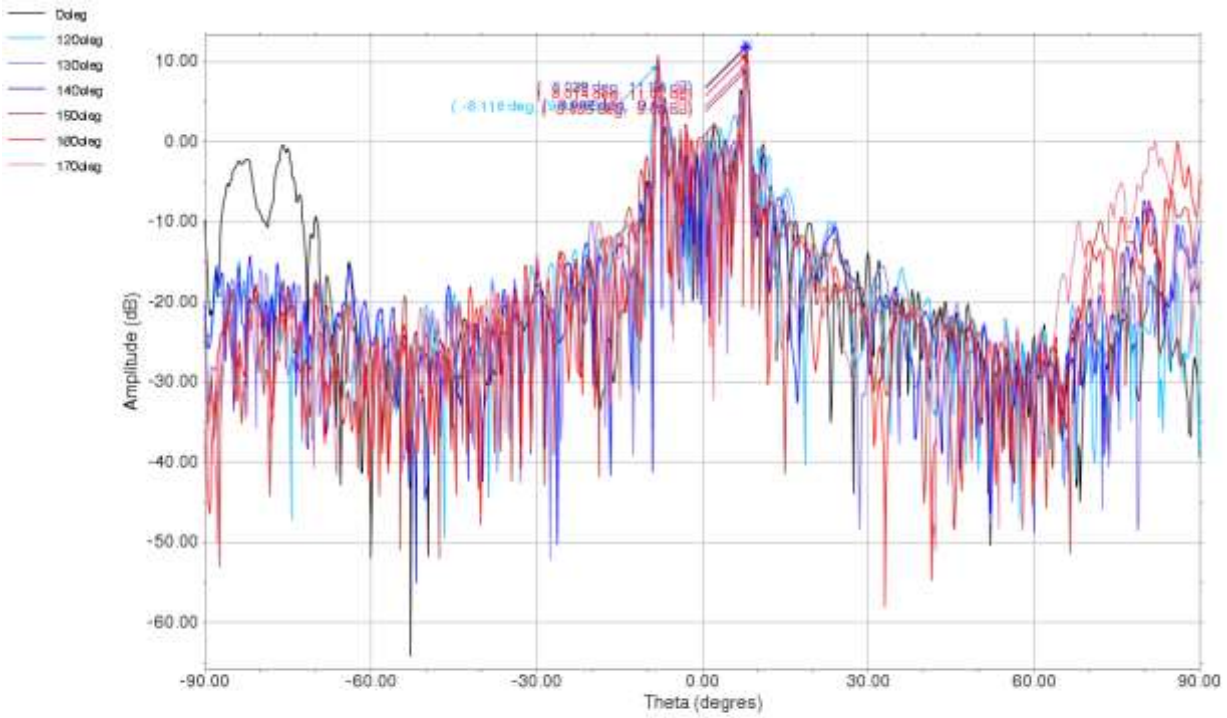
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :40.78 dB **CX max :9.75 dB**



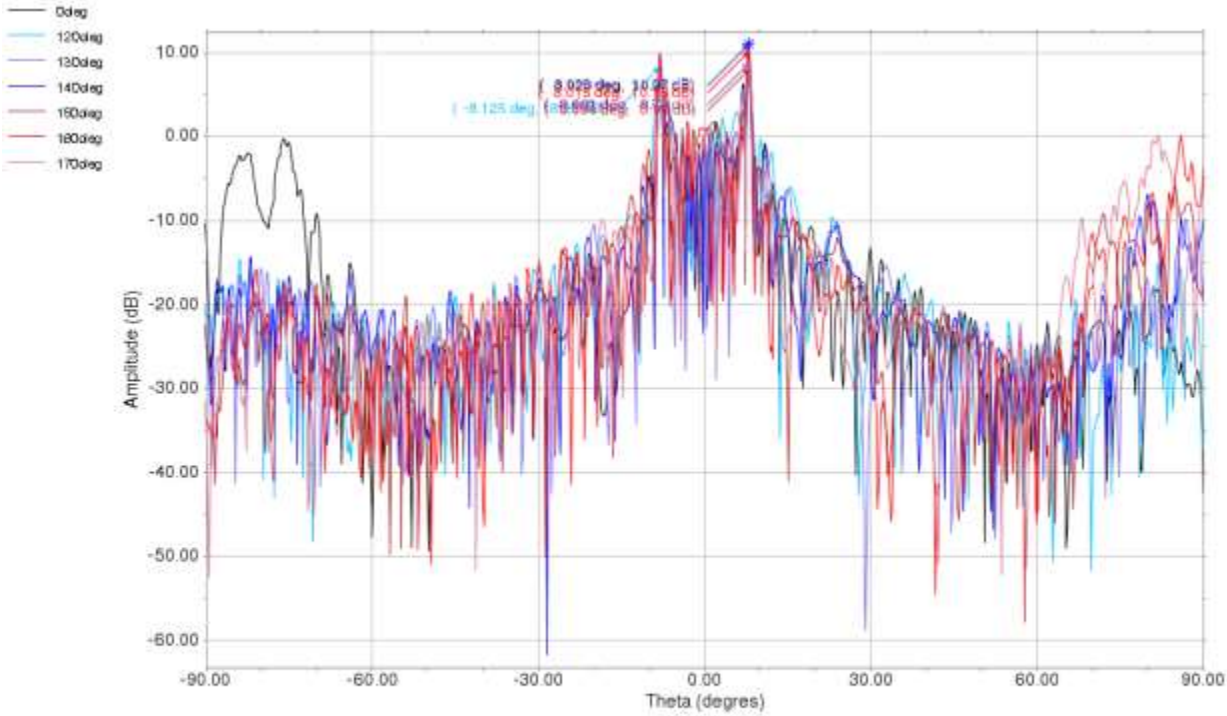
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :39.80 dB **CX max :12.12 dB**



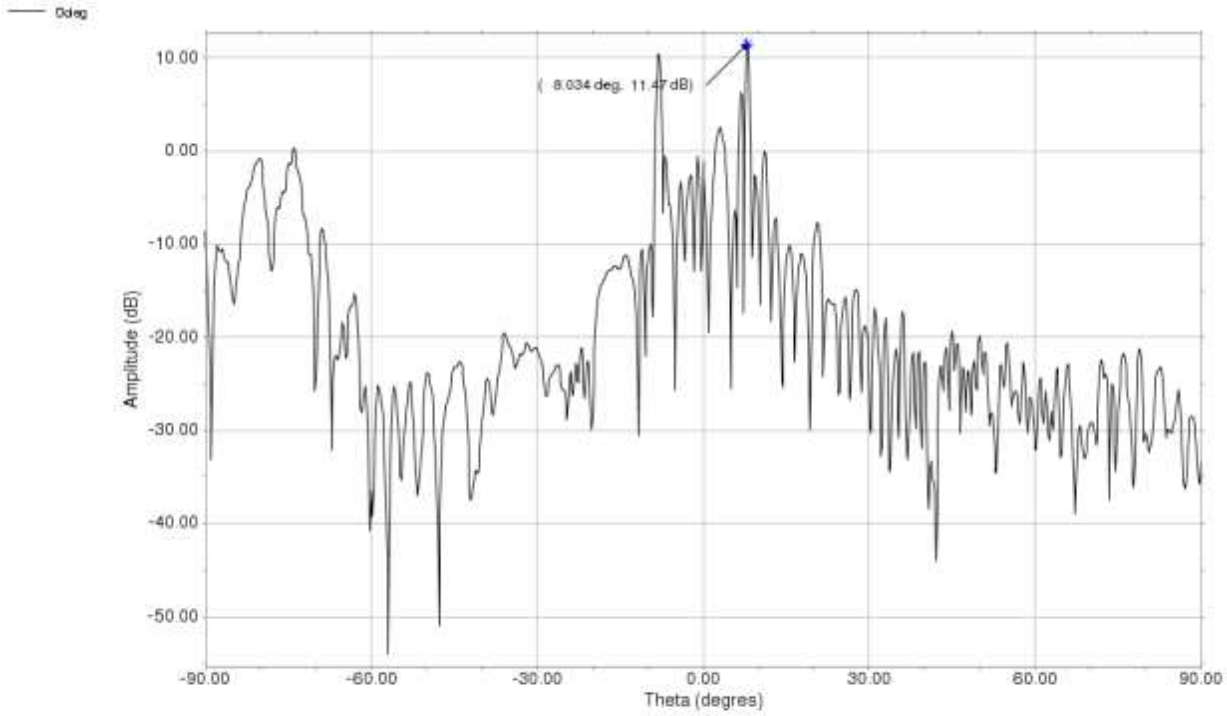
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :40.78 dB **CX max :9.75 dB**



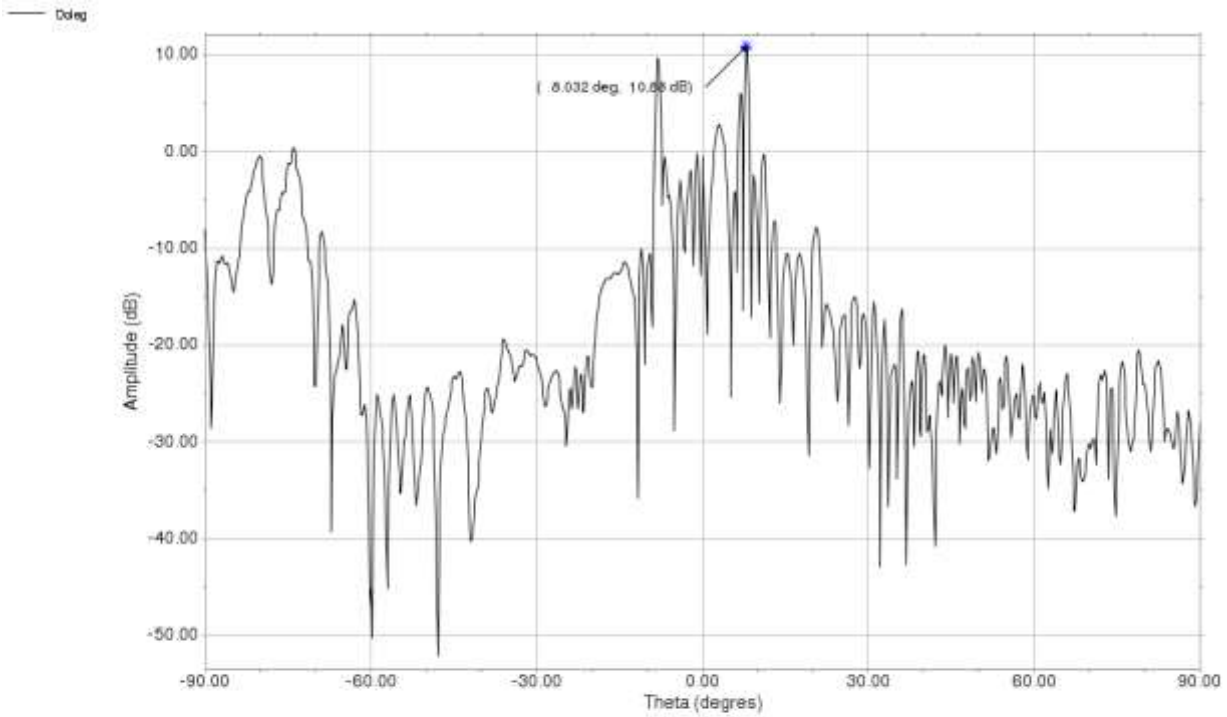
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :39.80 dB **CX max :12.12 dB**



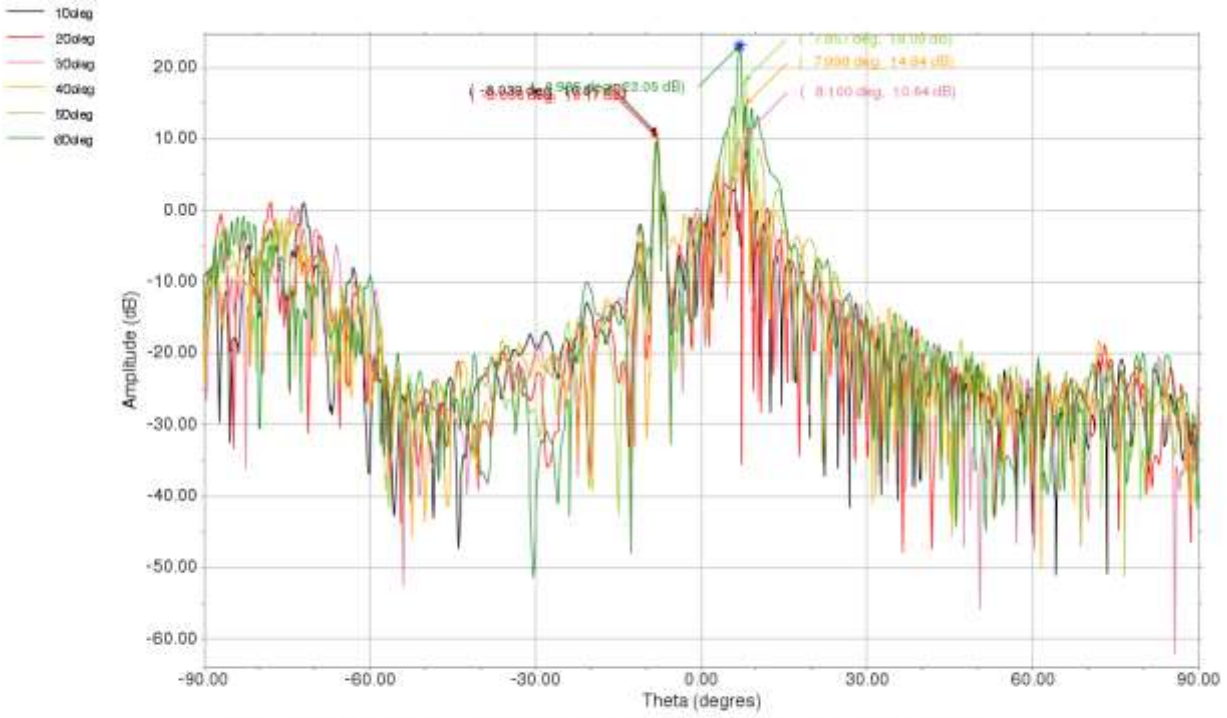
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :40.70 dB **CX max :10.09 dB**



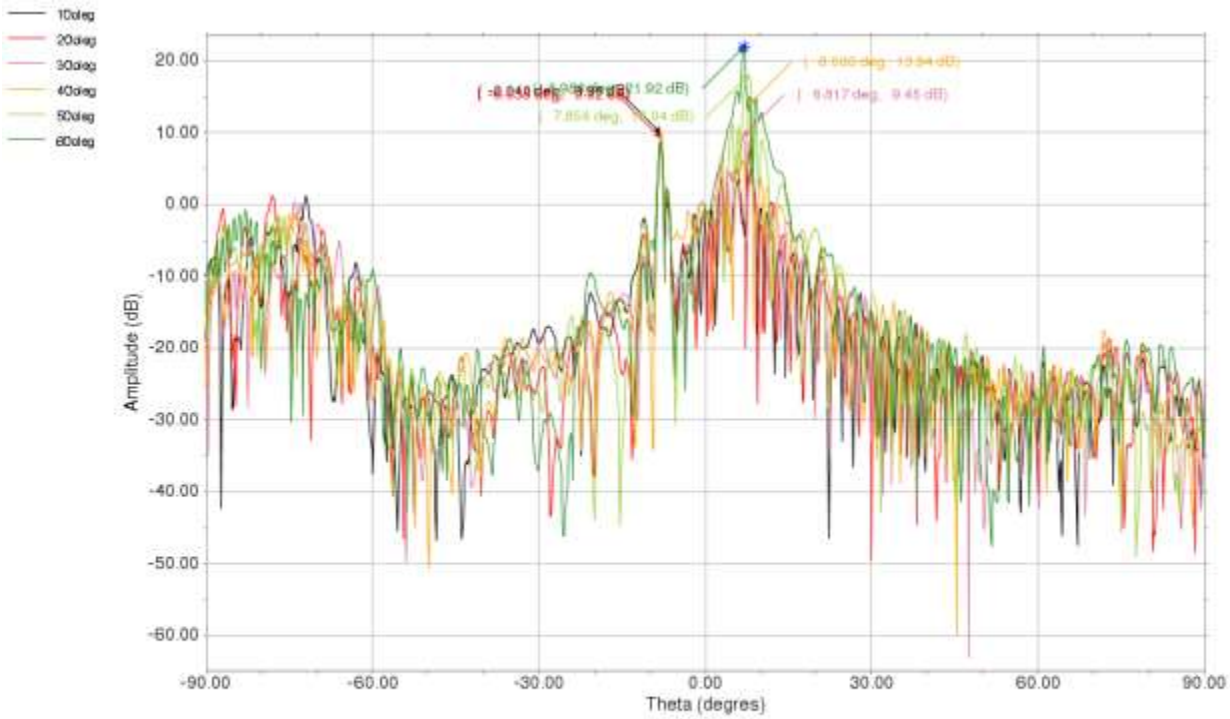
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :39.72 dB **CX max :11.86 dB**



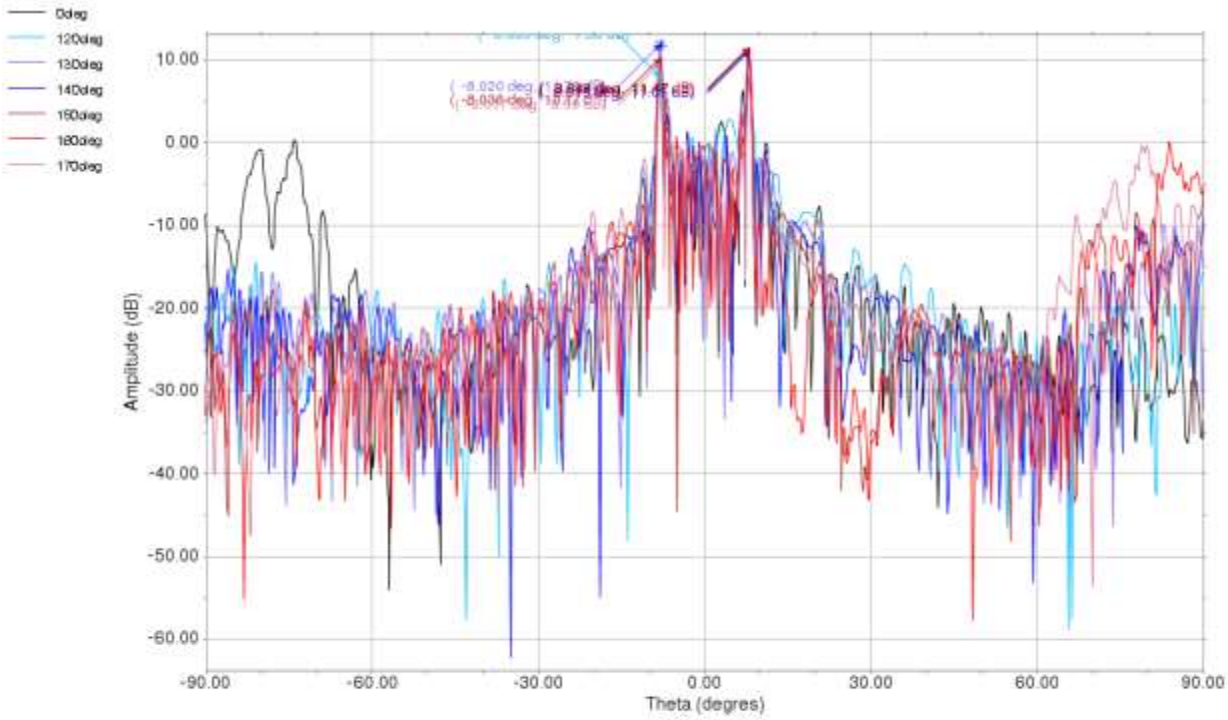
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :40.70 dB **CX max :10.09 dB**



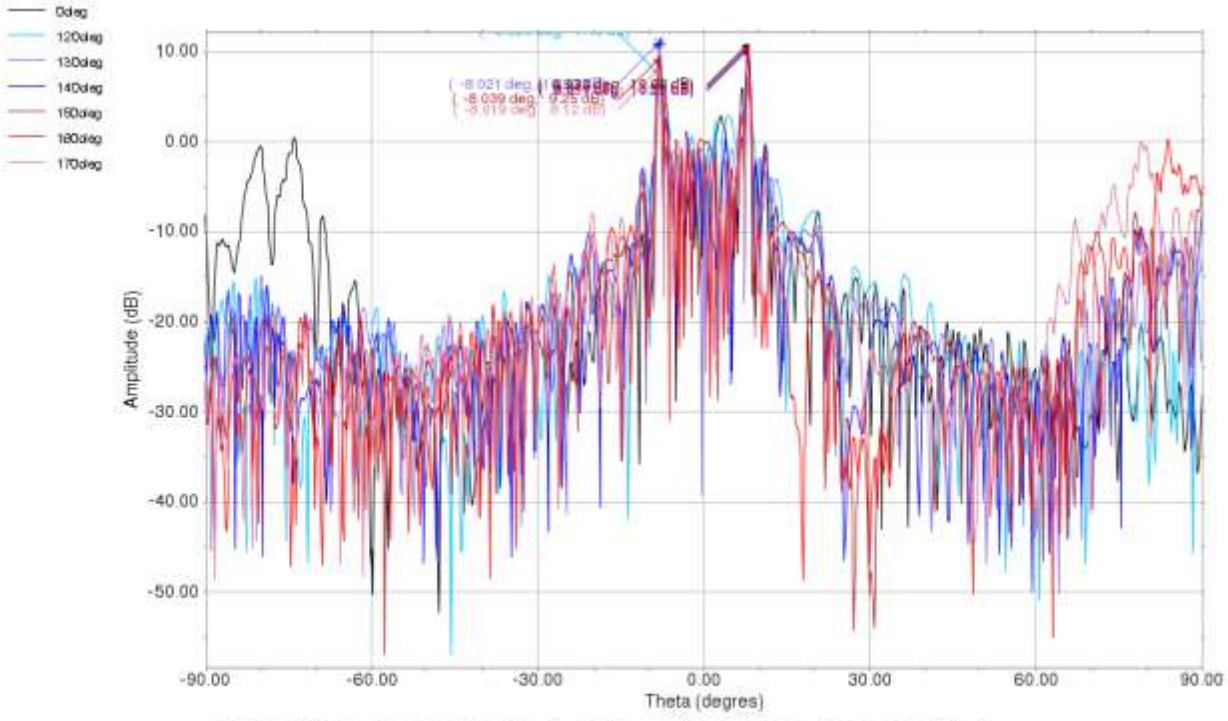
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :39.72 dB **CX max :11.86 dB**



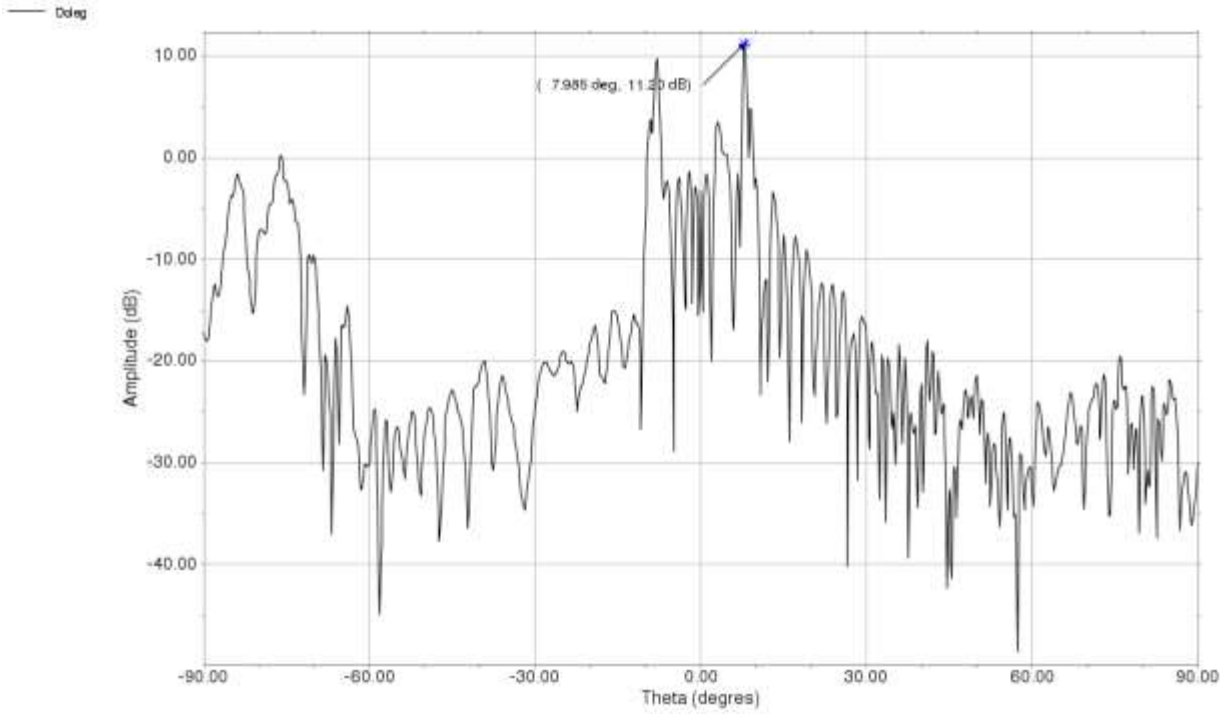
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :40.70 dB **CX max :10.09 dB**



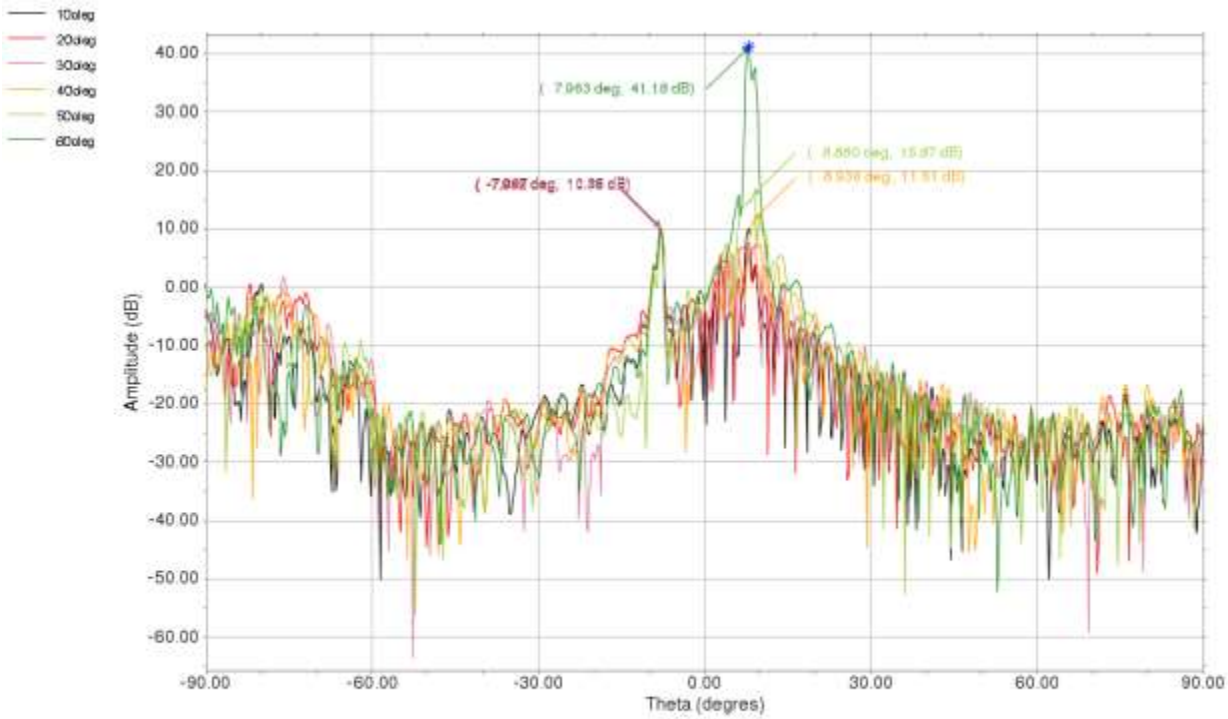
BEAM GW No3 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :39.72 dB **CX max :11.86 dB**



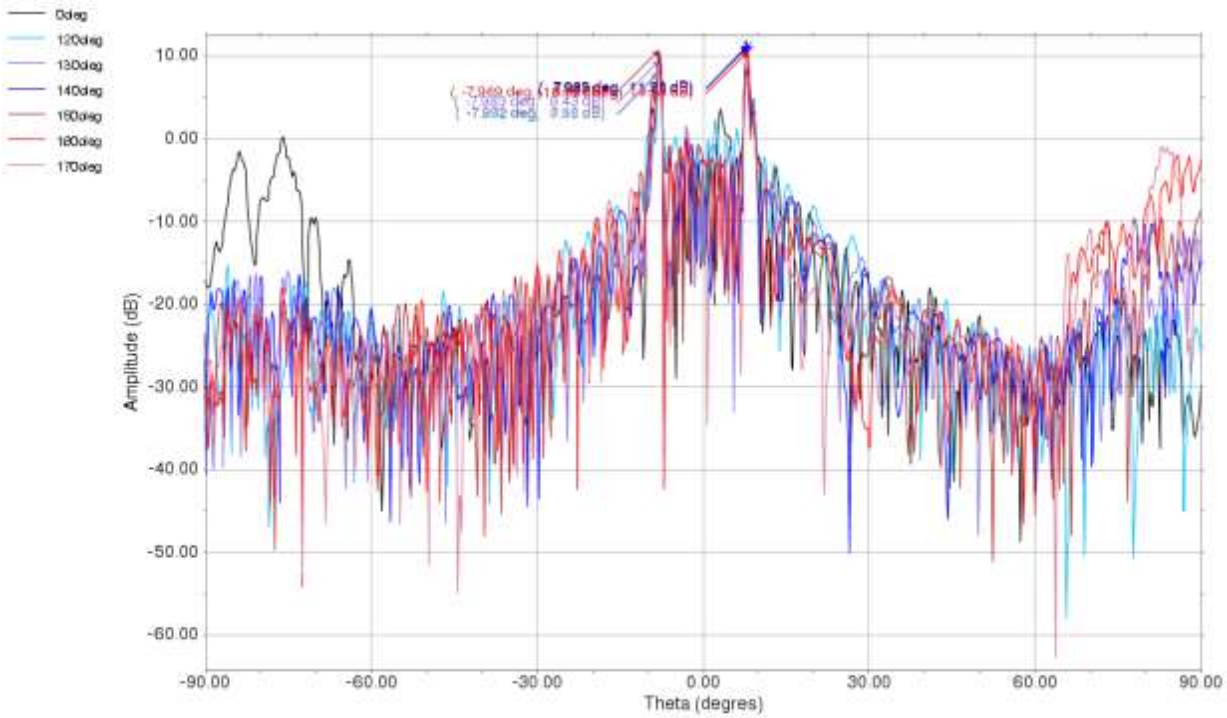
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :41.19 dB **CX max :9.57 dB**



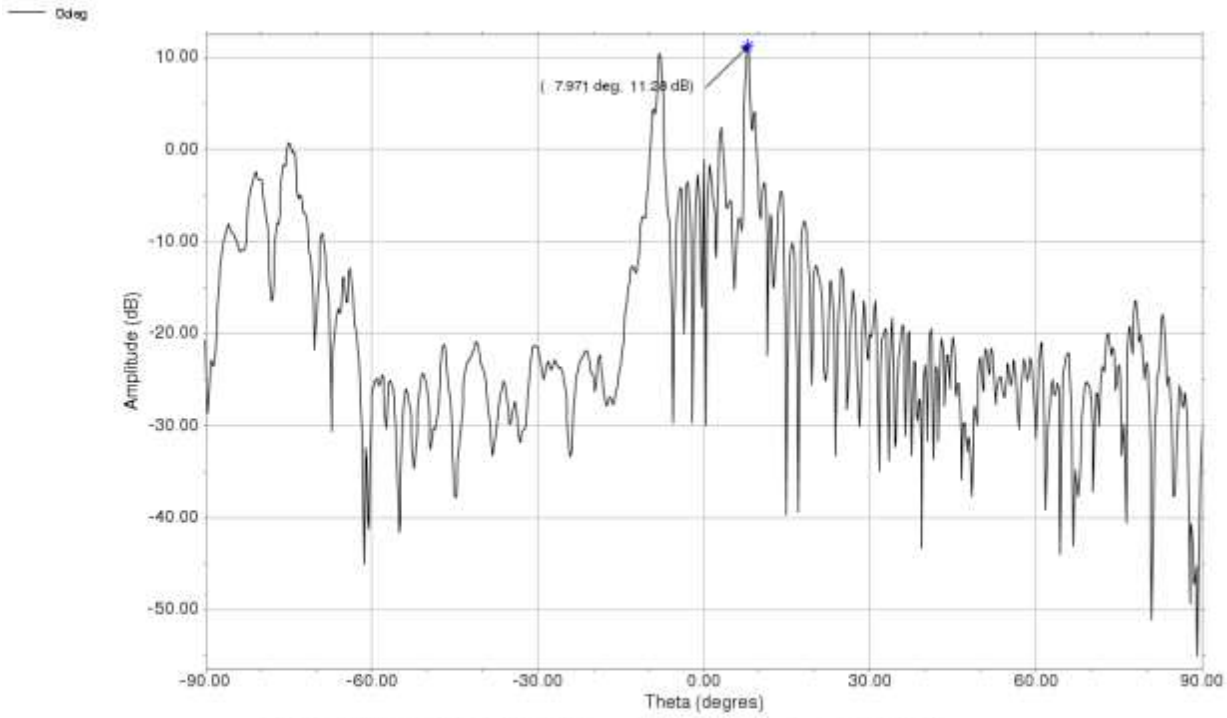
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :41.19 dB **CX max :9.57 dB**



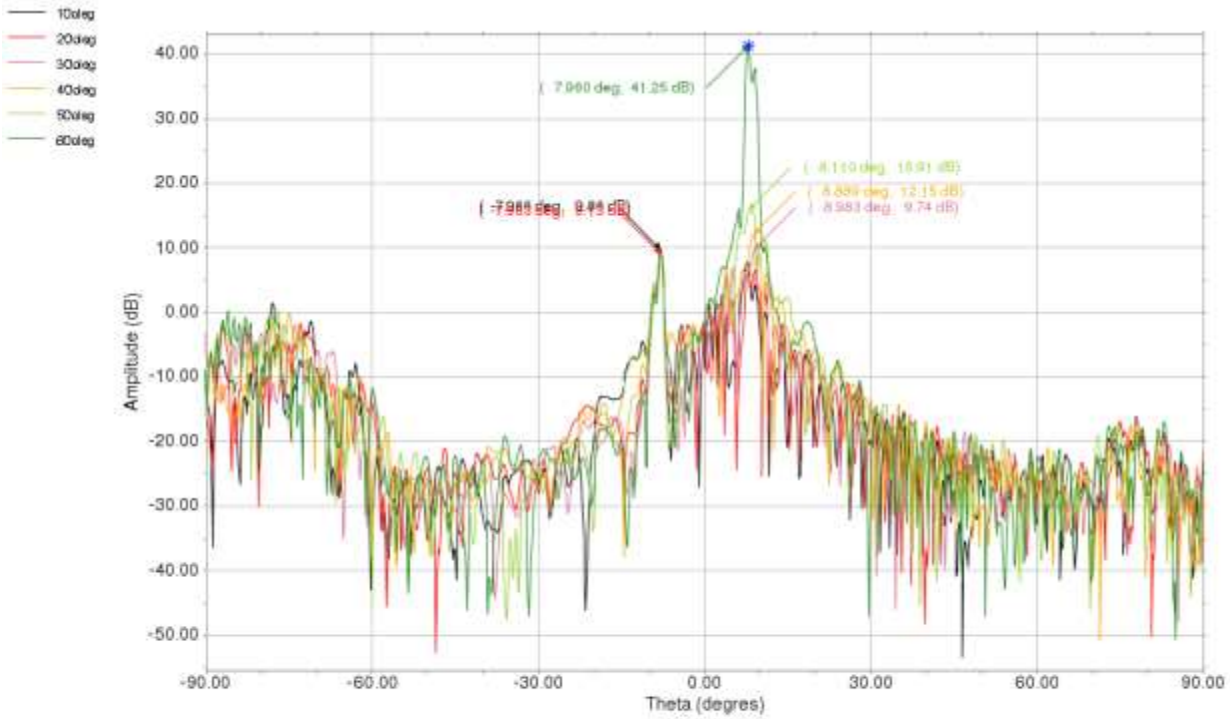
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :41.19 dB **CX max :9.57 dB**



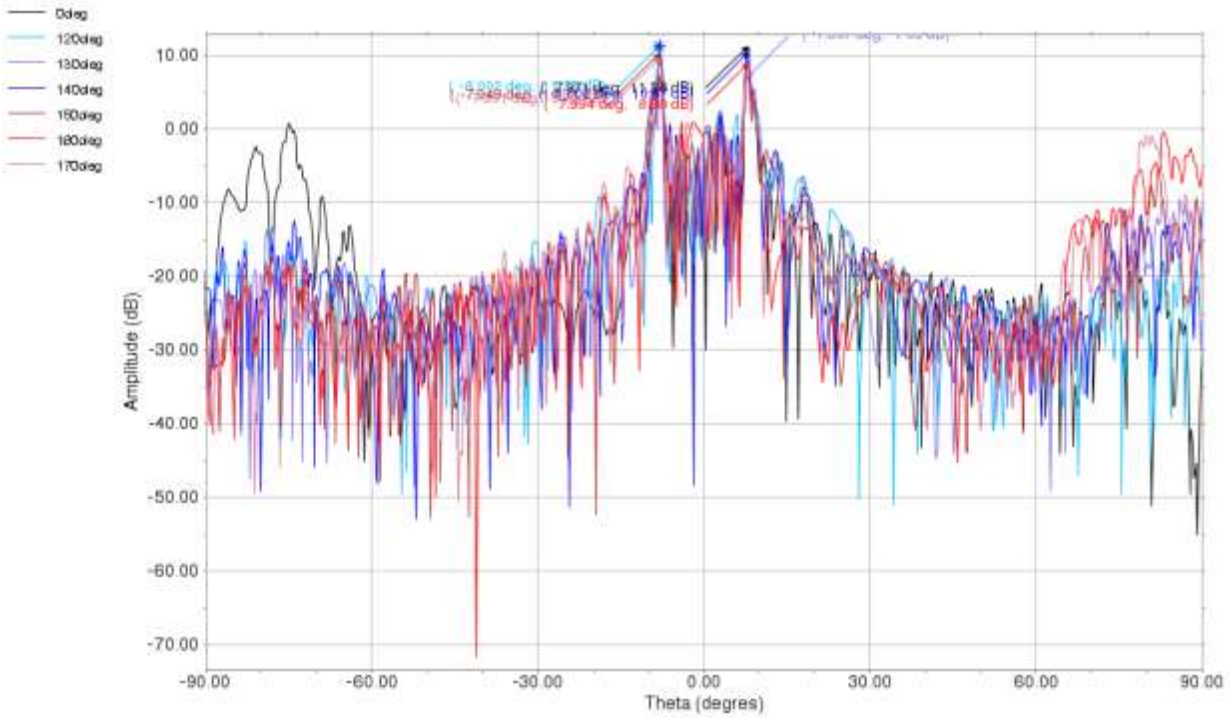
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

CO max :41.27 dB **CX max :7.70 dB**



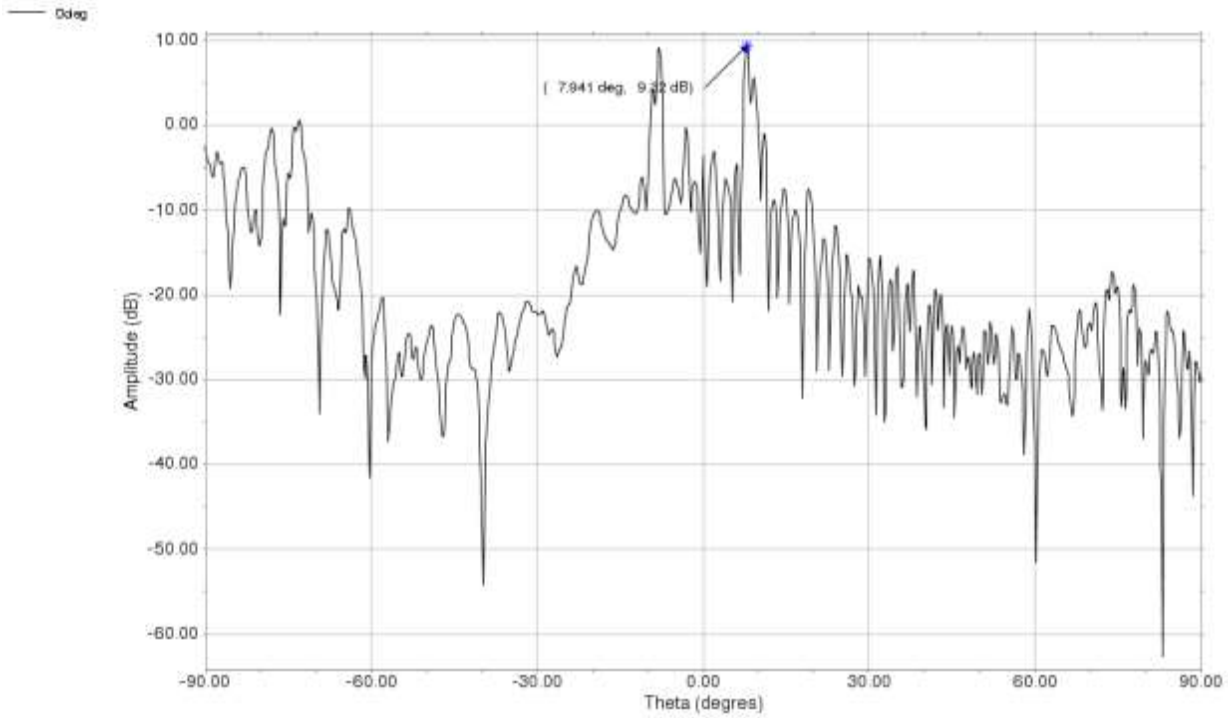
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :41.27 dB **CX max :7.70 dB**



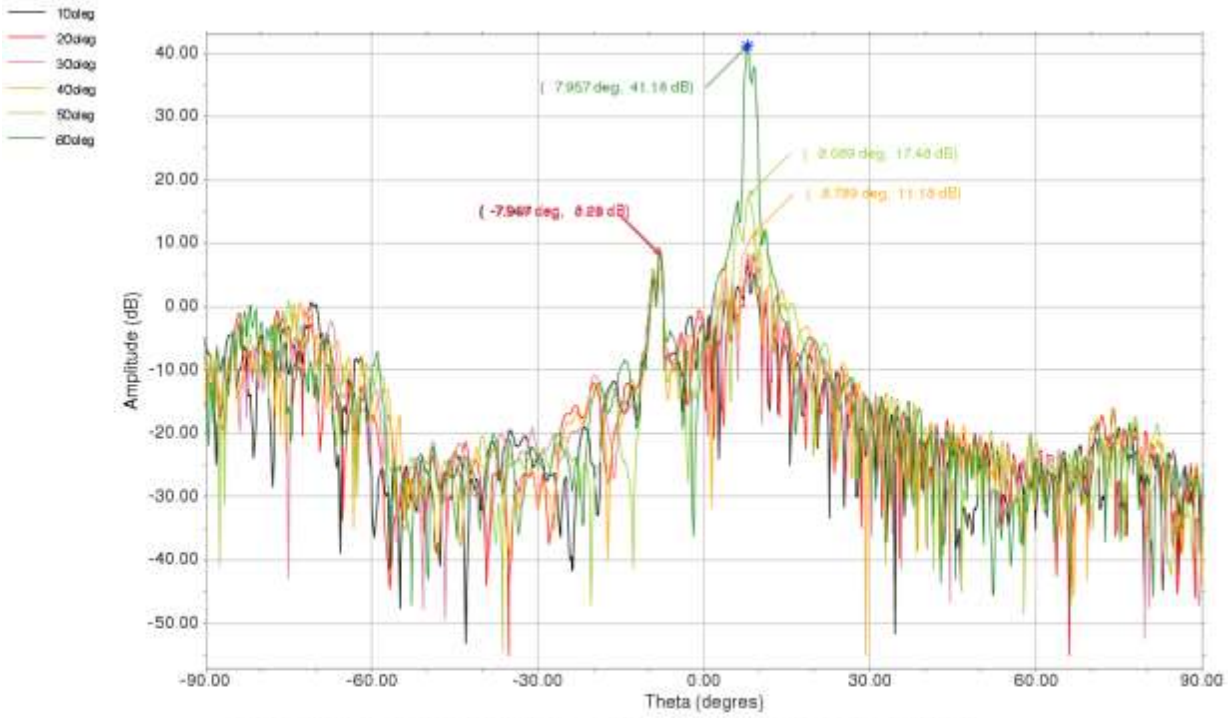
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :41.27 dB **CX max :7.70 dB**



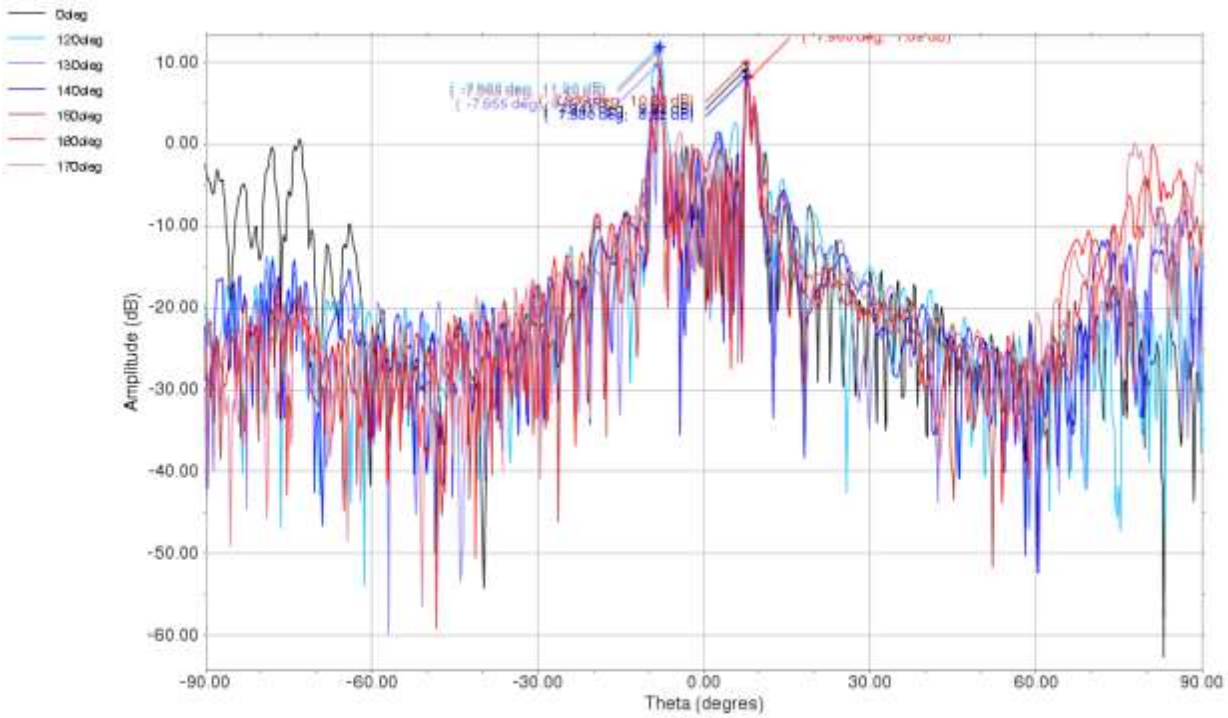
BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :41.17 dB **CX max :7.77 dB**



BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

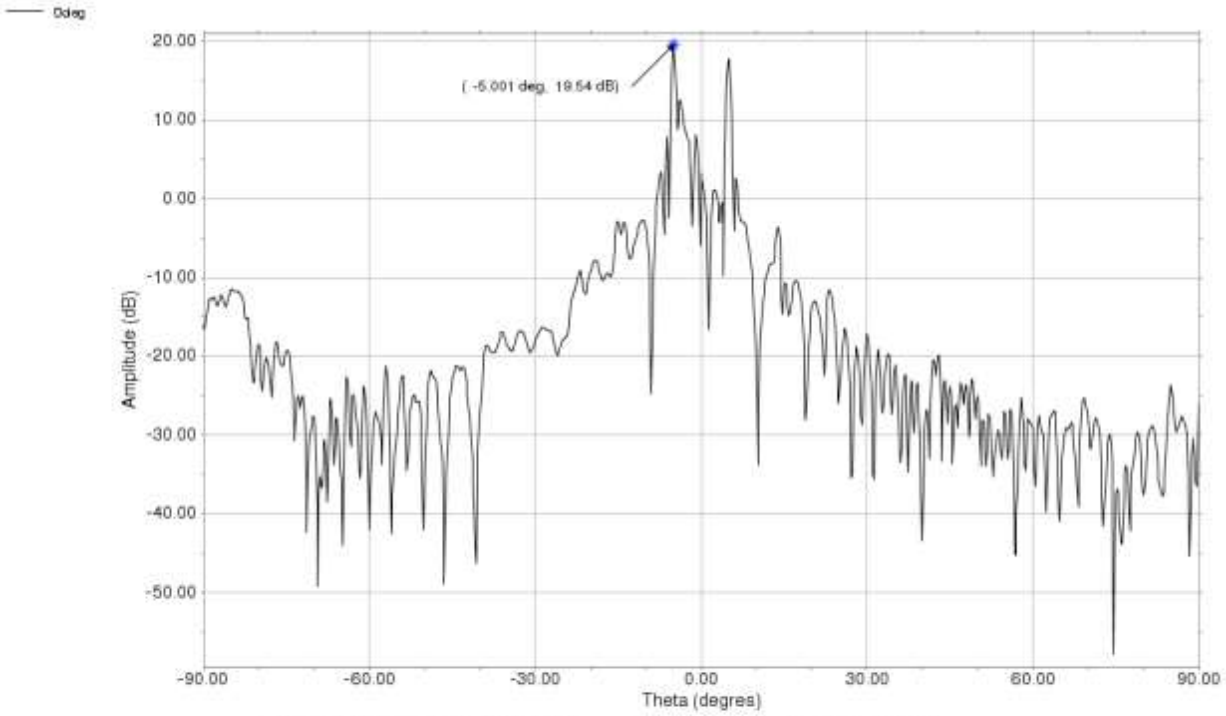
CO max :41.17 dB **CX max :7.77 dB**



BEAM GW No4 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

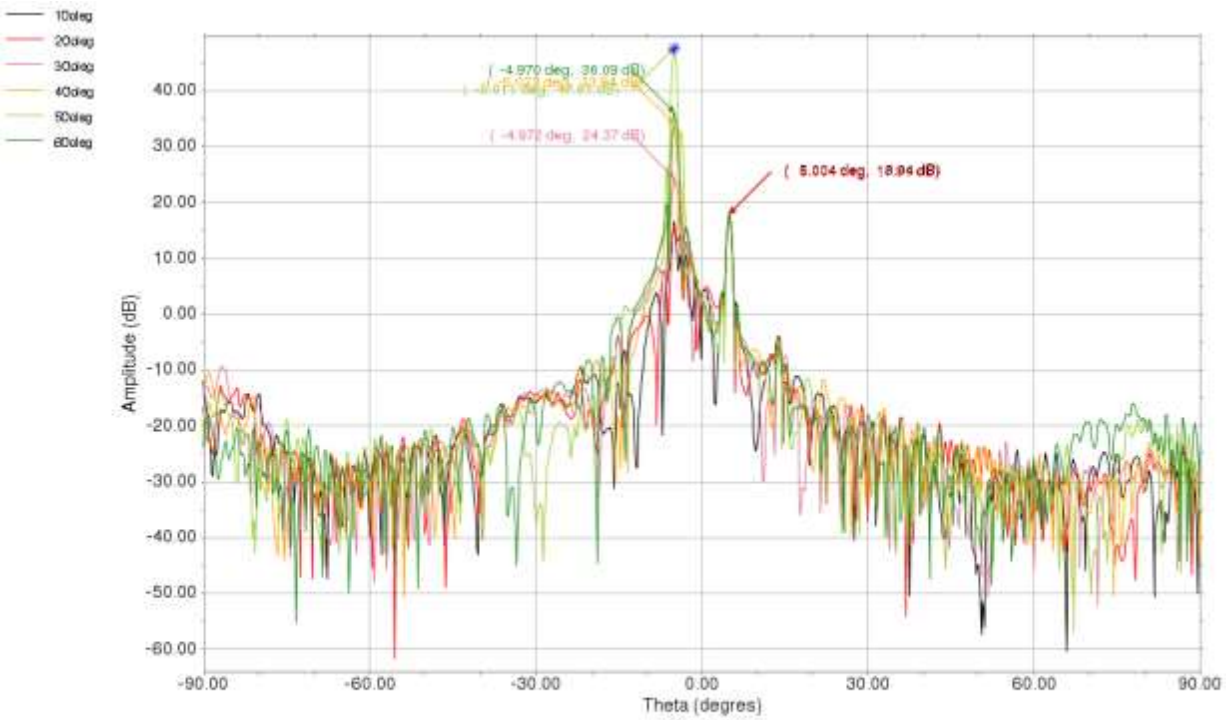
CO max :41.17 dB

CX max :7.77 dB



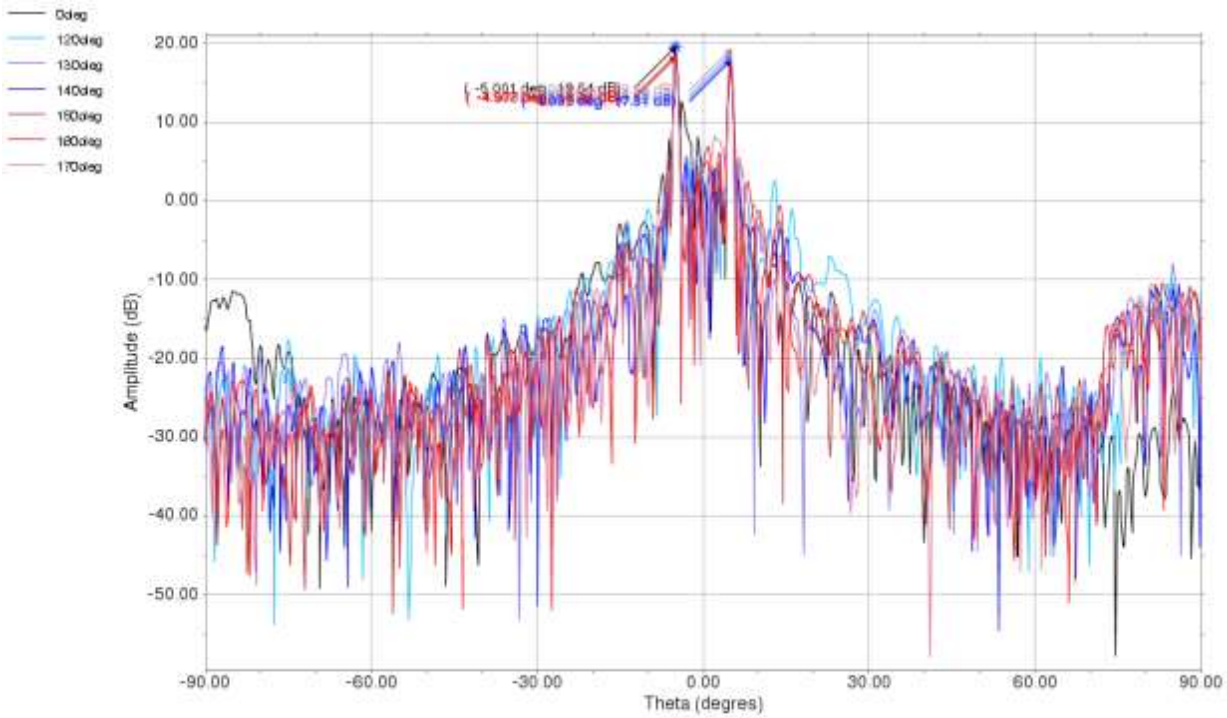
BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :47.61 dB **CX max :16.30 dB**



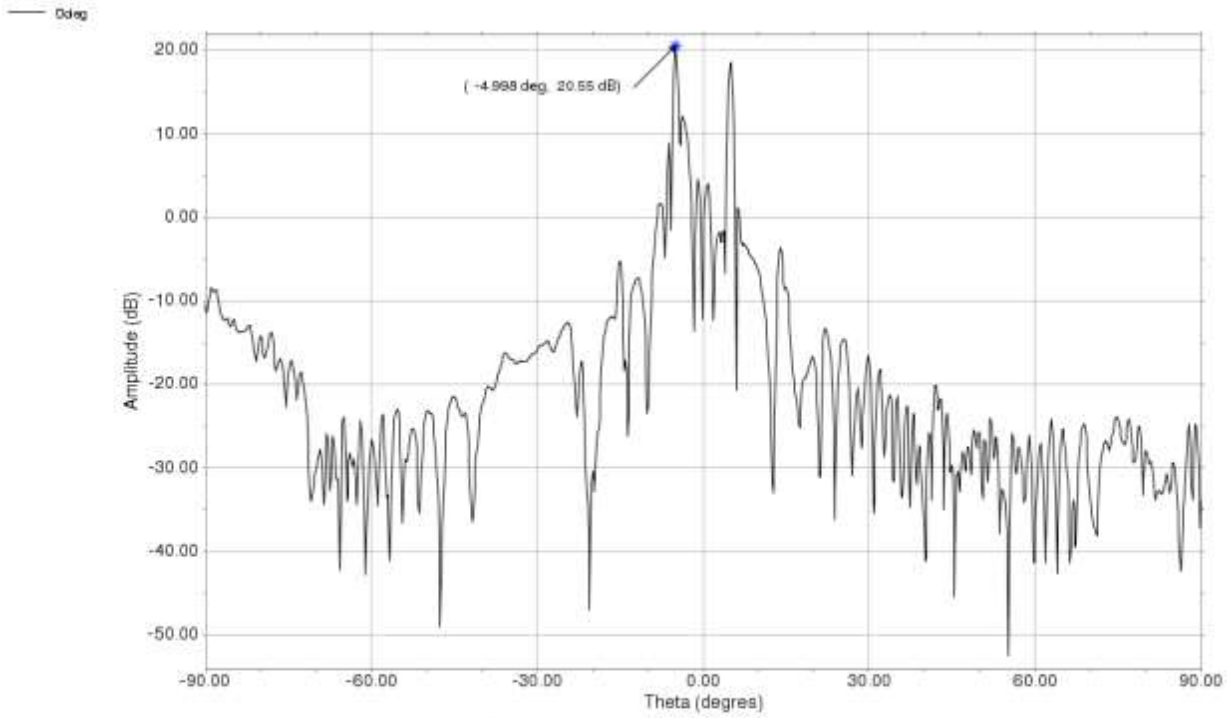
BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :47.61 dB **CX max :16.30 dB**



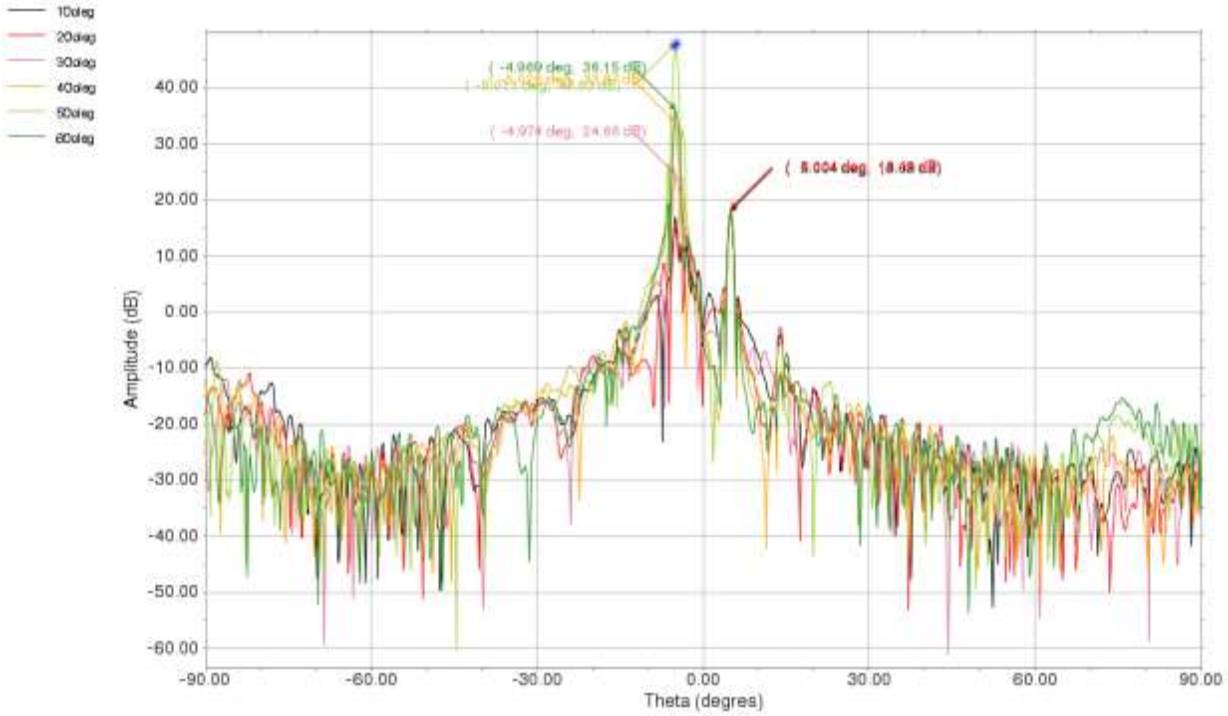
BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :47.61 dB **CX max :16.30 dB**



BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

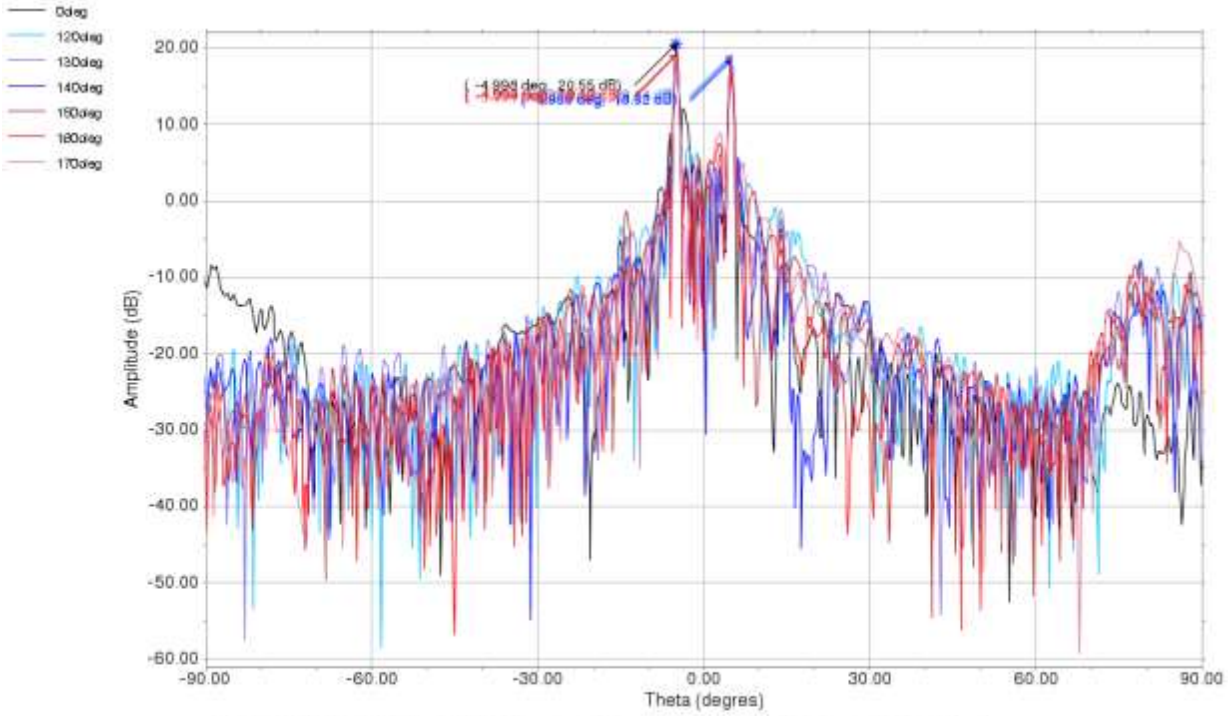
CO max :47.84 dB **CX max :15.57 dB**



BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :47.84 dB

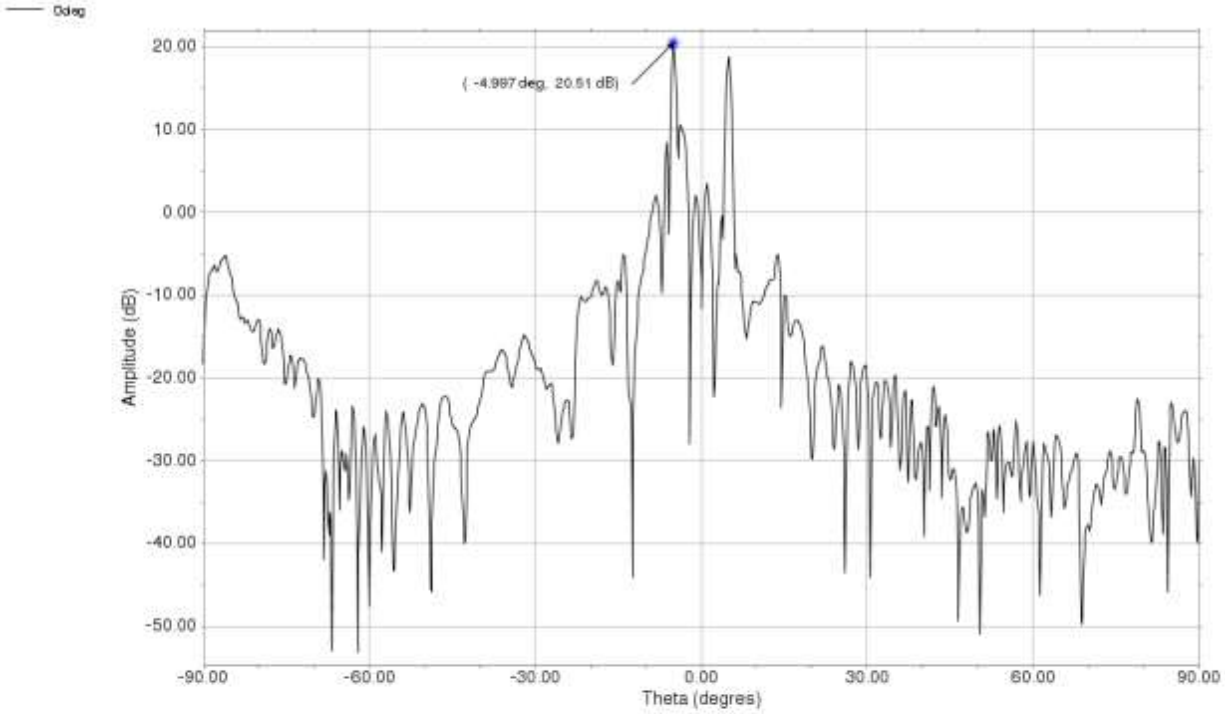
CX max :15.57 dB



BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

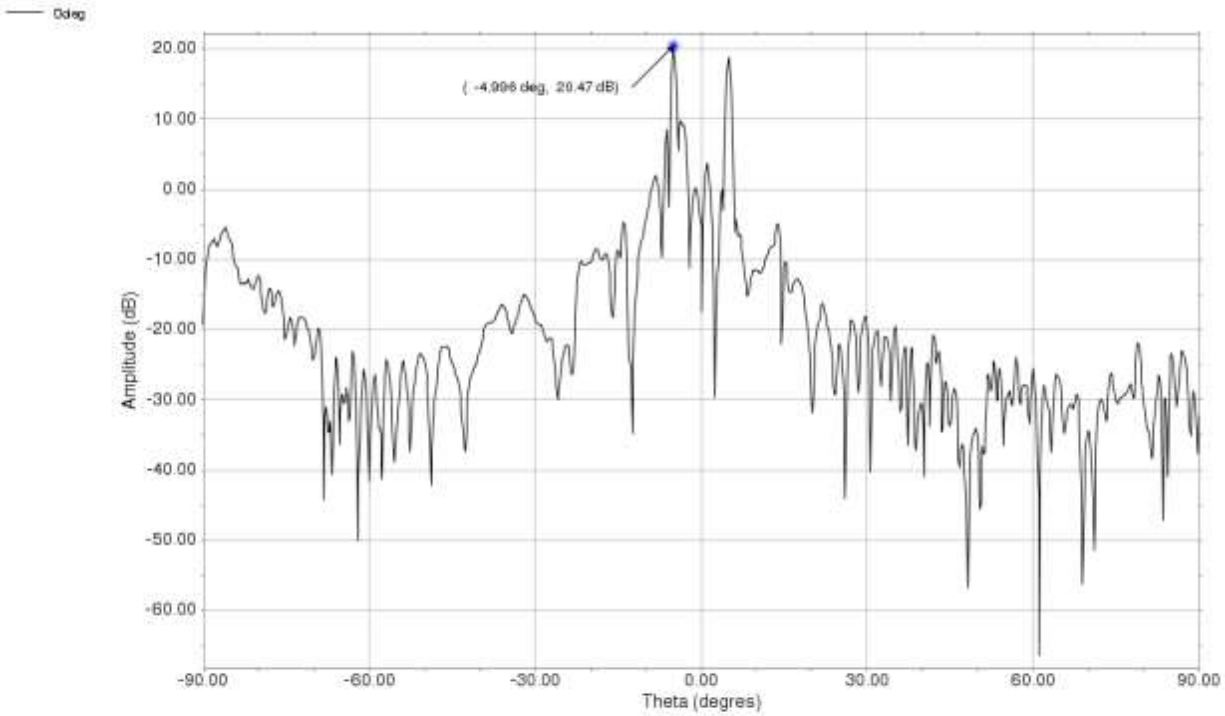
CO max :47.84 dB

CX max :15.57 dB



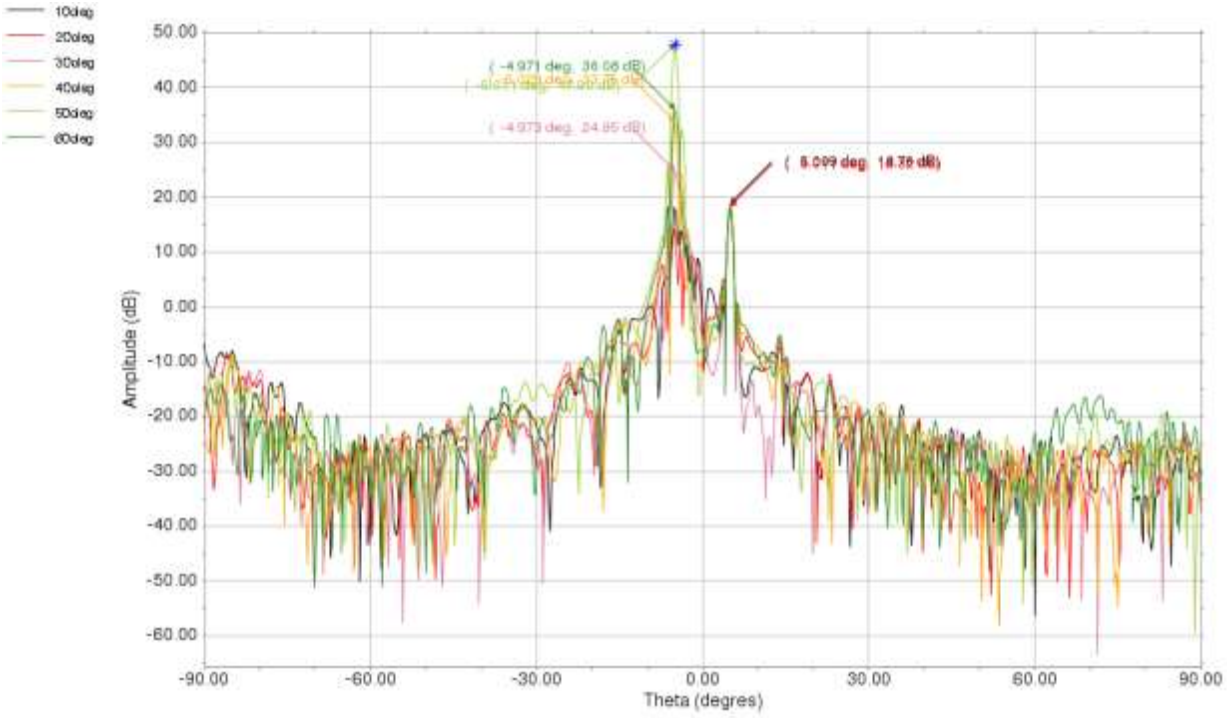
BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :47.90 dB **CX max :15.00 dB**



BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

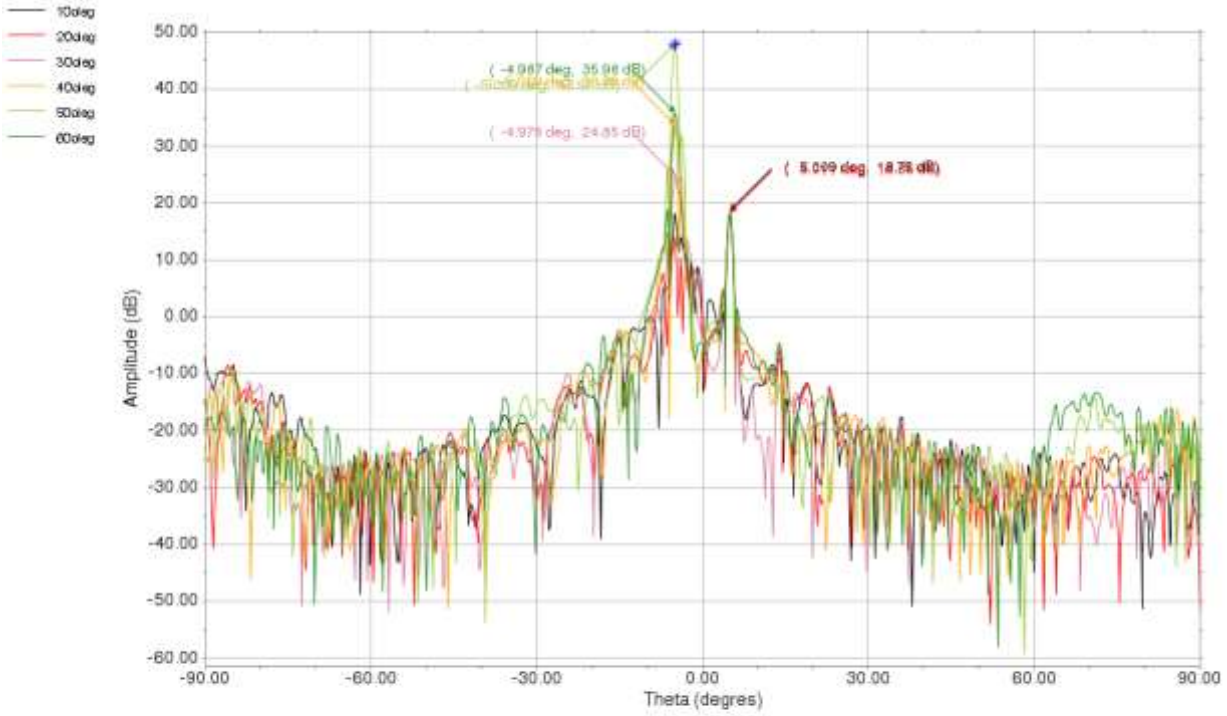
CO max :47.93 dB **CX max :19.29 dB**



BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :47.90 dB

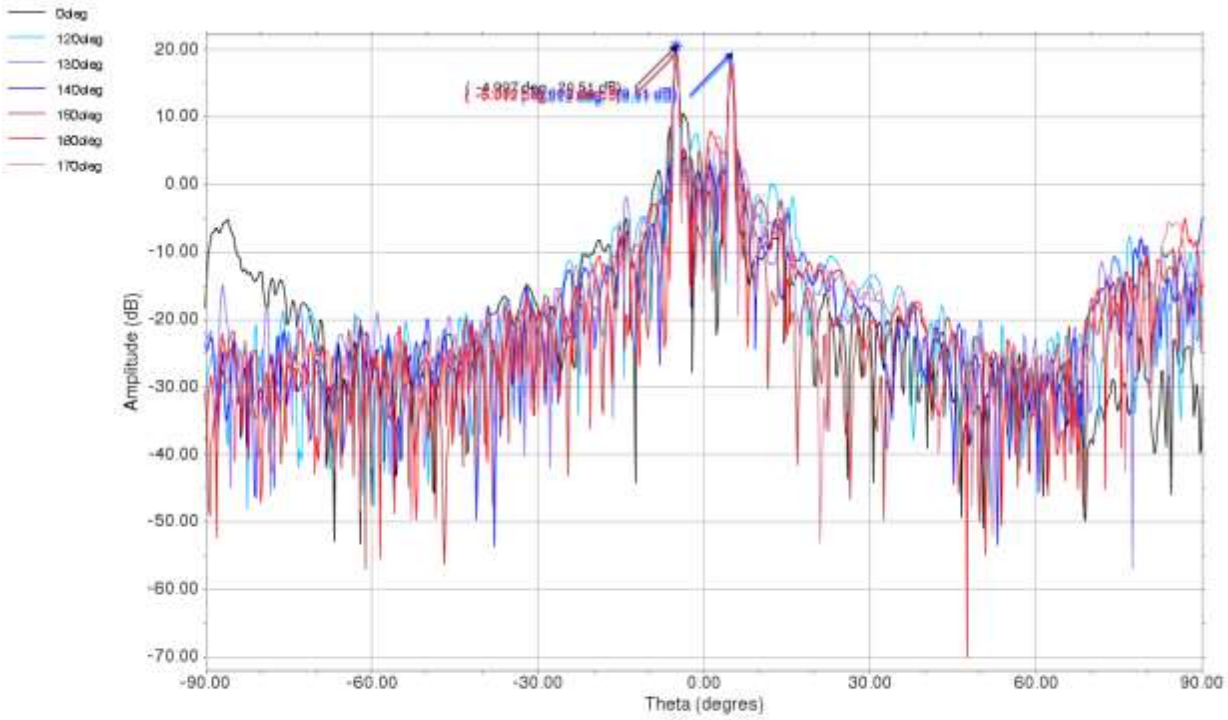
CX max :15.00 dB



BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

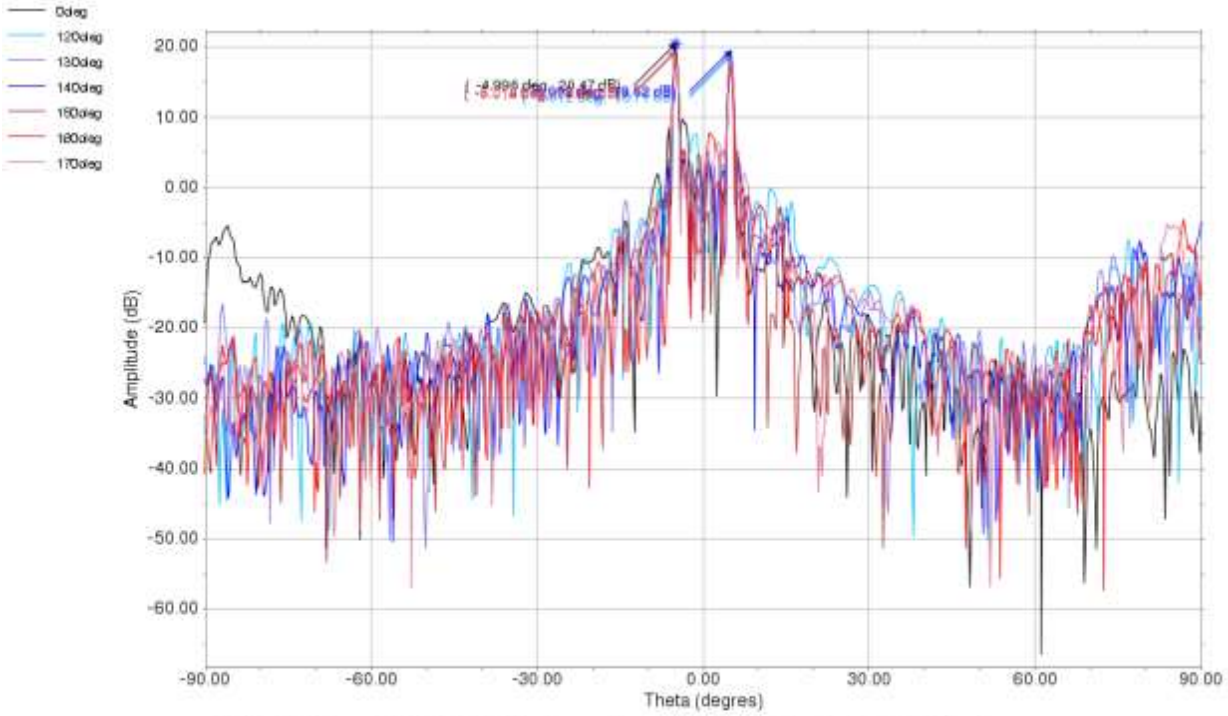
CO max :47.93 dB

CX max :19.29 dB



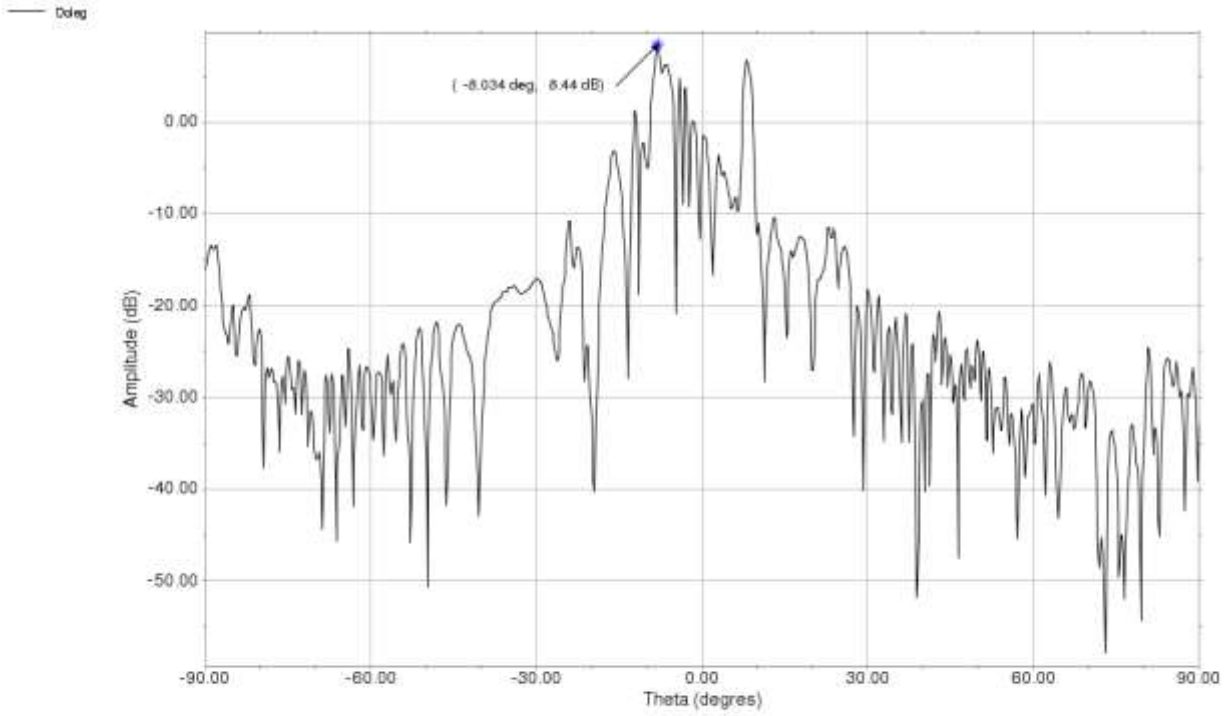
BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :47.90 dB **CX max :15.00 dB**



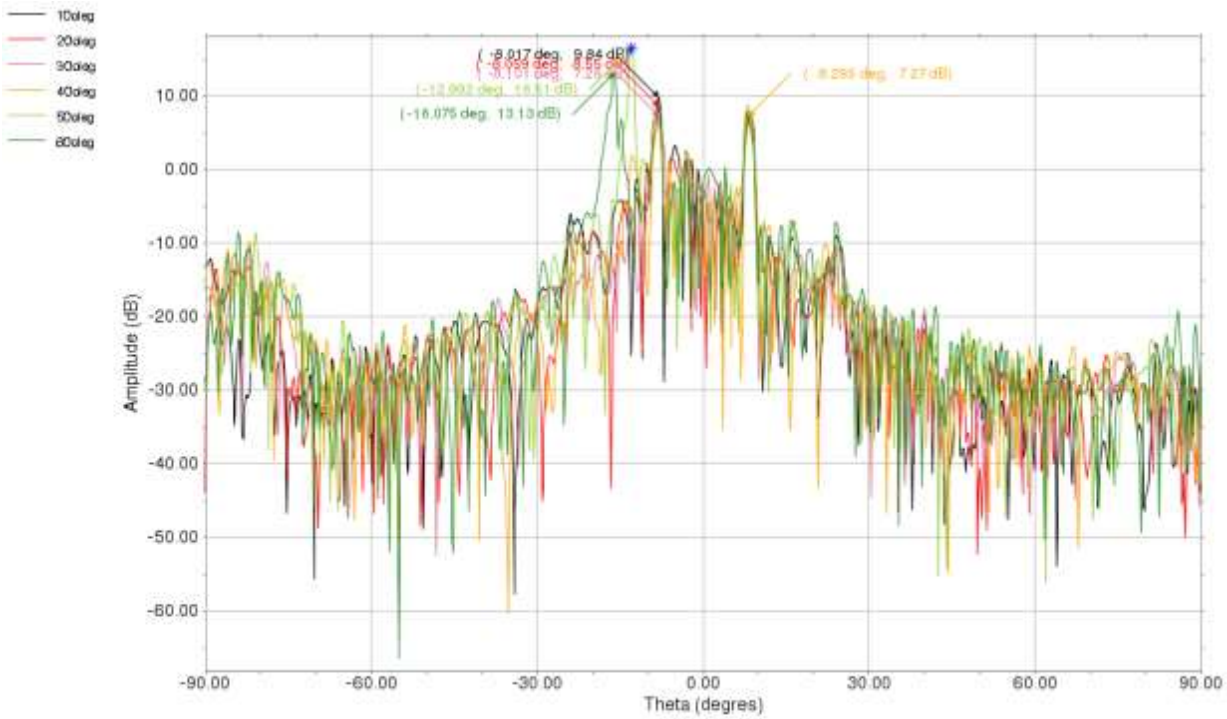
BEAM GW No5 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :47.93 dB **CX max :19.29 dB**



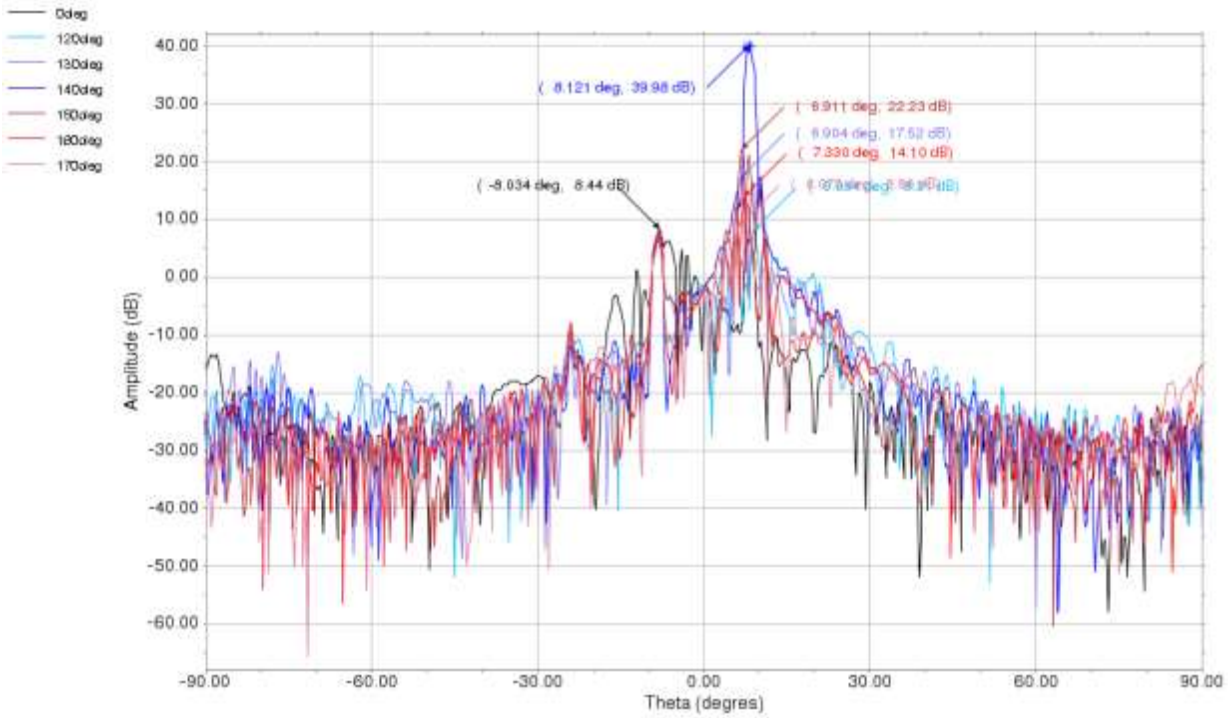
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :39.98 dB **CX max :13.18 dB**



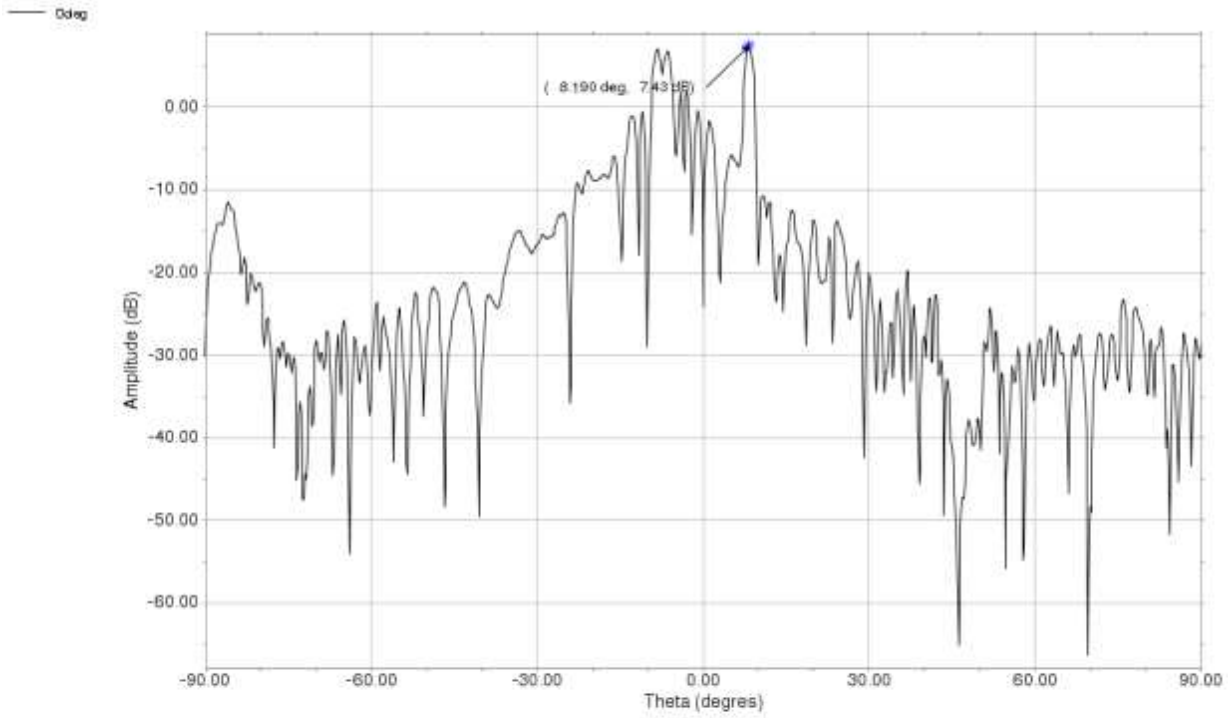
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :39.98 dB **CX max :13.18 dB**



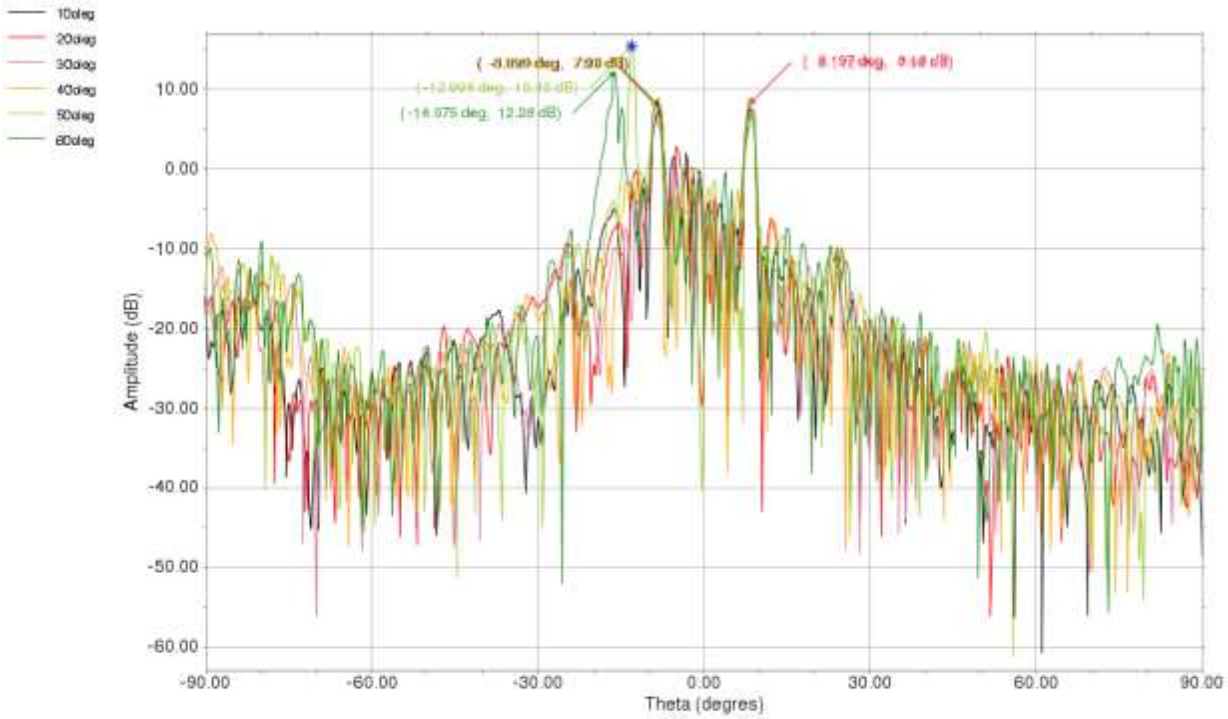
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :39.98 dB **CX max :13.18 dB**



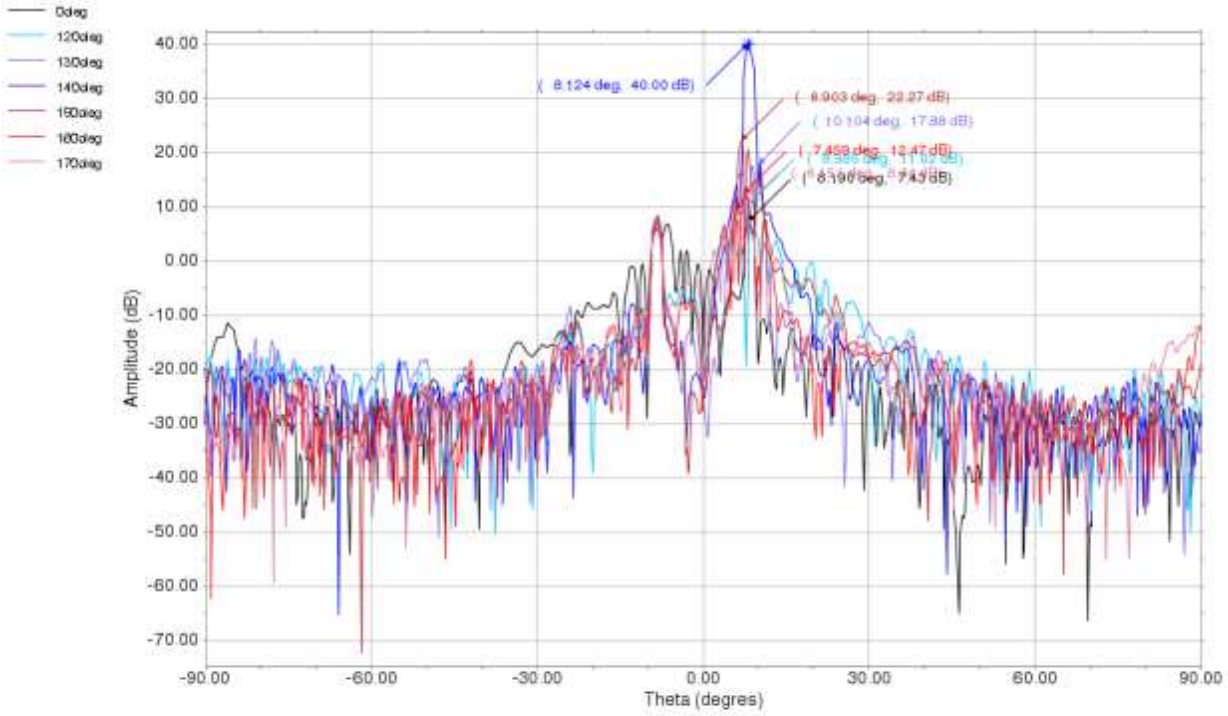
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :39.99 dB **CX max :11.91 dB**



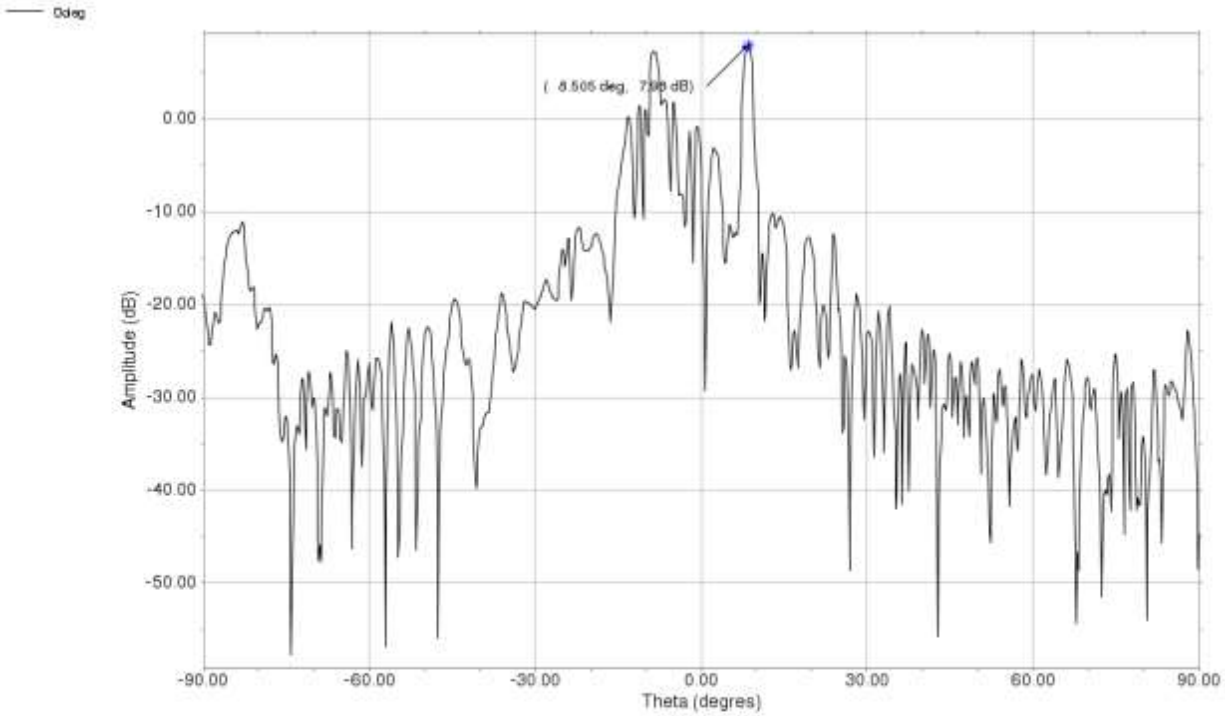
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :39.99 dB CX max :11.91 dB



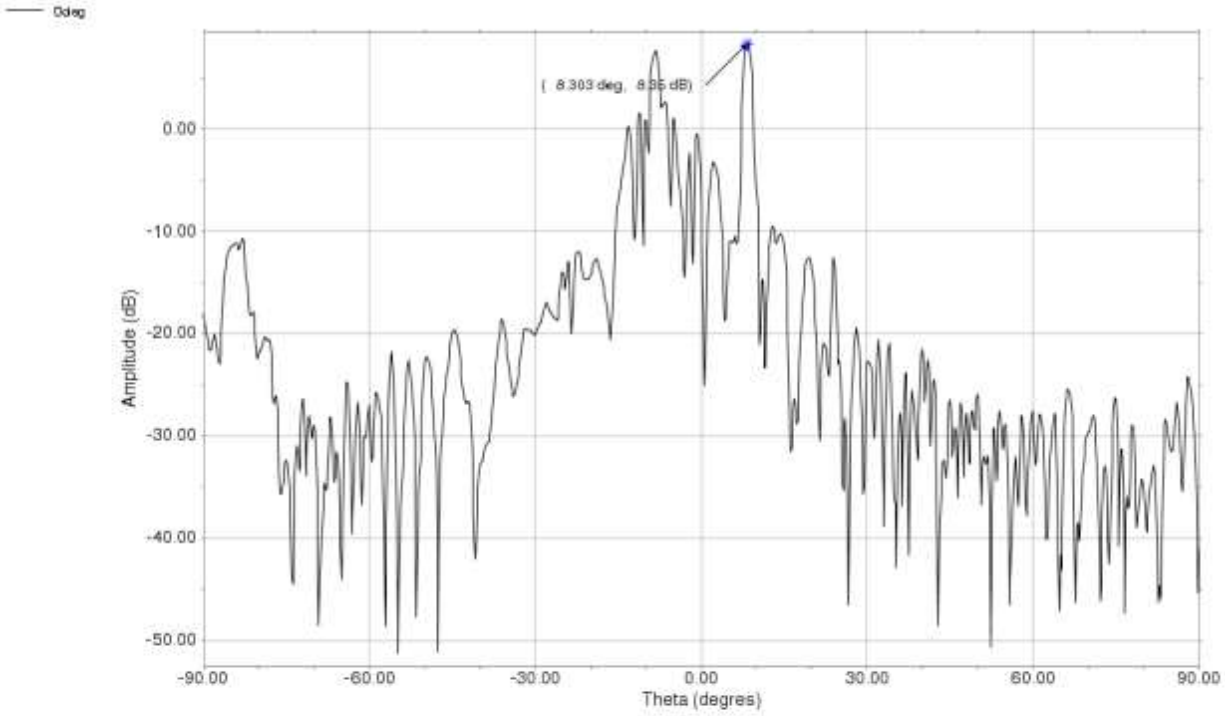
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :39.99 dB CX max :11.91 dB



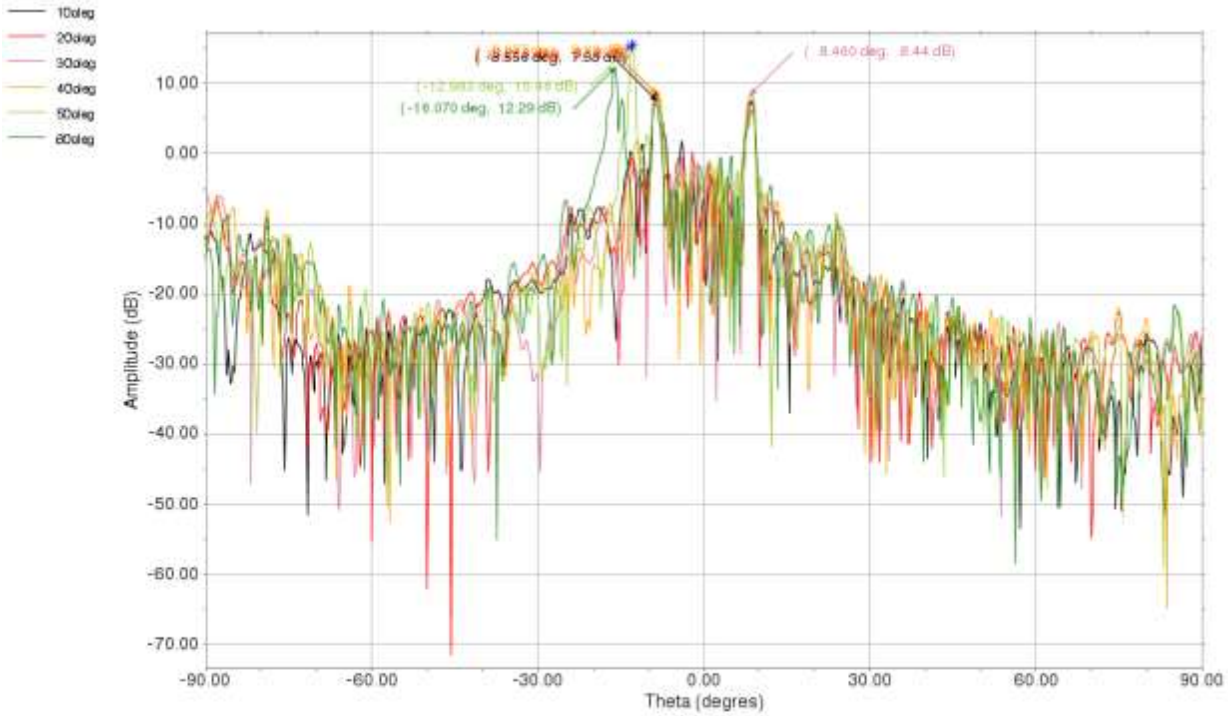
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :39.27 dB **CX max :11.90 dB**



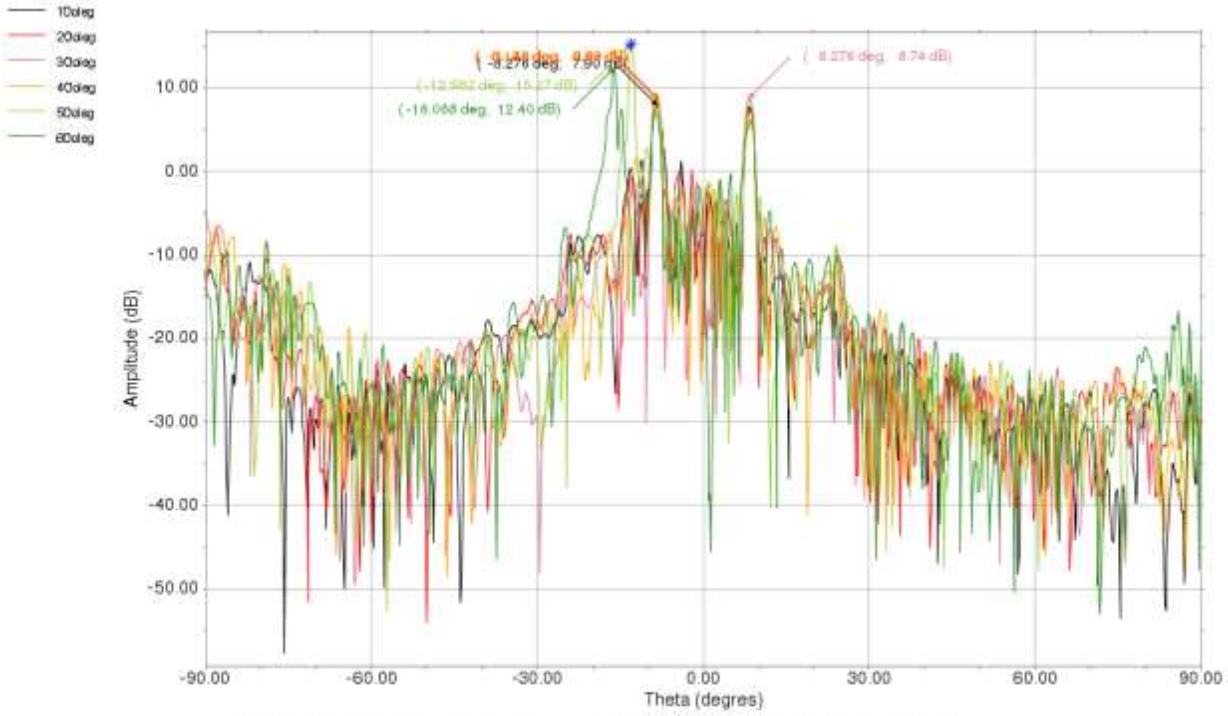
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :39.83 dB **CX max :11.70 dB**



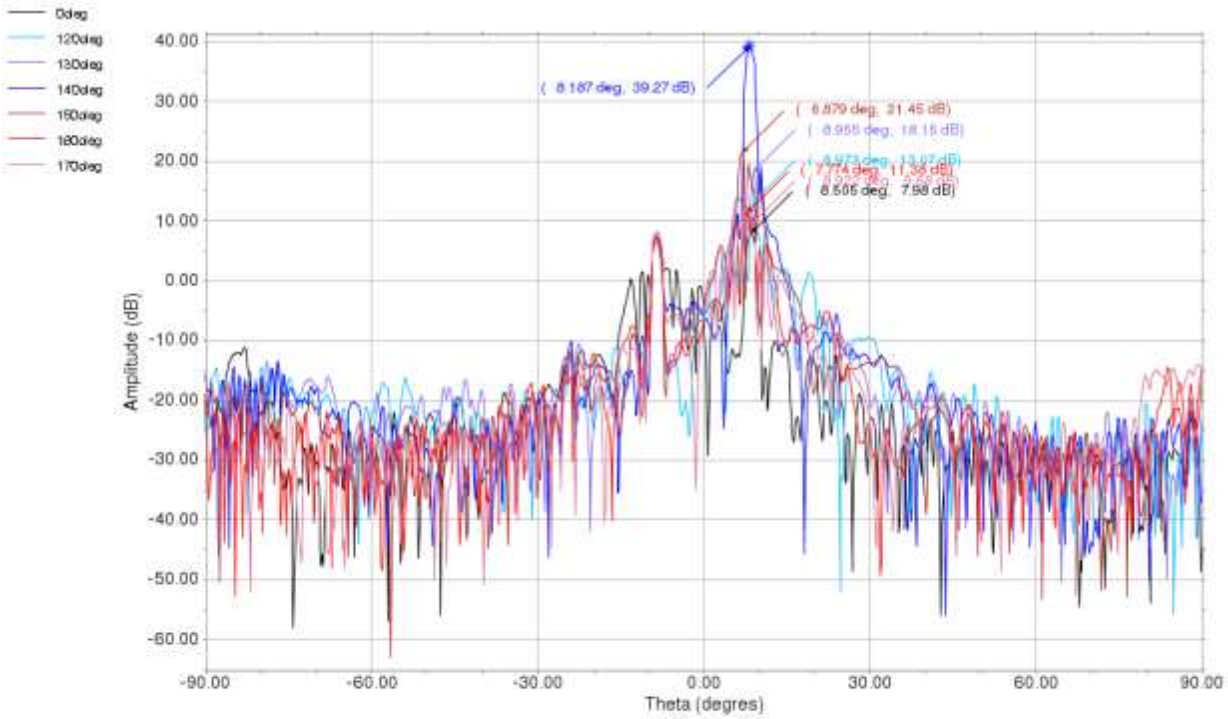
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :39.27 dB **CX max :11.90 dB**



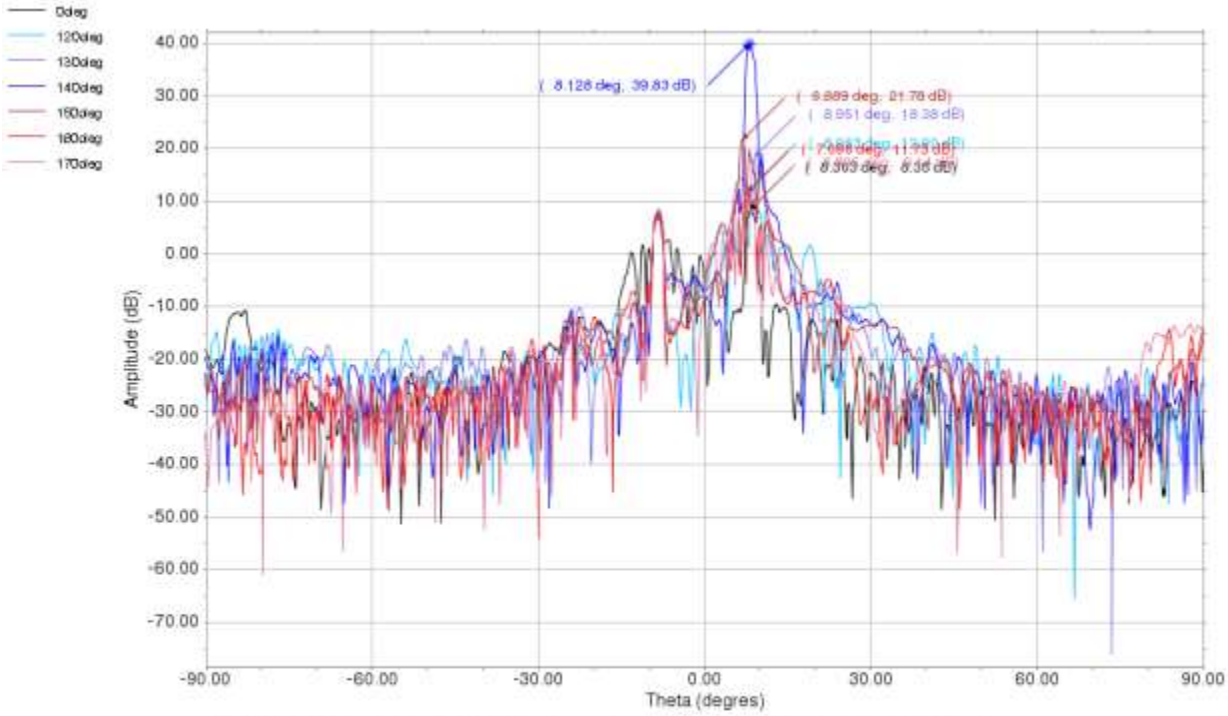
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :39.83 dB **CX max :11.70 dB**



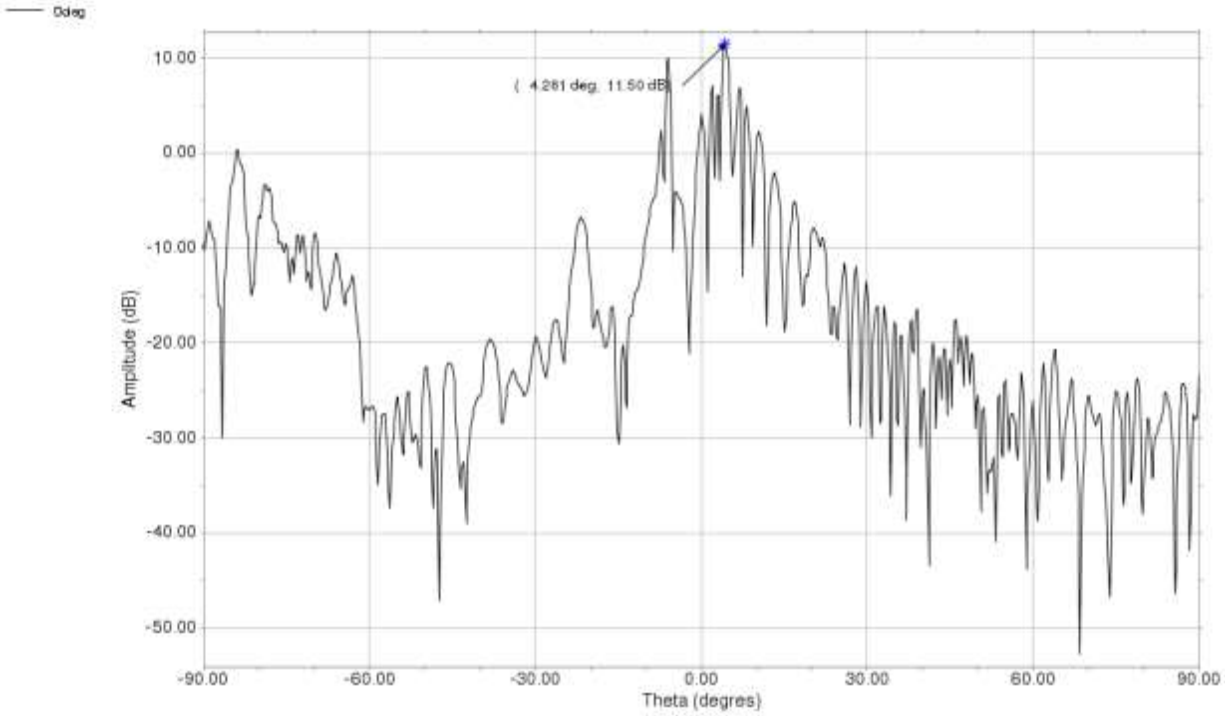
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :39.27 dB **CX max :11.90 dB**



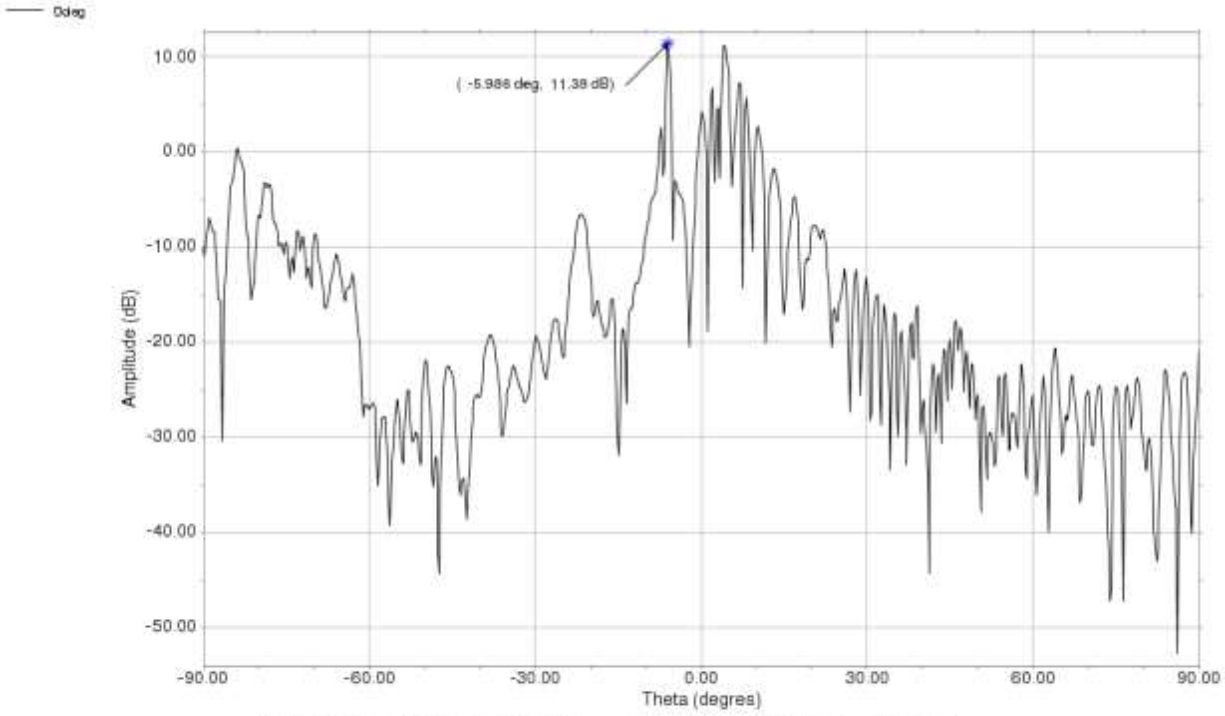
BEAM GW No6 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :39.83 dB **CX max :11.70 dB**



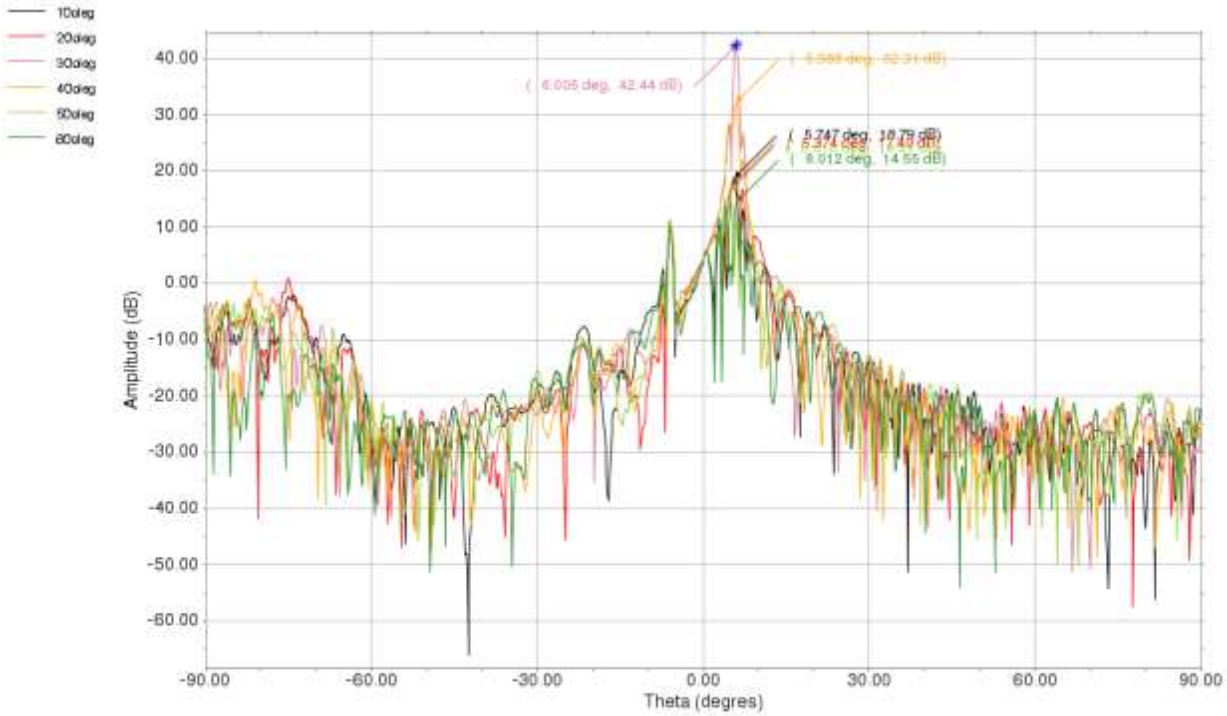
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :42.44 dB **CX max :11.73 dB**



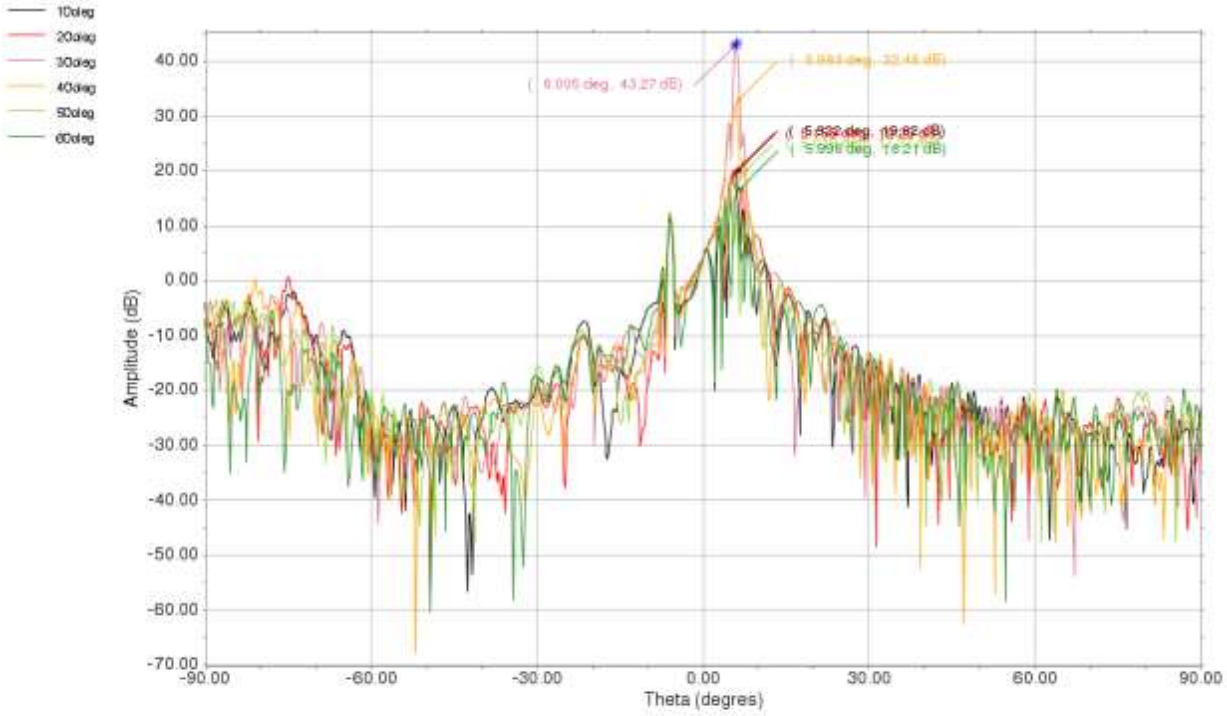
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :43.29 dB **CX max :14.53 dB**



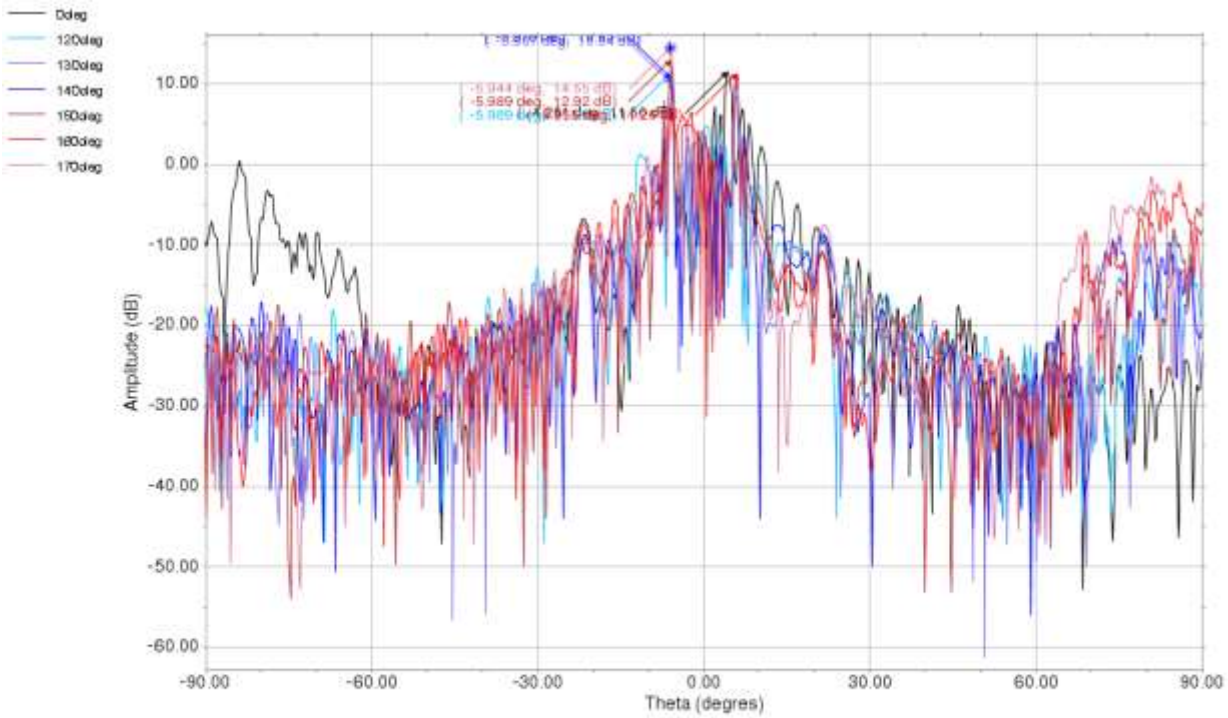
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :42.44 dB **CX max :11.73 dB**



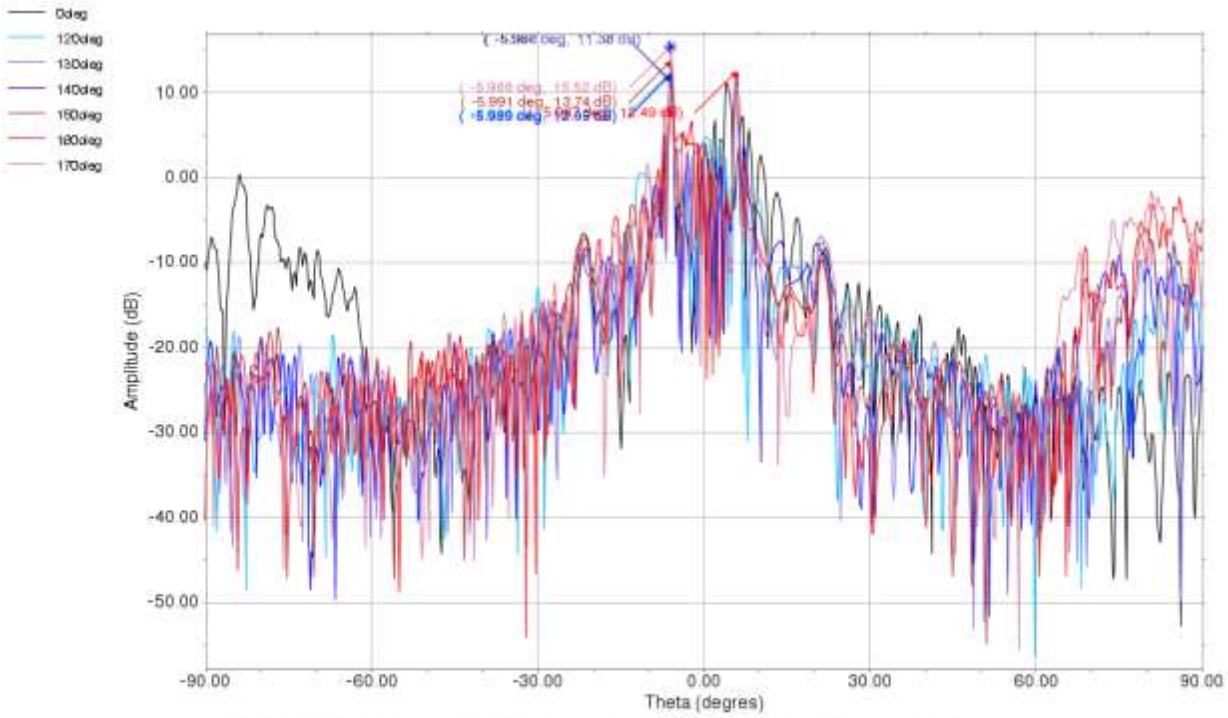
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :43.29 dB **CX max :14.53 dB**



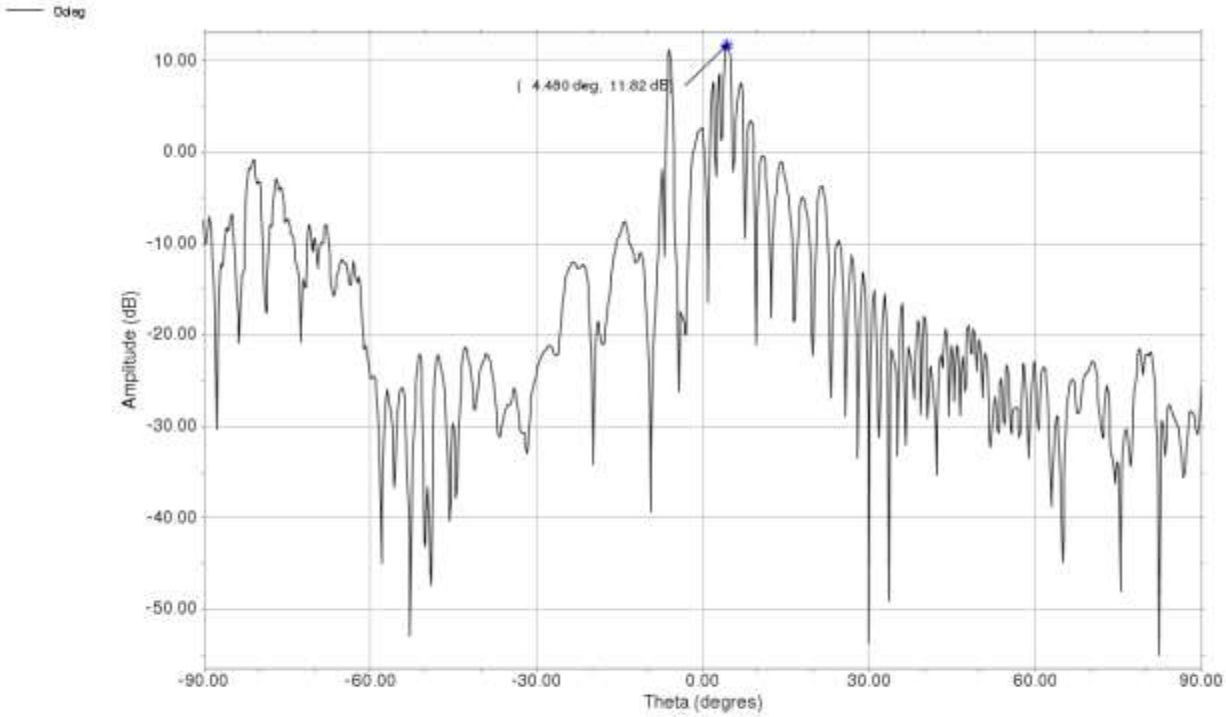
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :42.44 dB **CX max :11.73 dB**



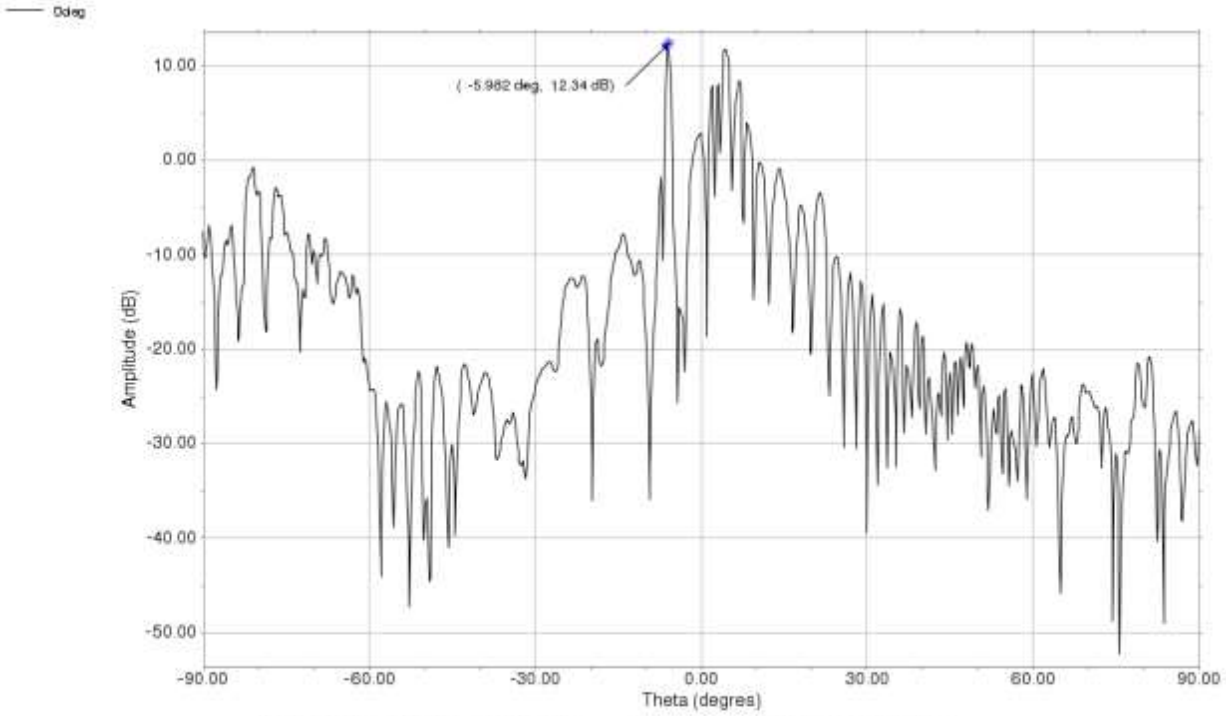
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :43.29 dB **CX max :14.53 dB**



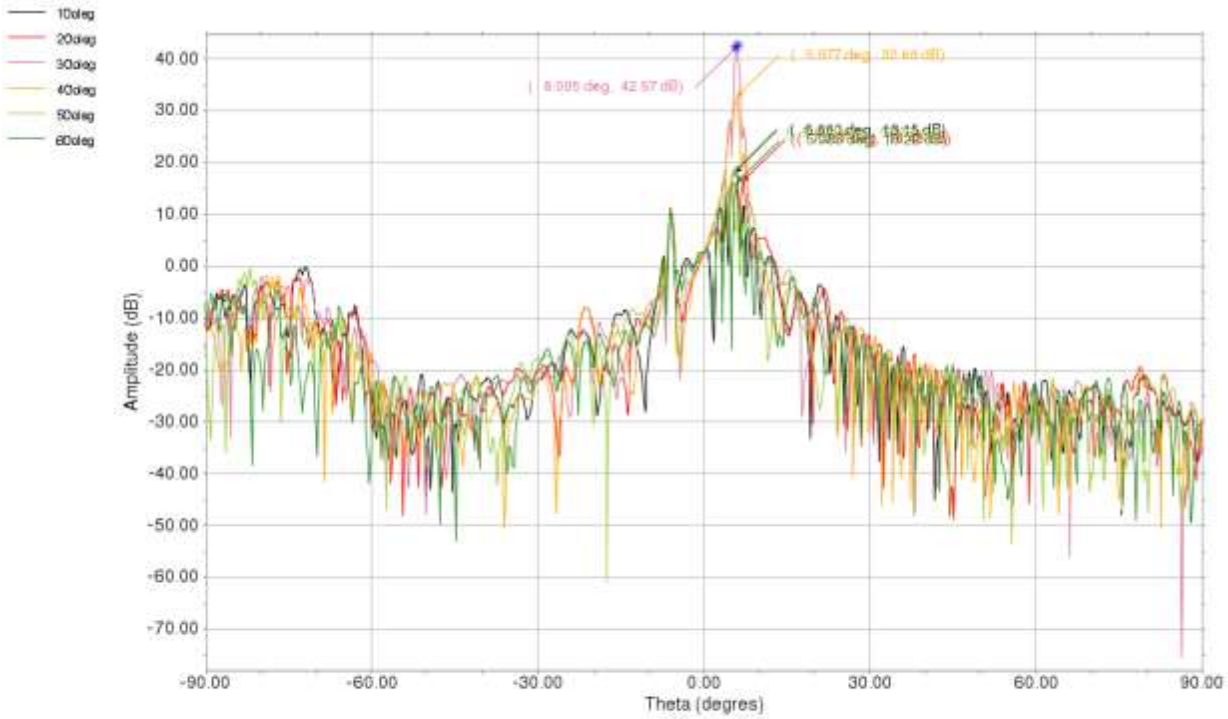
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

CO max :42.58 dB **CX max :12.98 dB**



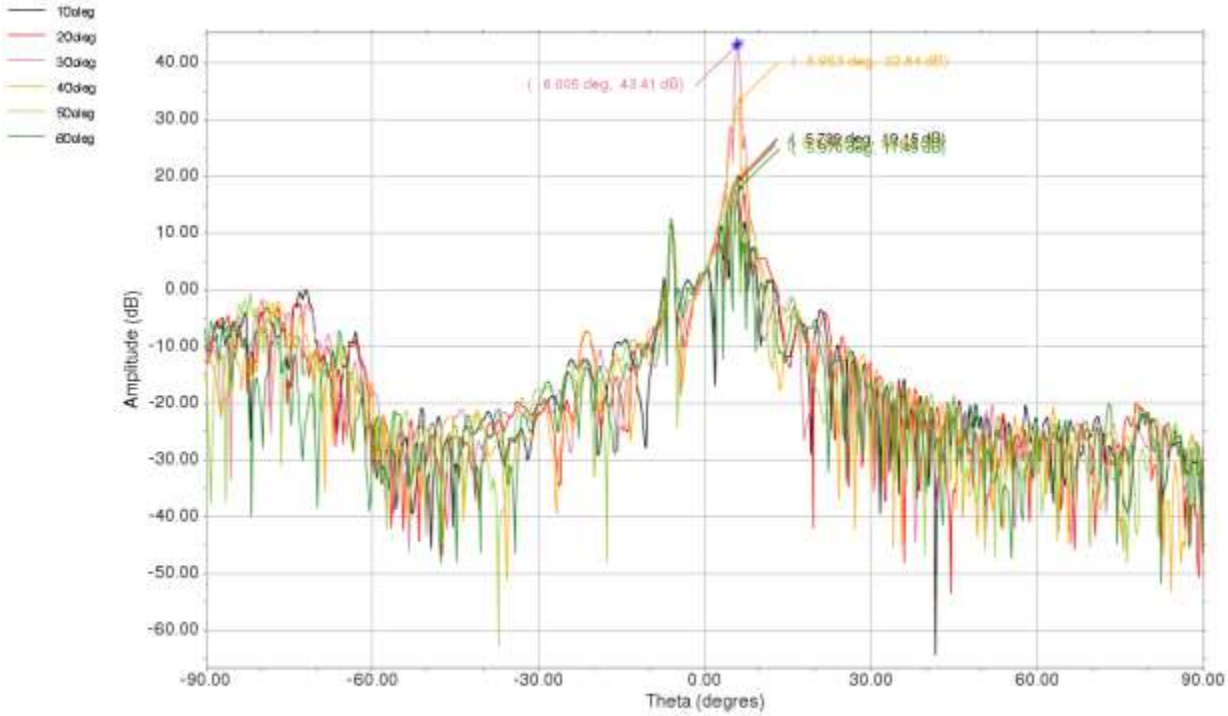
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :43.42 dB **CX max :13.69 dB**



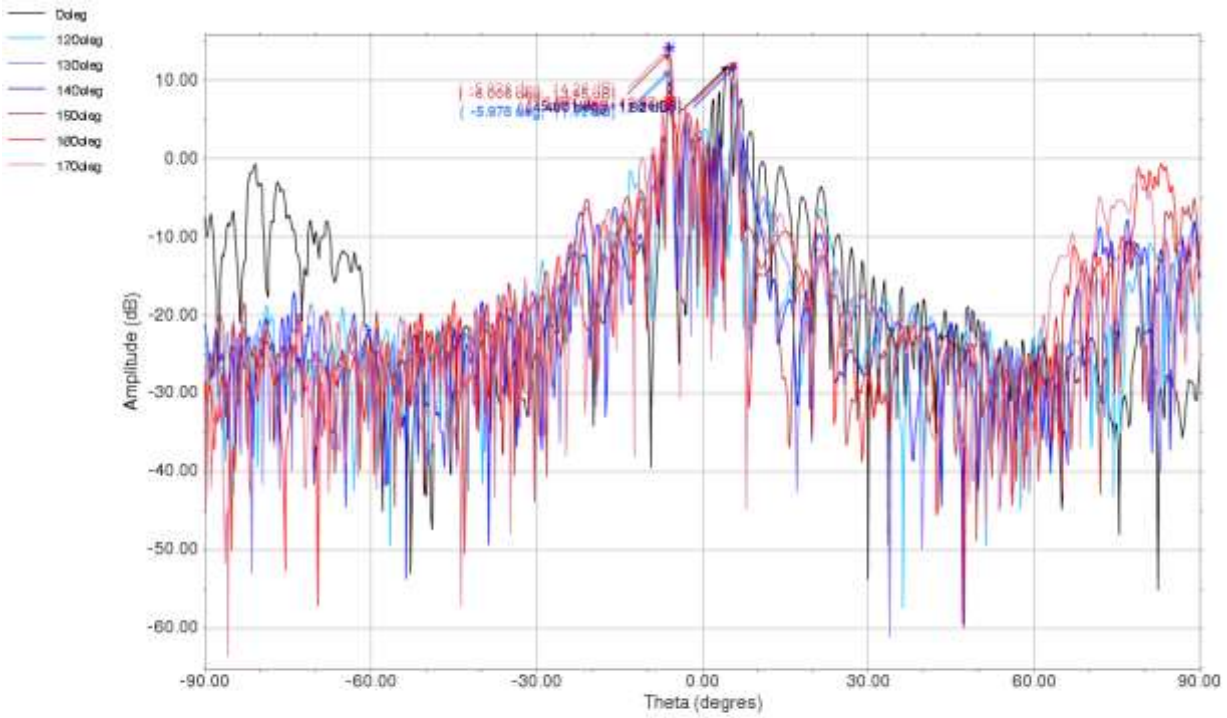
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :42.58 dB **CX max :12.98 dB**



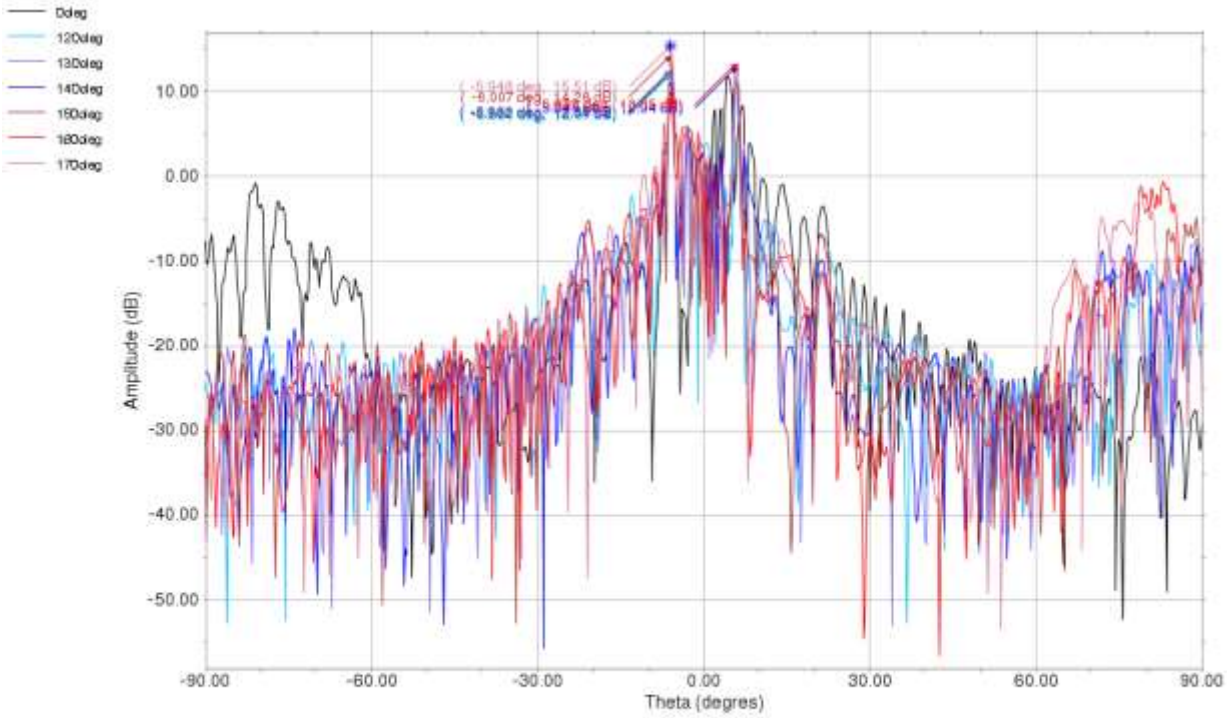
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :43.42 dB **CX max :13.69 dB**



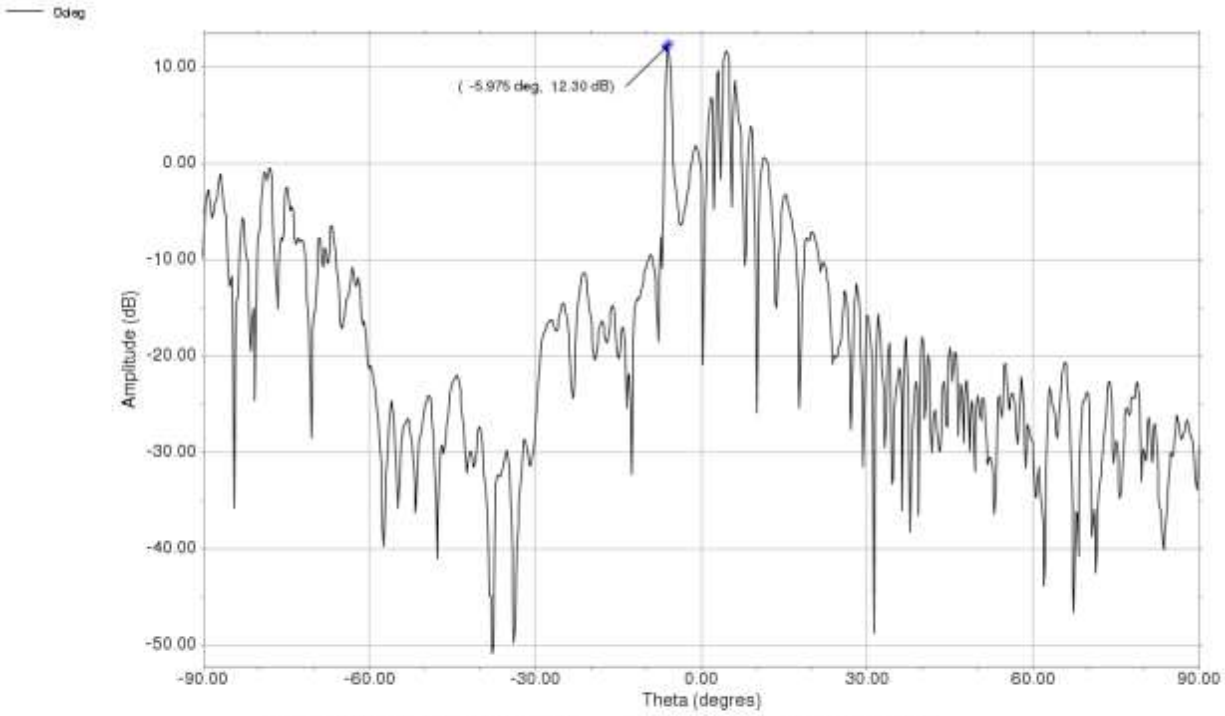
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :42.58 dB **CX max :12.98 dB**



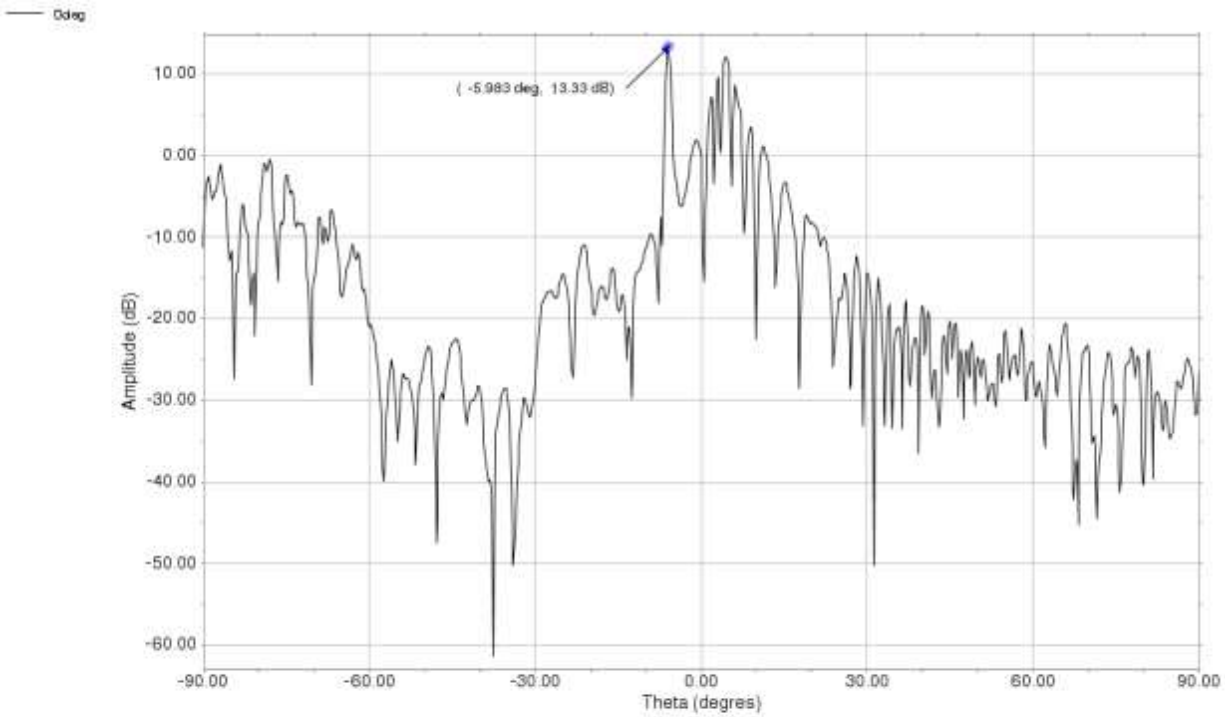
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :43.42 dB **CX max :13.69 dB**



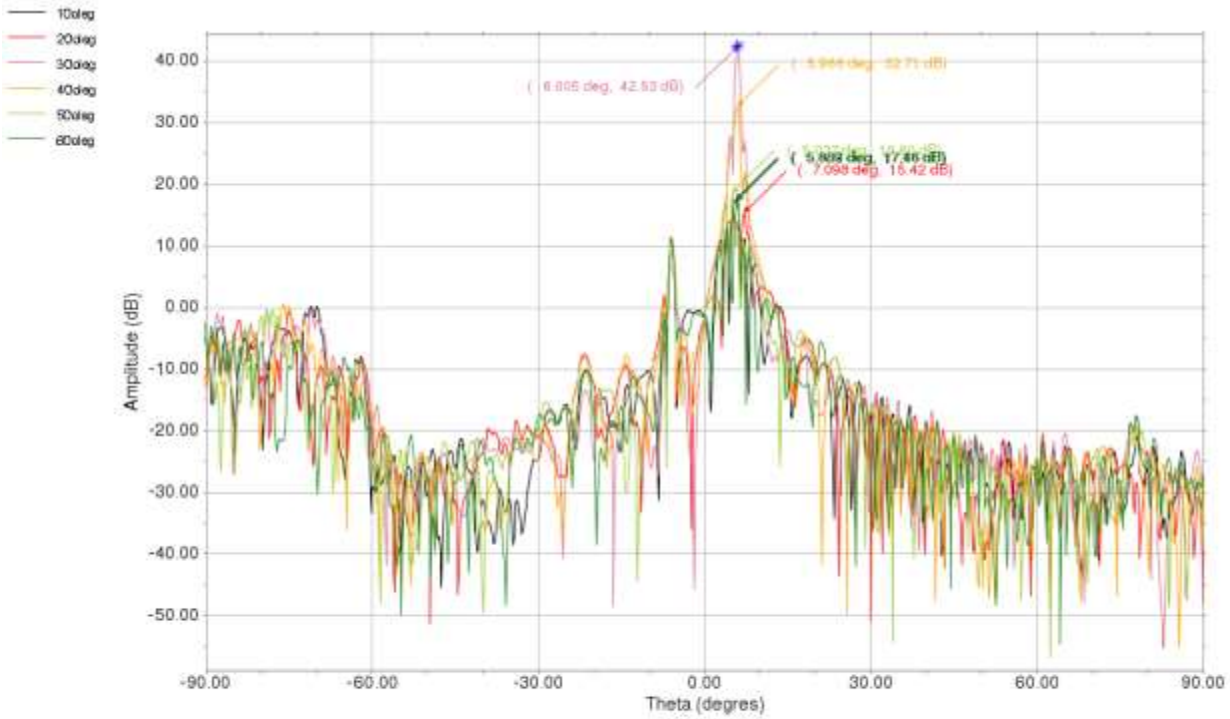
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :42.54 dB **CX max :13.60 dB**



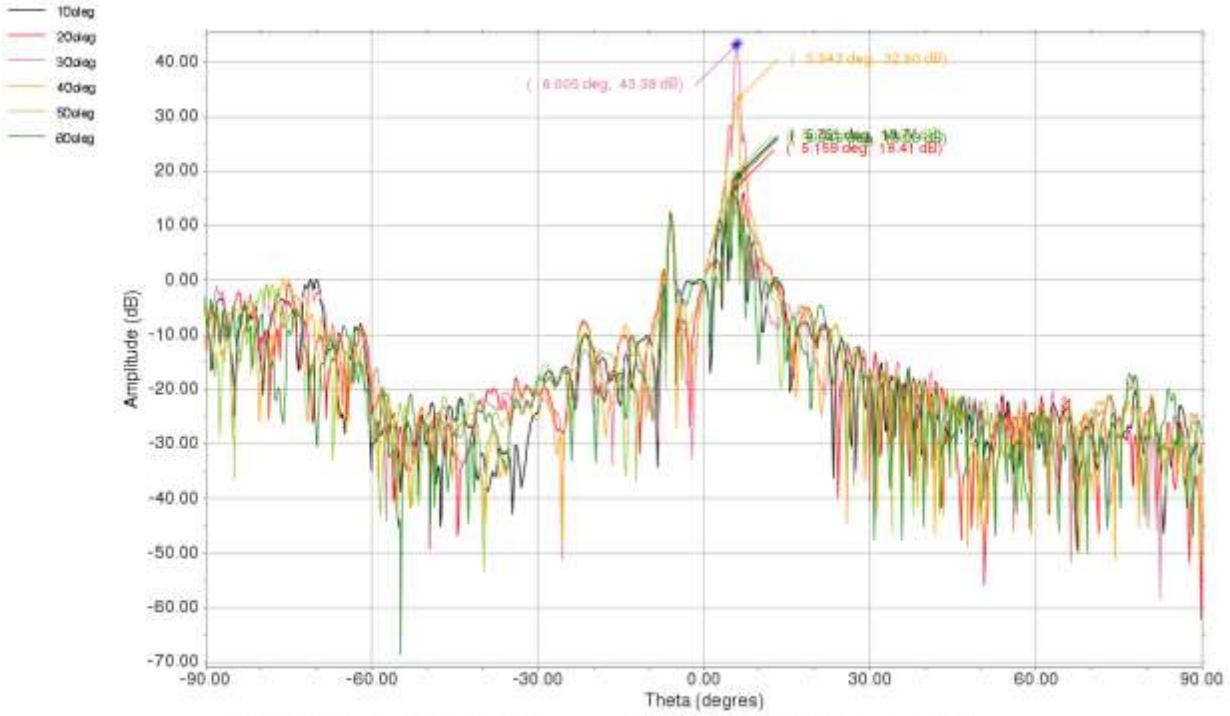
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :43.40 dB **CX max :13.60 dB**



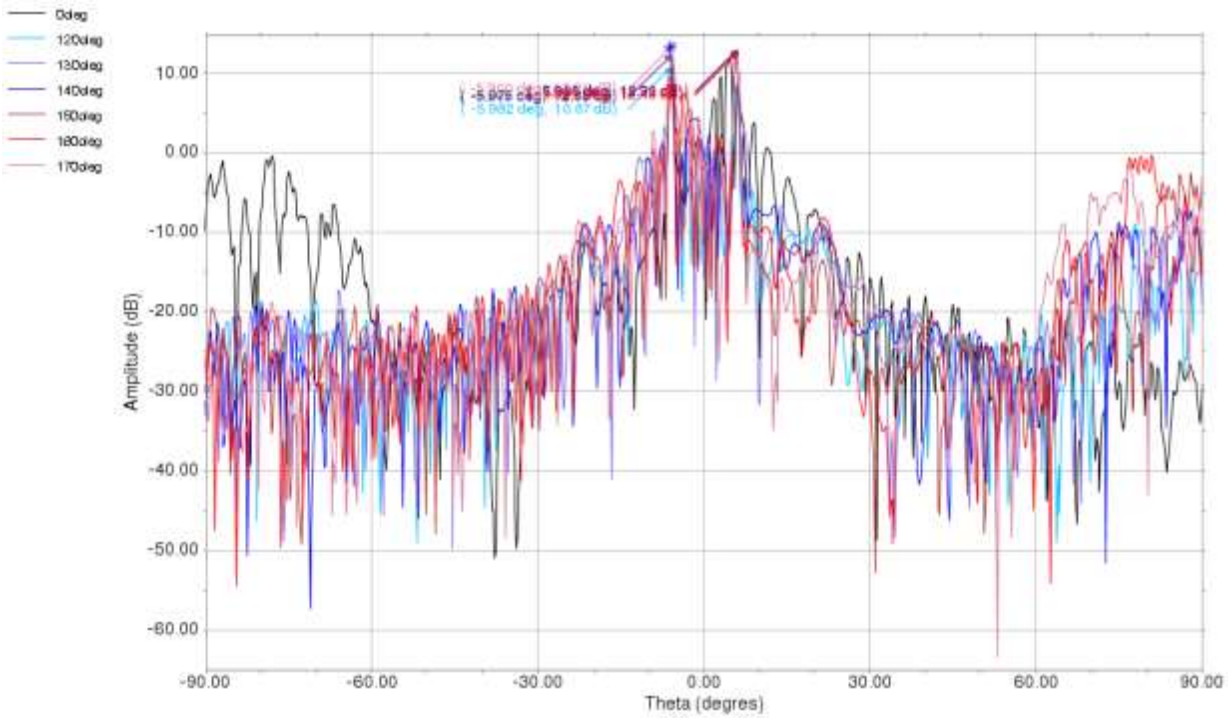
BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :42.54 dB **CX max :13.60 dB**



BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

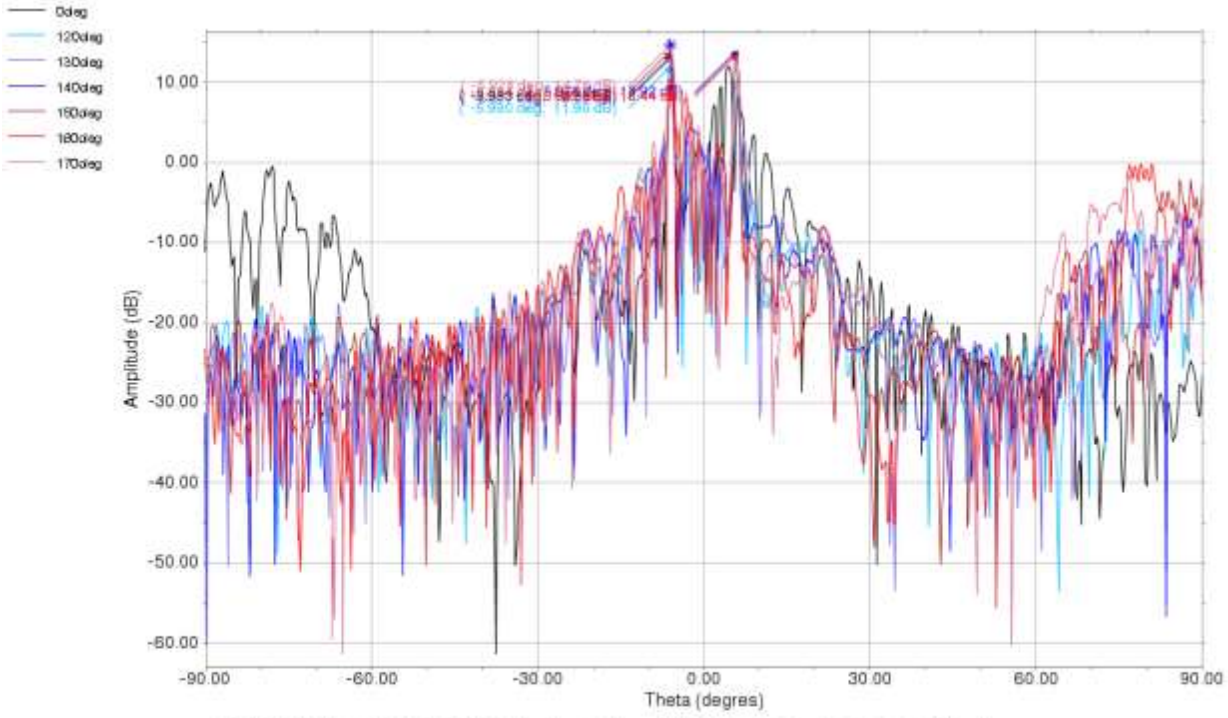
CO max :43.40 dB **CX max :13.60 dB**



BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :42.54 dB

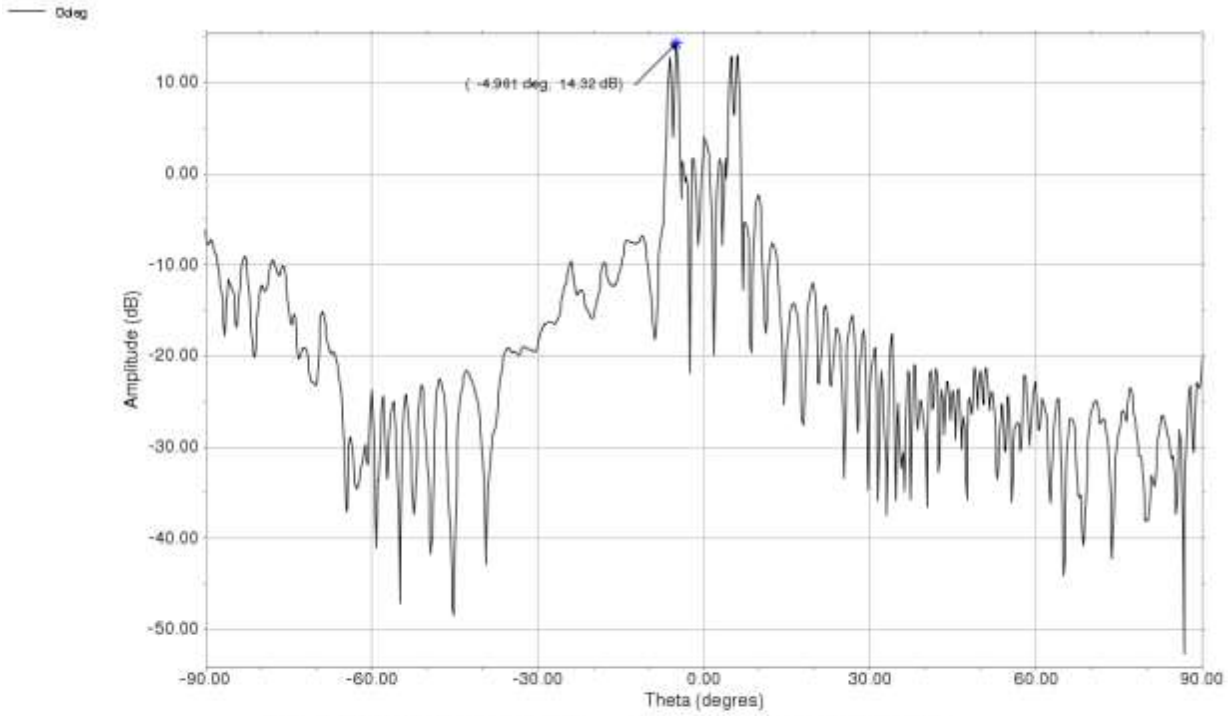
CX max :13.60 dB



BEAM GW No7 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

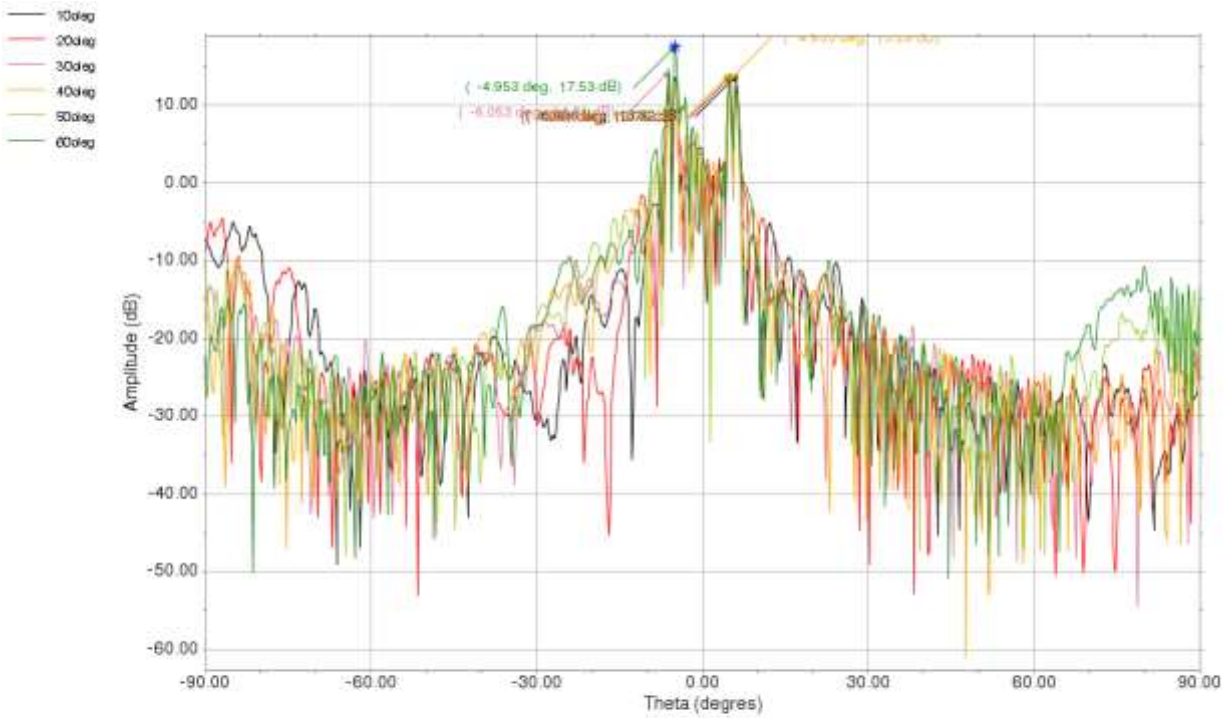
CO max :43.40 dB

CX max :13.60 dB



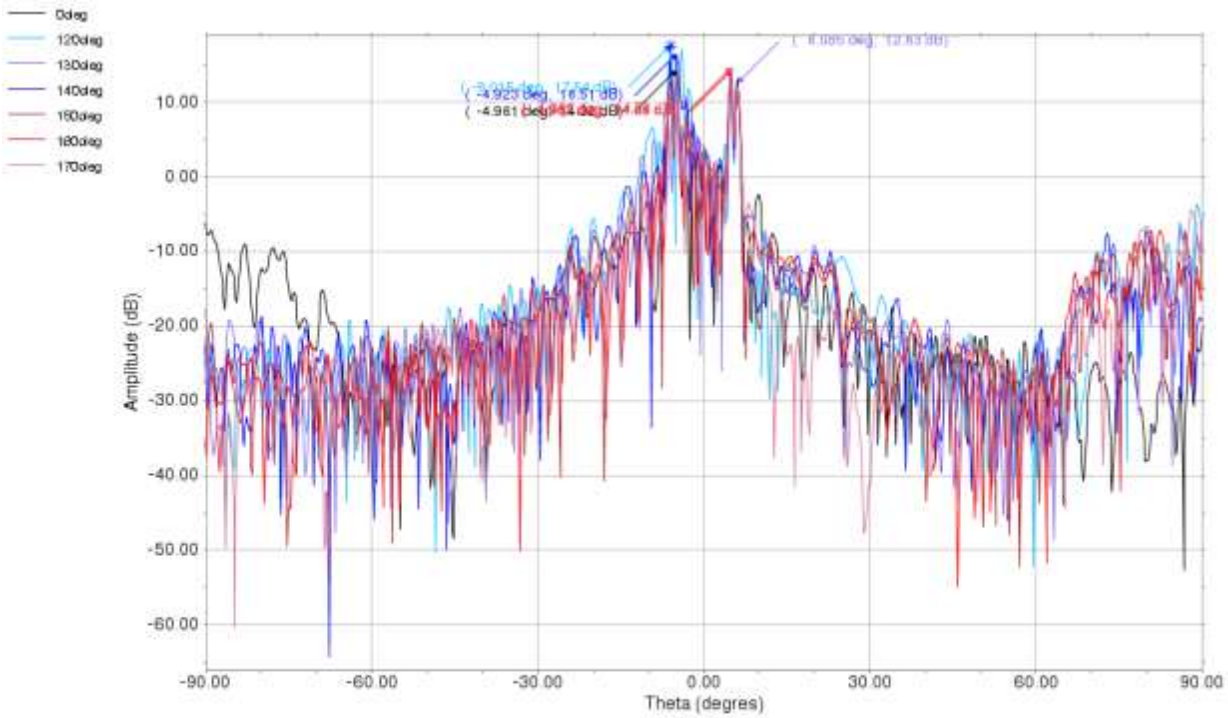
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :41.69 dB **CX max :9.89 dB**



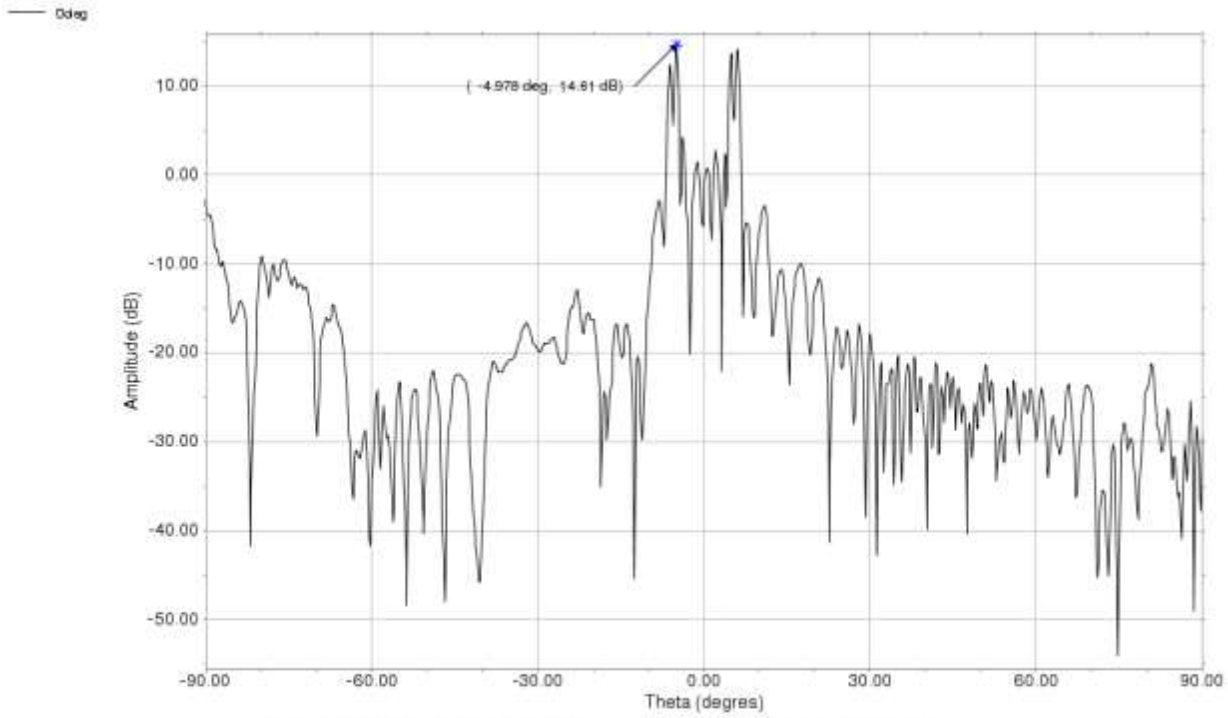
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :41.69 dB **CX max :9.89 dB**



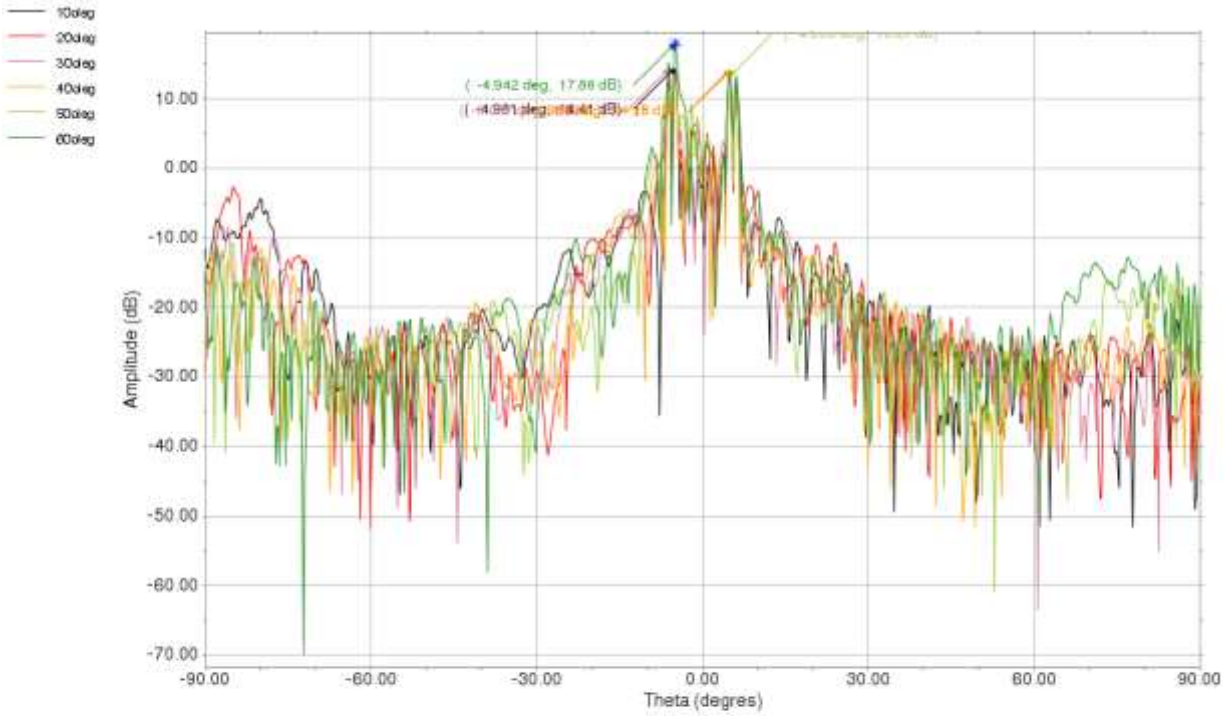
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :41.69 dB **CX max :9.89 dB**



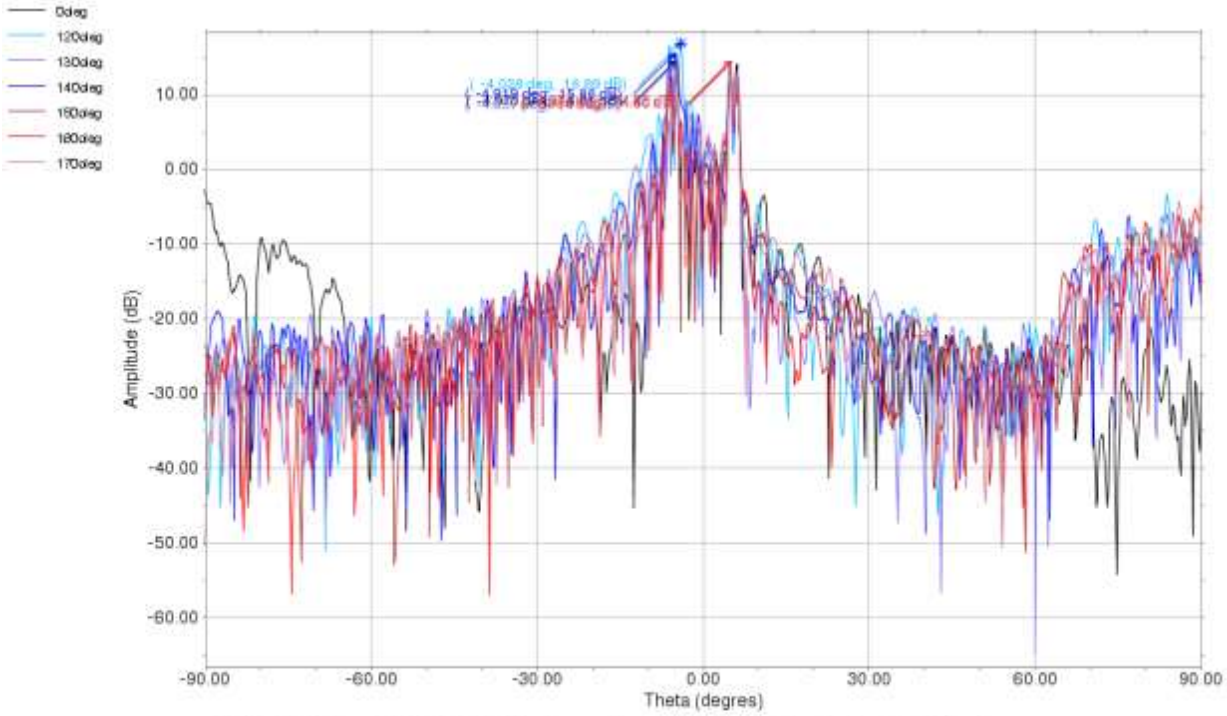
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :41.90 dB **CX max :9.63 dB**



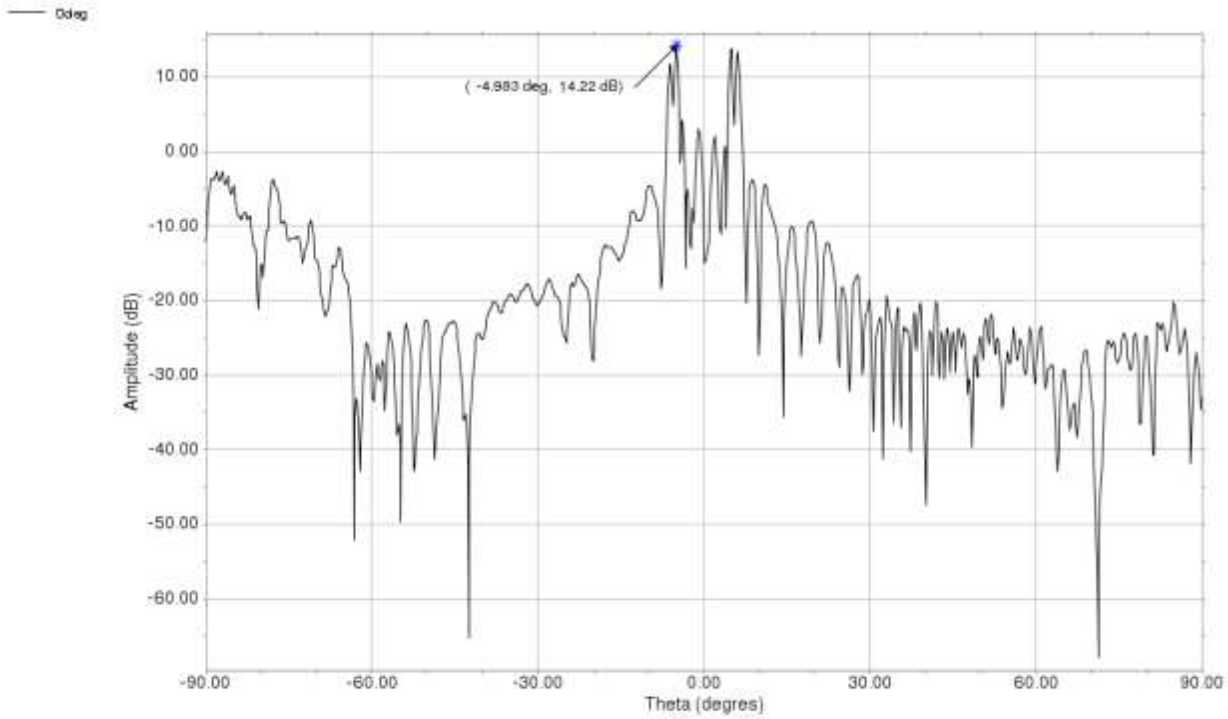
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :41.90 dB **CX max :9.63 dB**



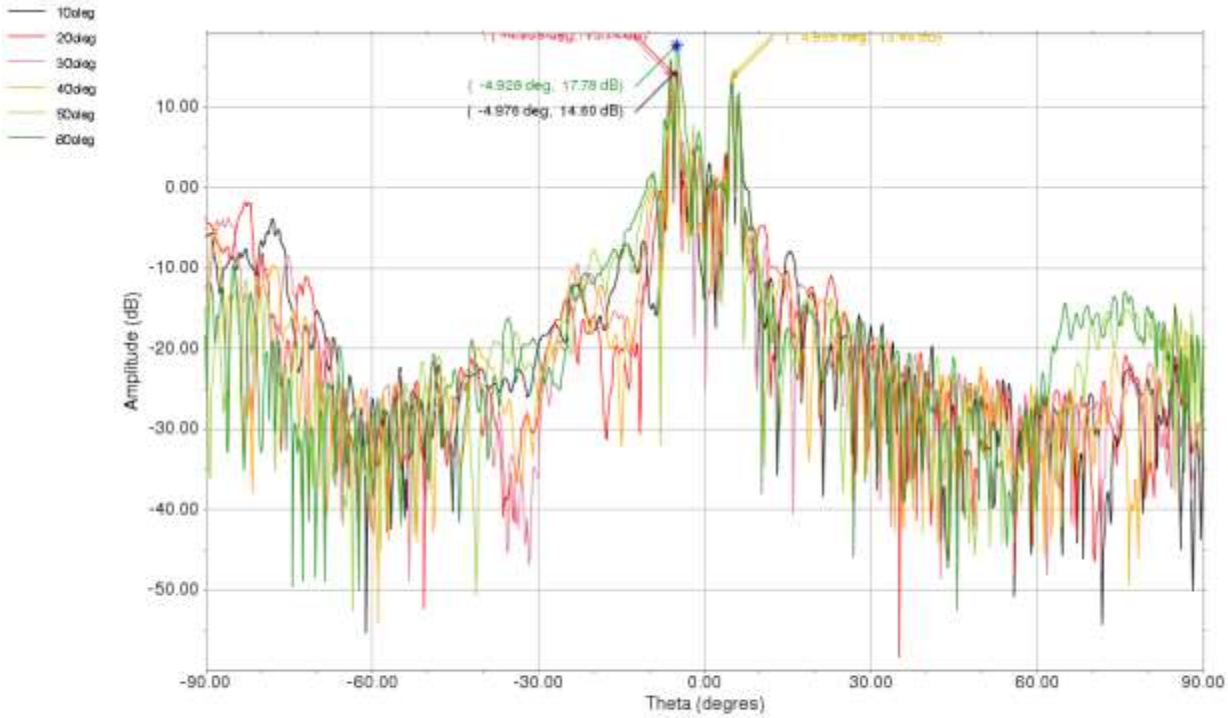
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :41.90 dB **CX max :9.63 dB**



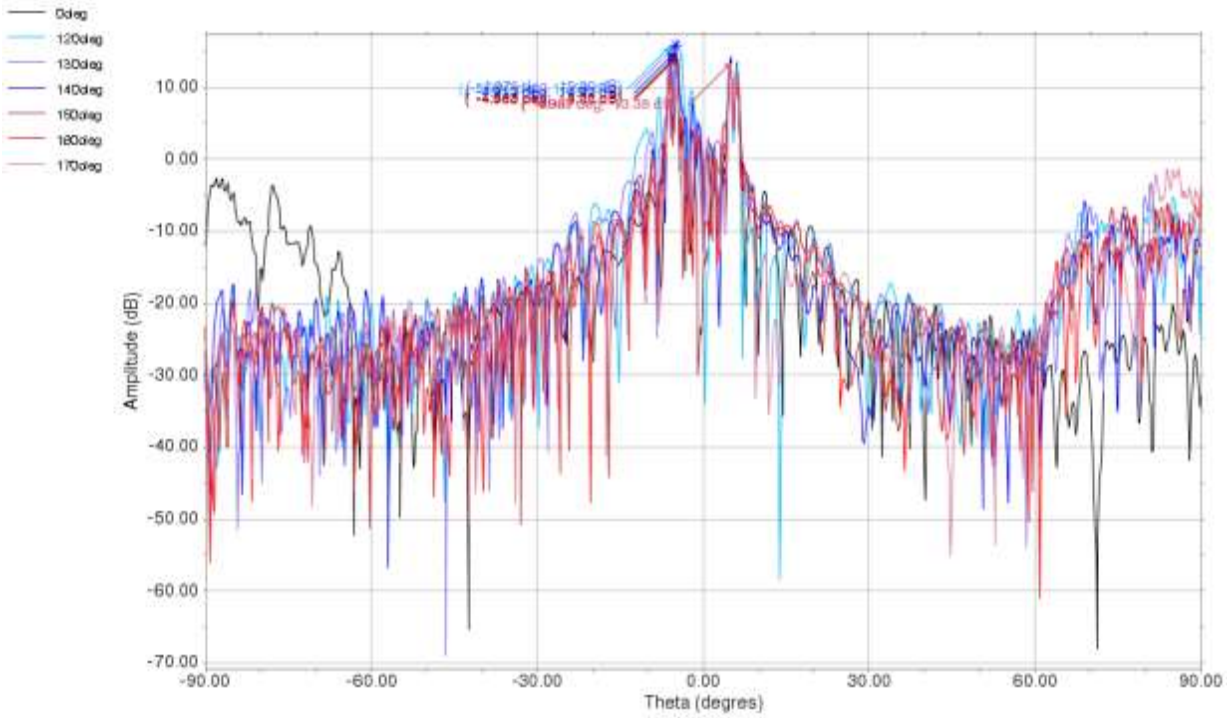
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :41.95 dB **CX max :9.38 dB**



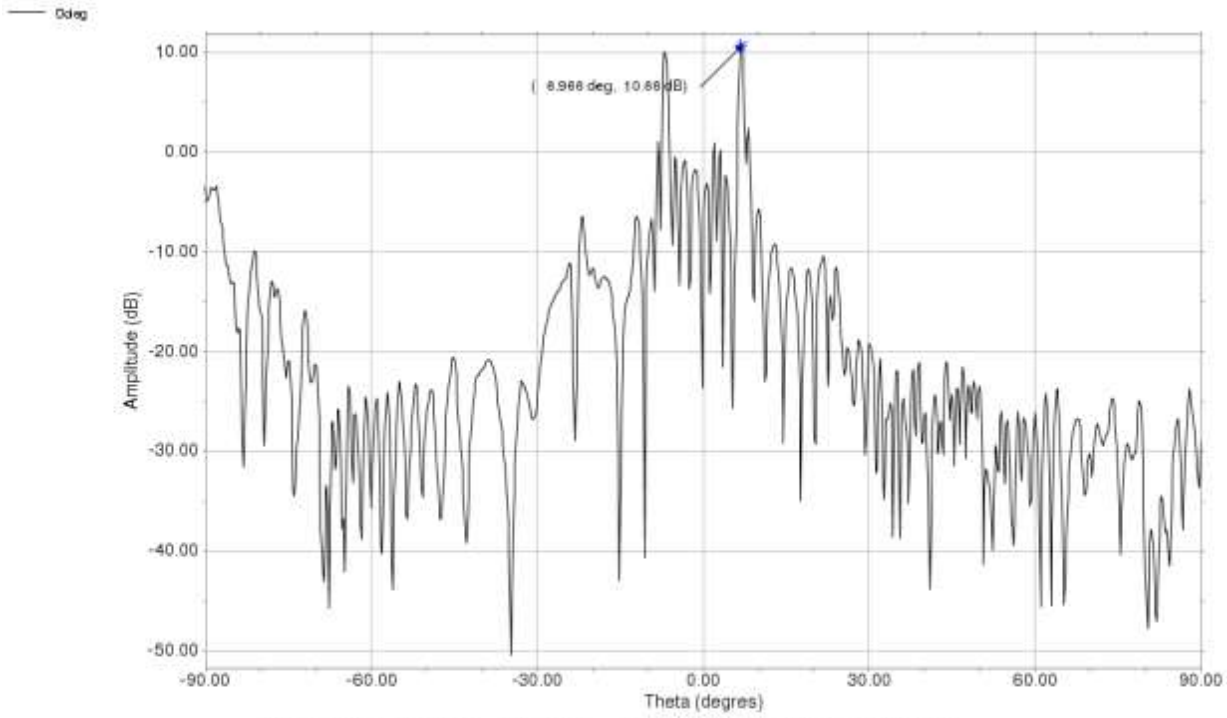
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :41.95 dB **CX max :9.38 dB**



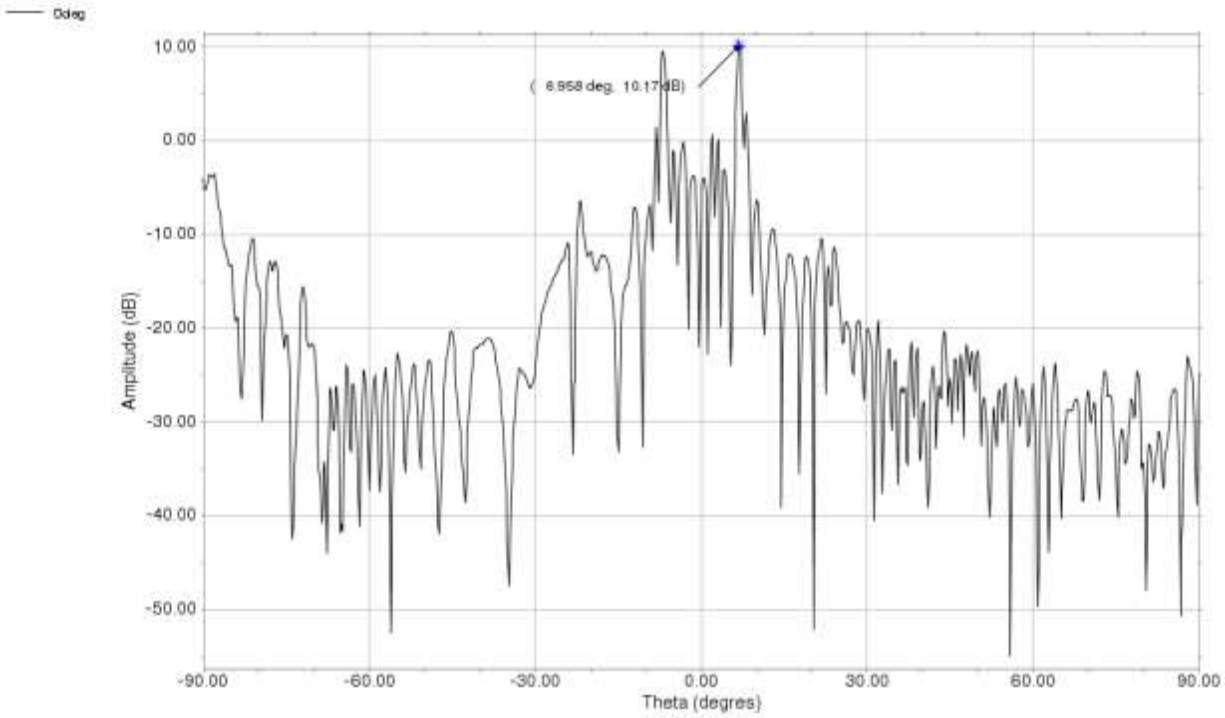
BEAM GW No8 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :41.95 dB **CX max :9.38 dB**



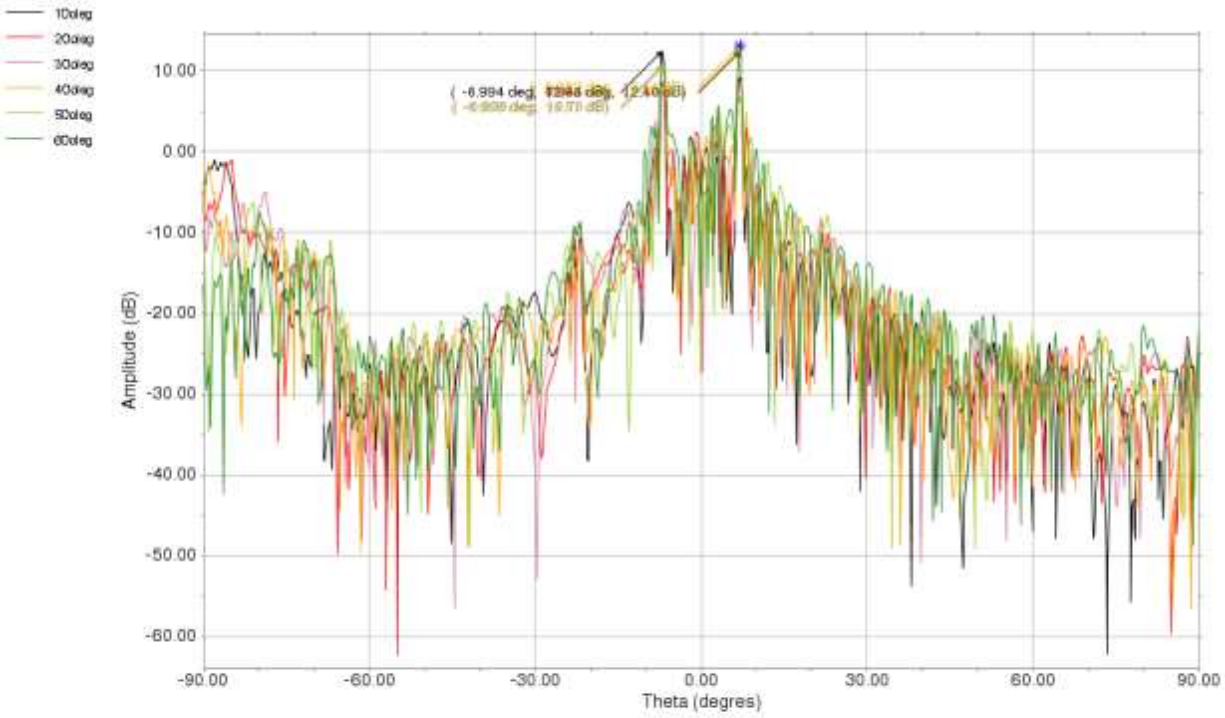
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :42.00 dB **CX max :14.01 dB**



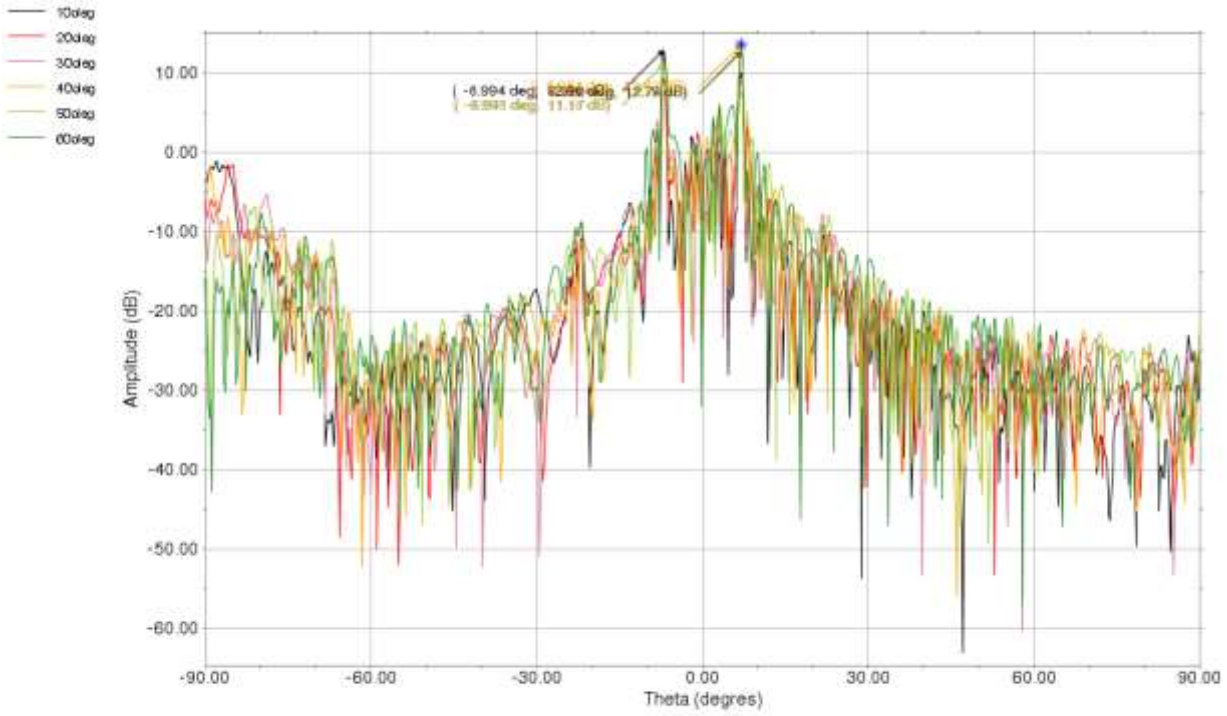
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :41.33 dB **CX max :11.94 dB**



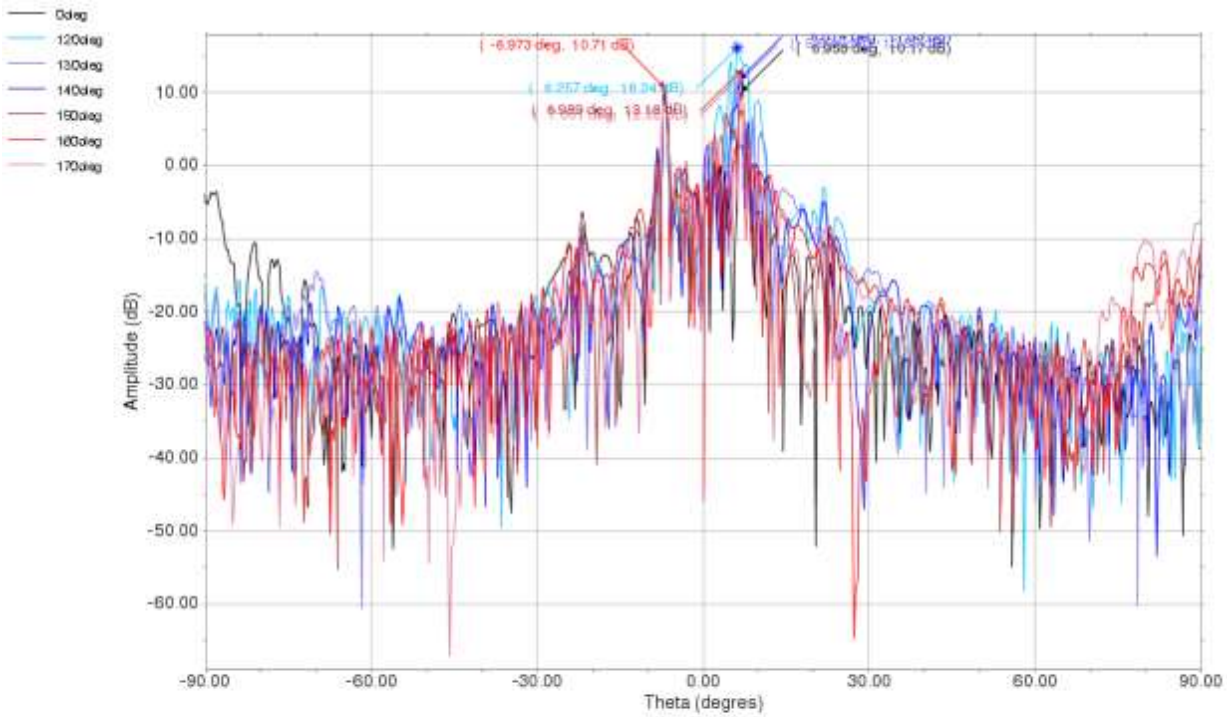
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :41.33 dB **CX max :11.94 dB**



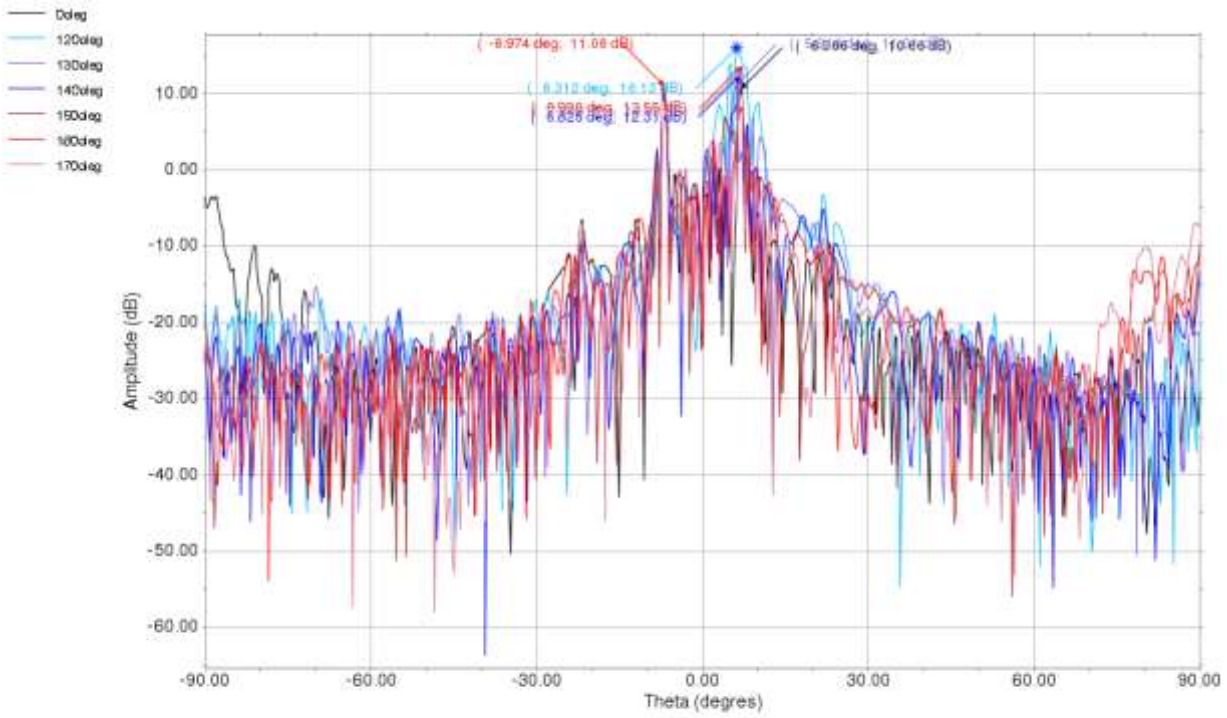
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :42.00 dB **CX max :14.01 dB**



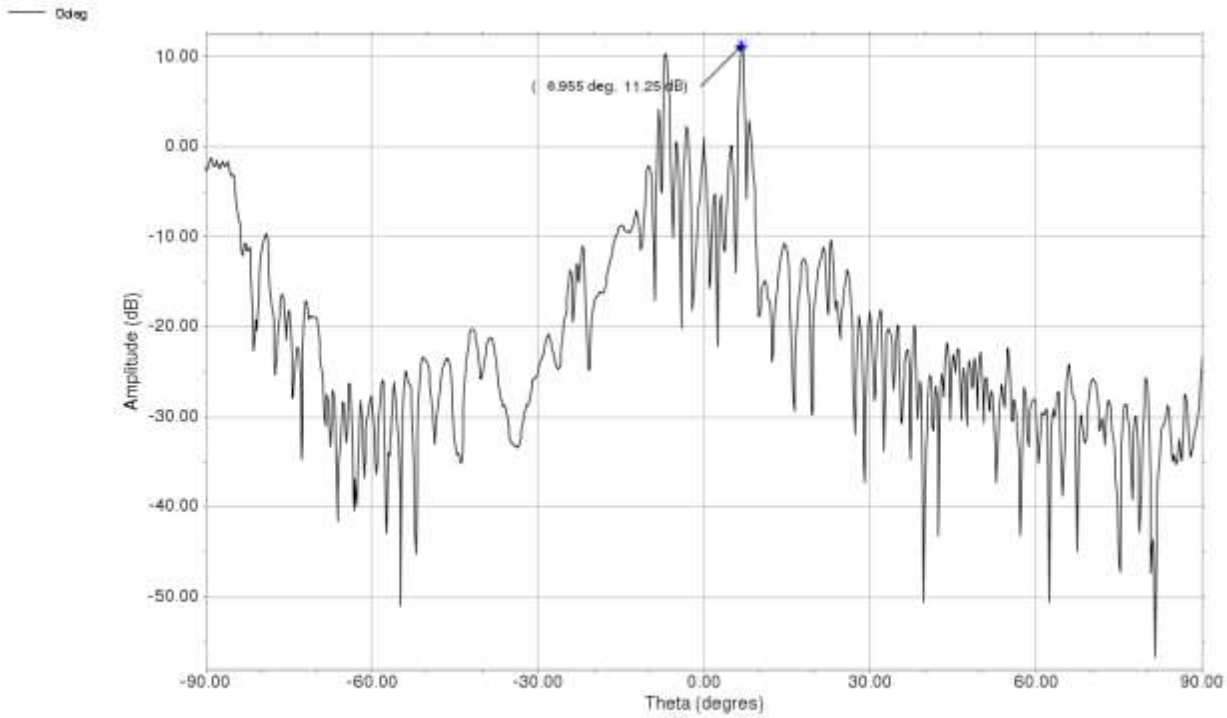
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :41.33 dB **CX max :11.94 dB**



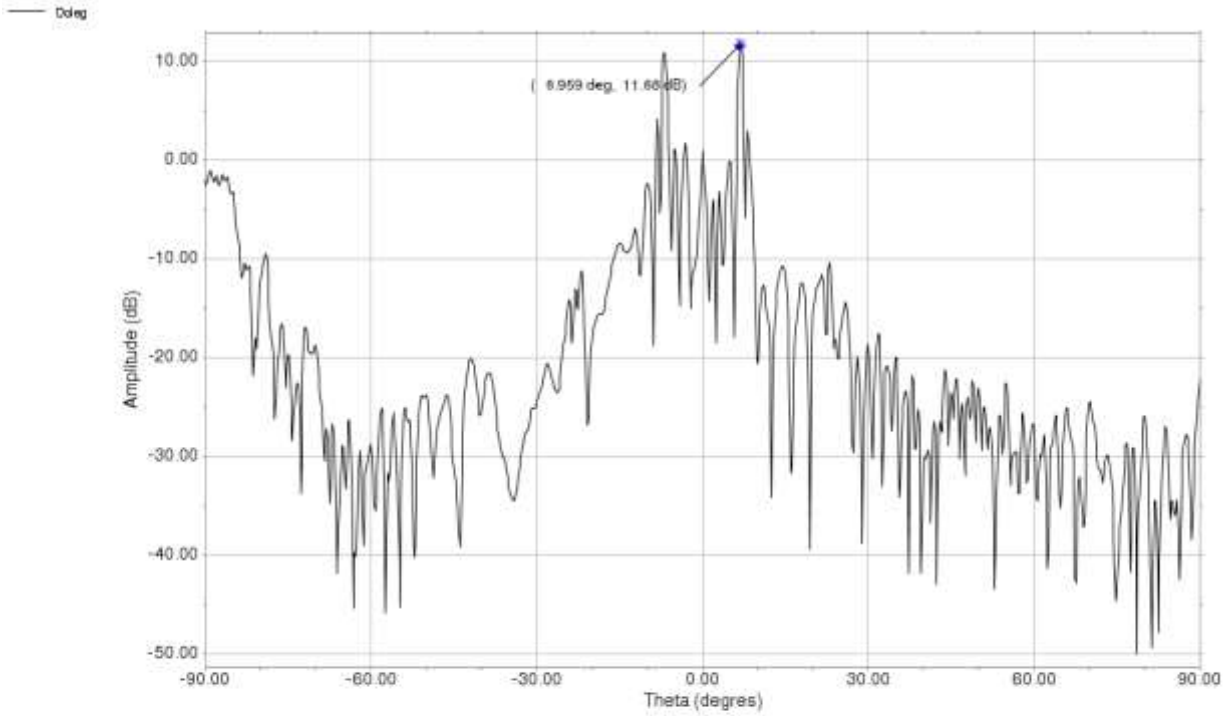
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :42.00 dB **CX max :14.01 dB**



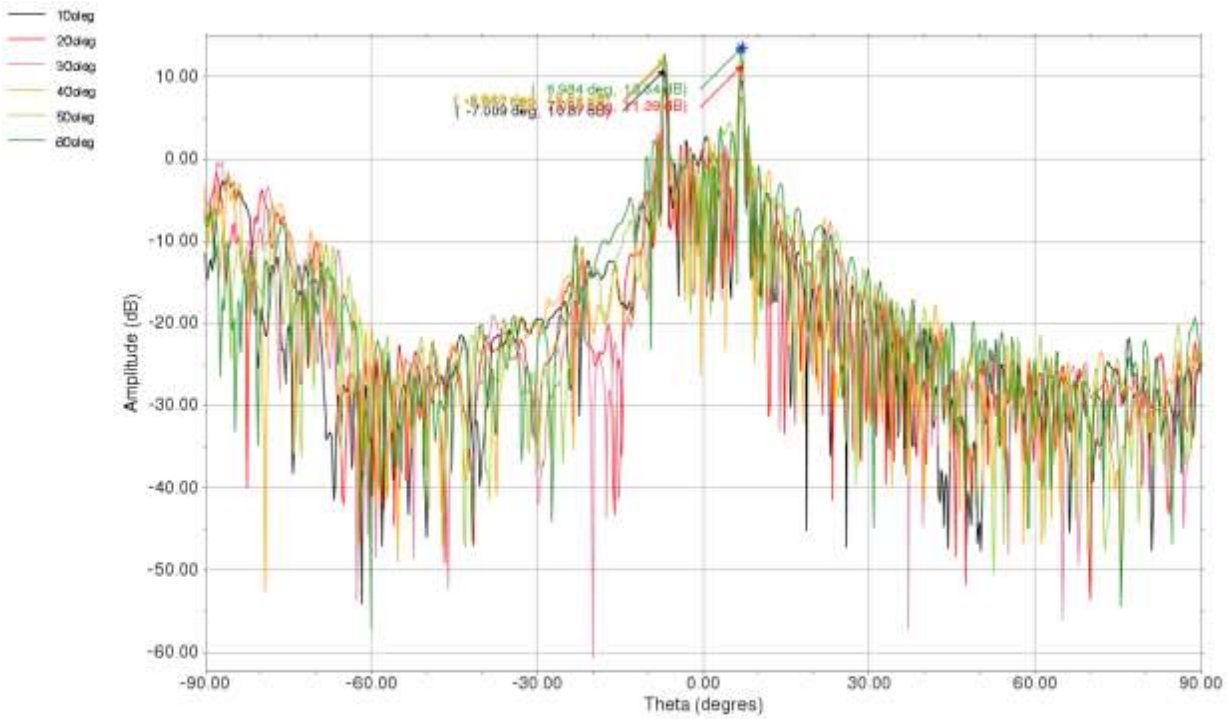
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

CO max :41.41 dB **CX max :12.66 dB**



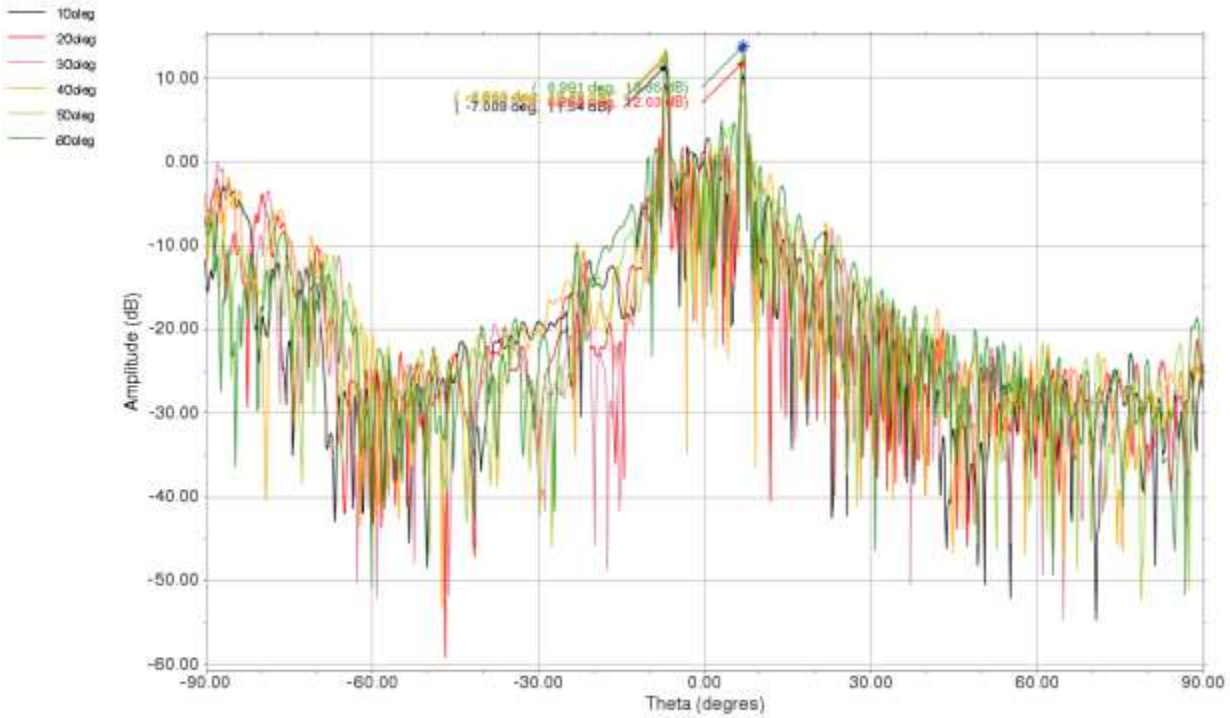
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :42.08 dB **CX max :13.47 dB**



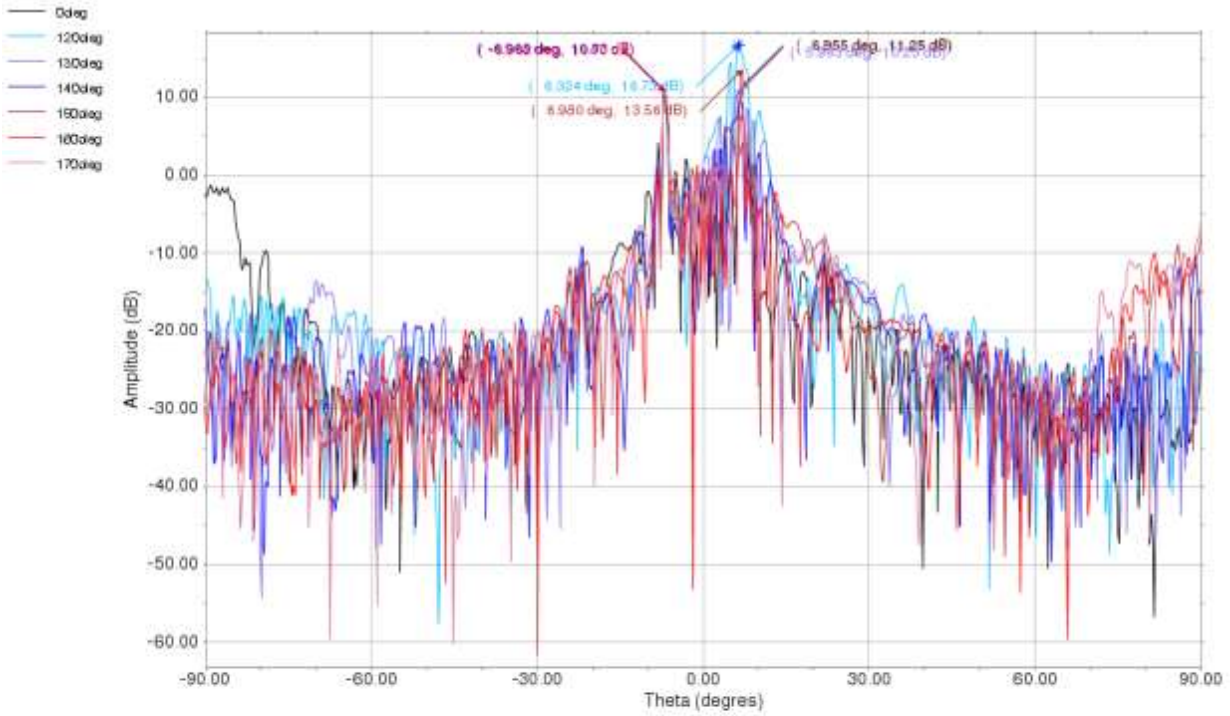
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :41.41 dB **CX max :12.66 dB**



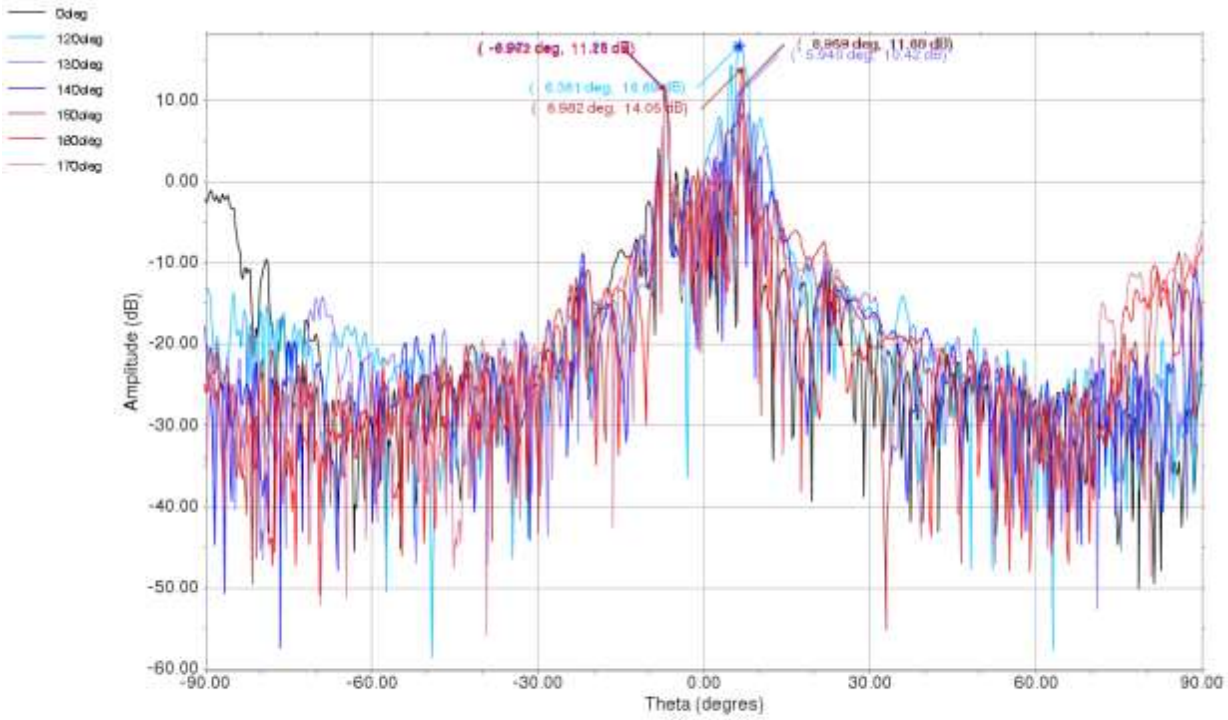
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :42.08 dB **CX max :13.47 dB**



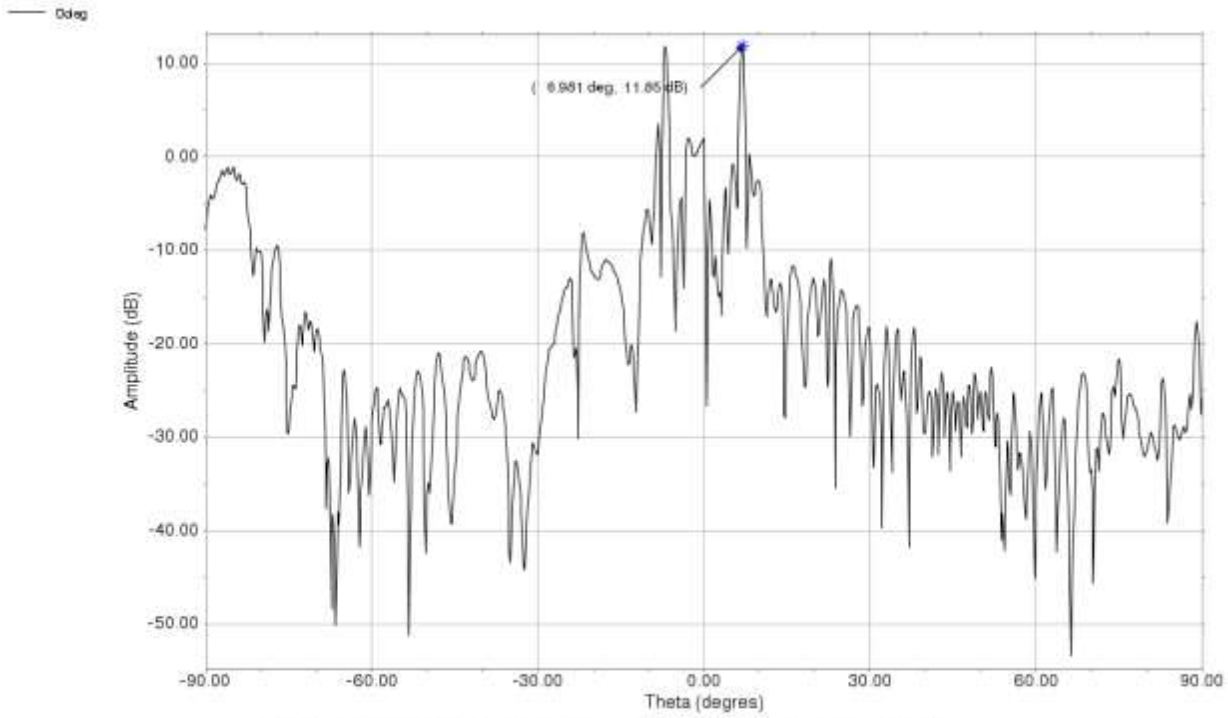
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :41.41 dB **CX max :12.66 dB**



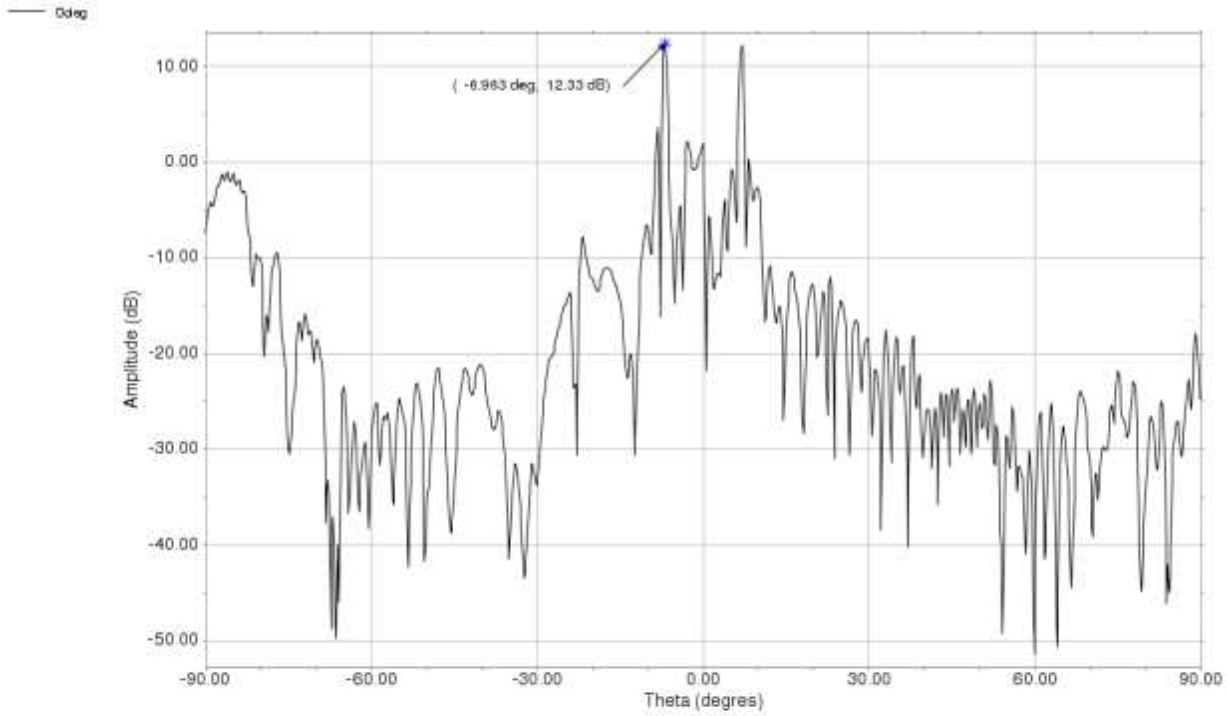
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :42.08 dB **CX max :13.47 dB**



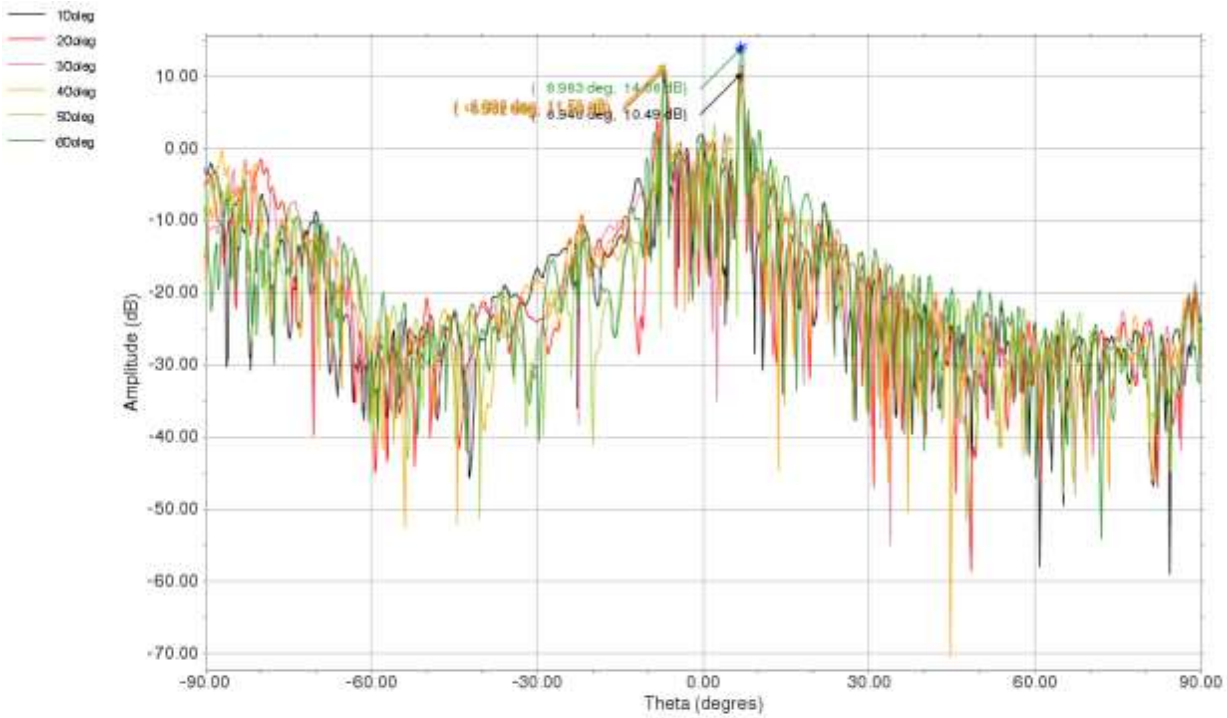
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp

CO max :41.30 dB **CX max :13.05 dB**



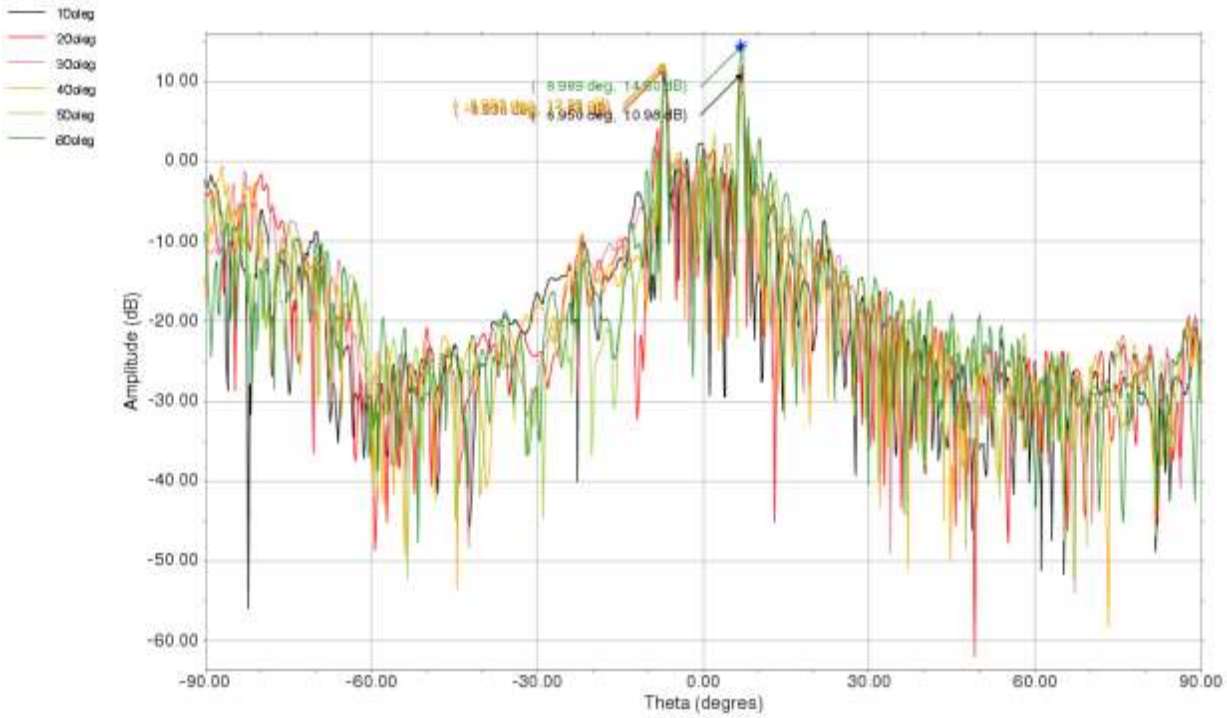
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :41.98 dB **CX max :13.46 dB**



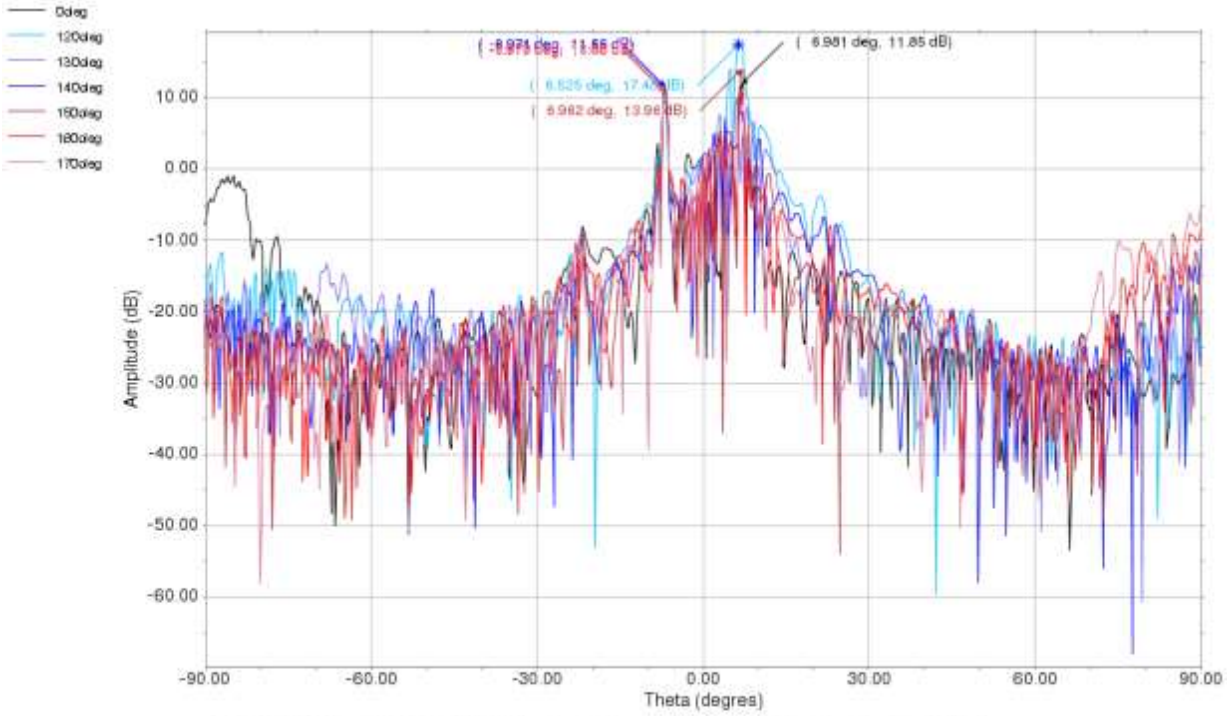
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :41.39 dB **CX max :13.05 dB**



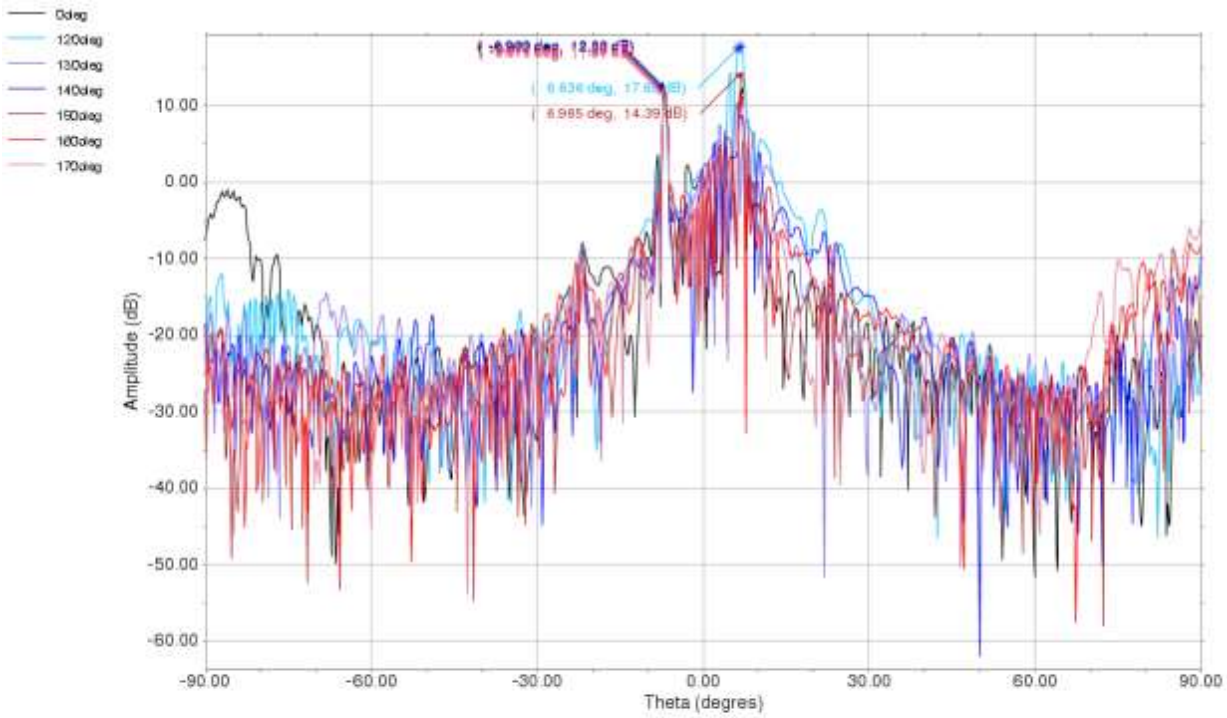
BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :41.98 dB **CX max :13.46 dB**



BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

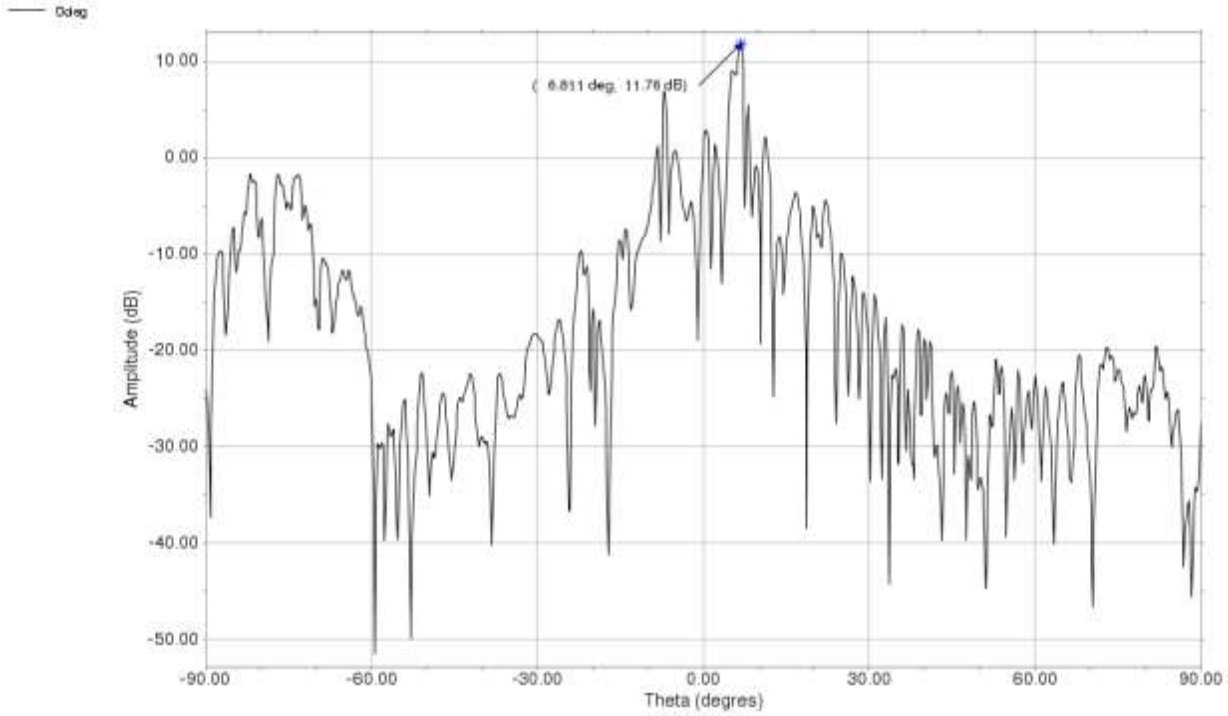
CO max :41.39 dB **CX max :13.05 dB**



BEAM GW No9 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

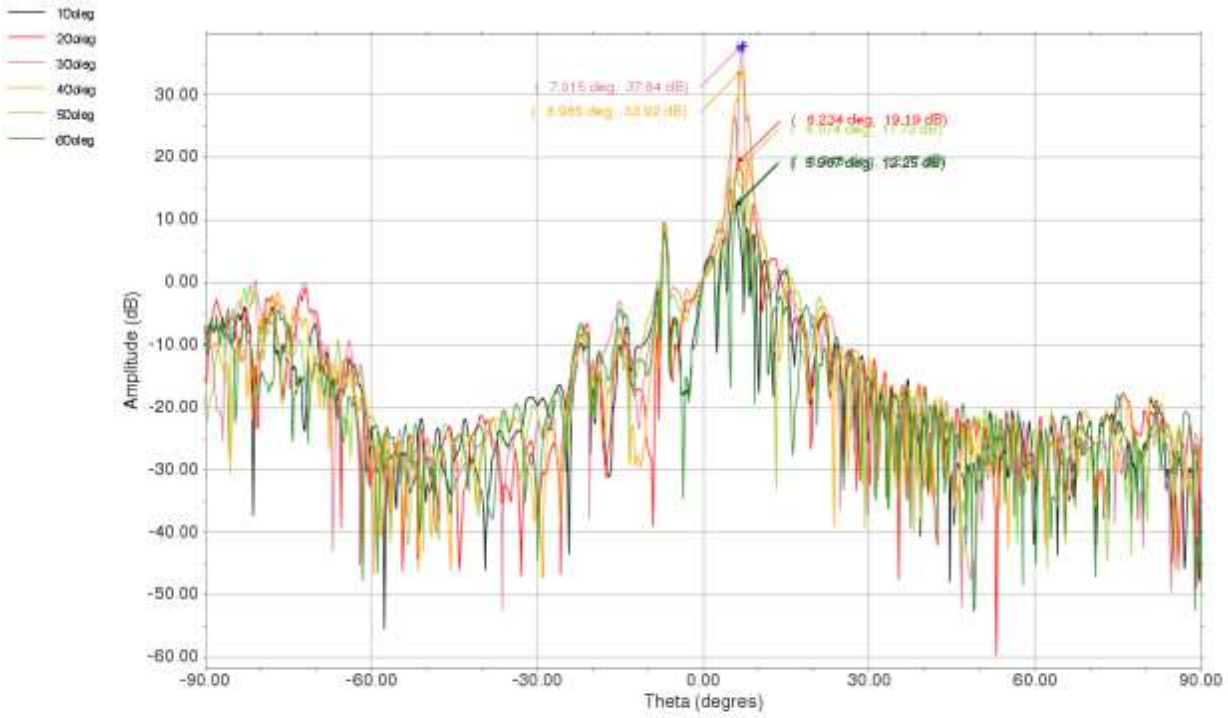
CO max :41.98 dB

CX max :13.46 dB



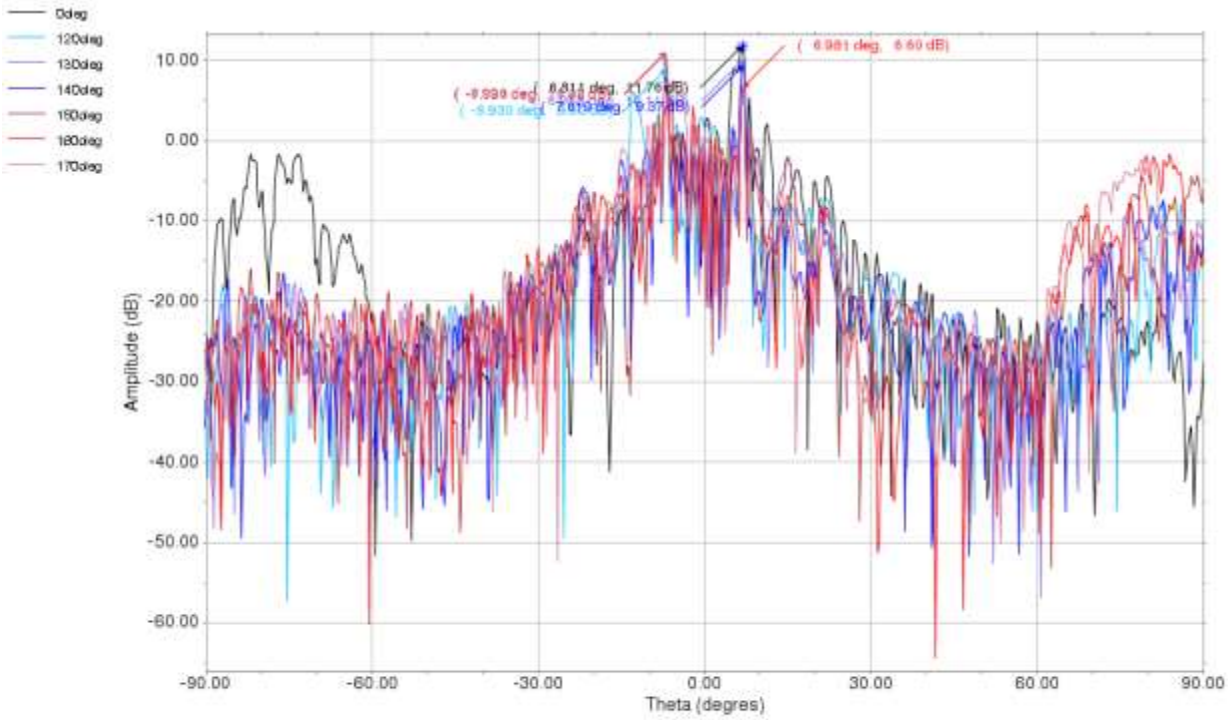
BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :37.86 dB **CX max :11.04 dB**



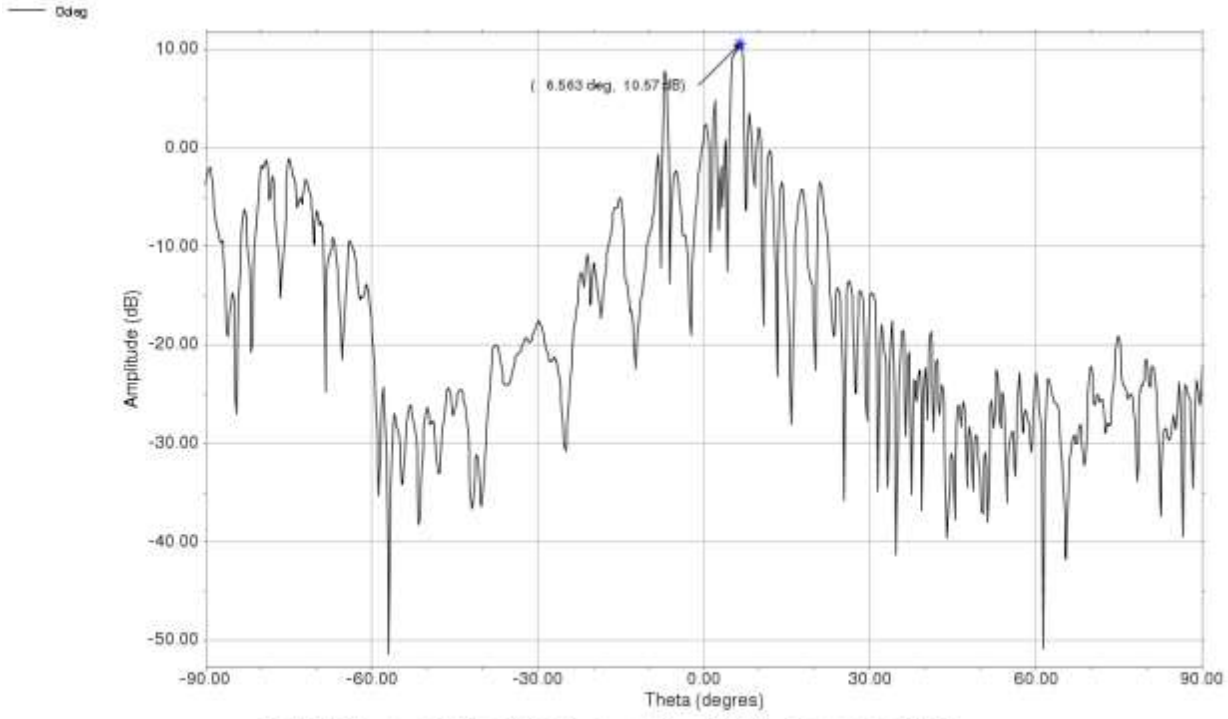
BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :37.86 dB **CX max :11.04 dB**



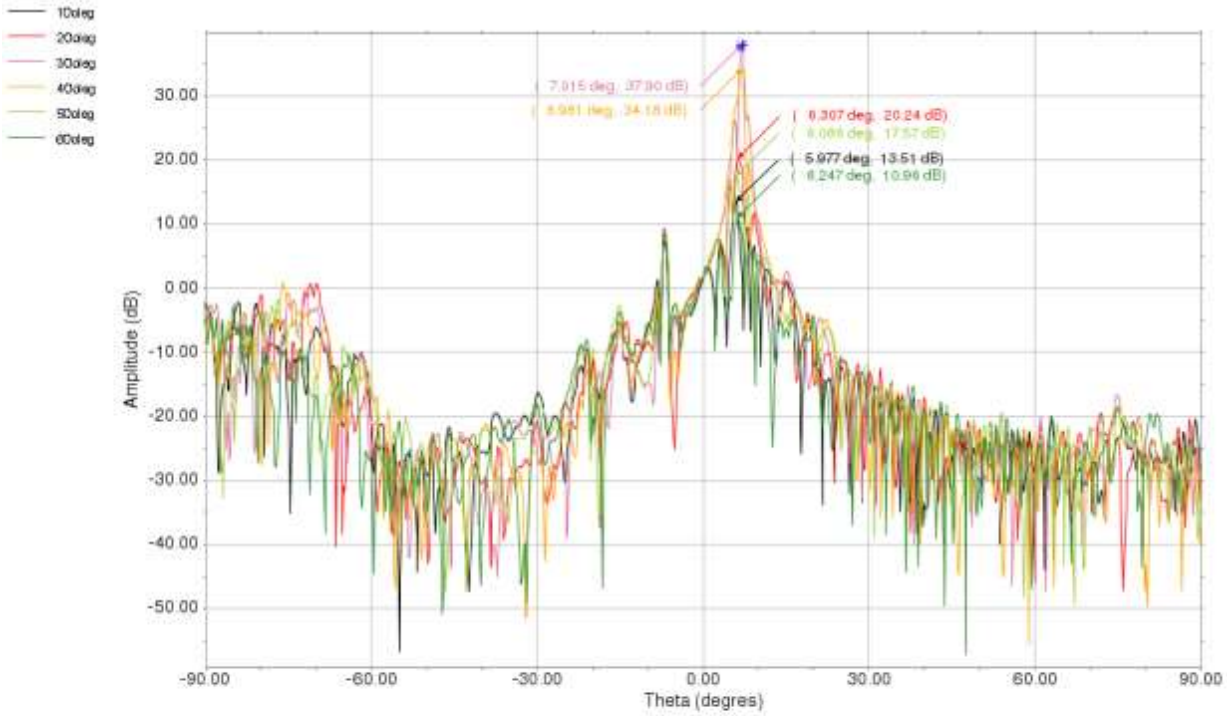
BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :37.86 dB **CX max :11.04 dB**



BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

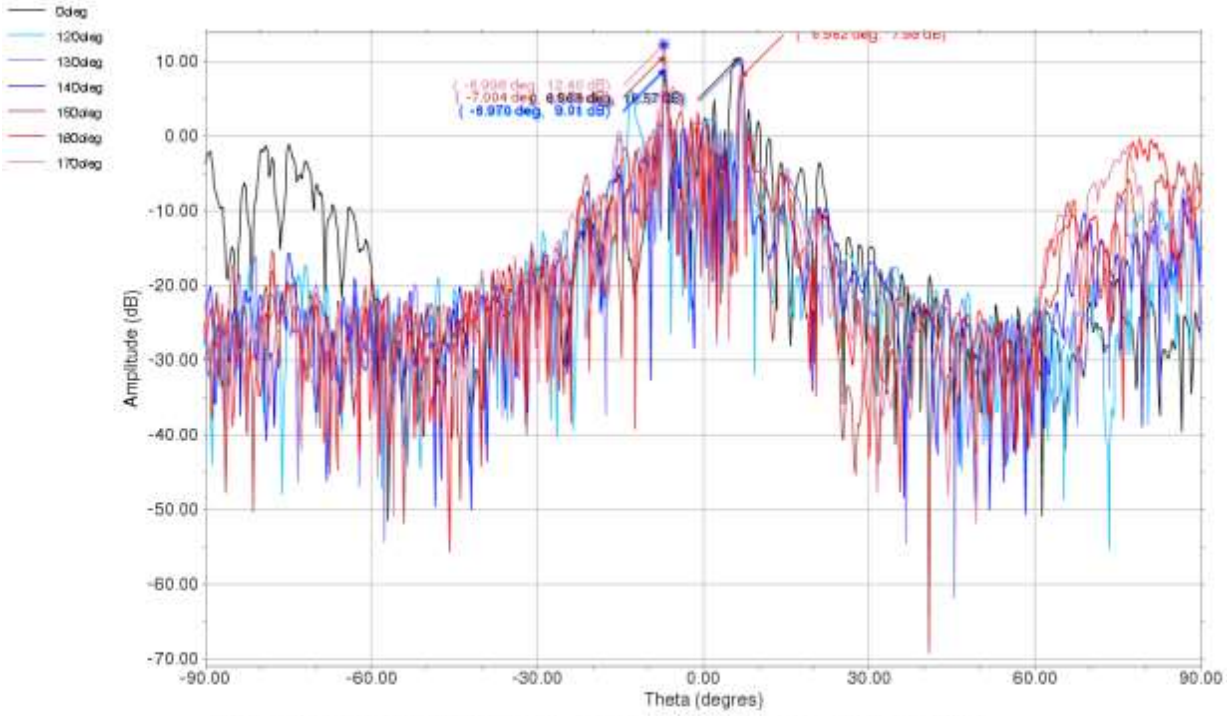
CO max :37.93 dB **CX max :9.51 dB**



BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :37.93 dB

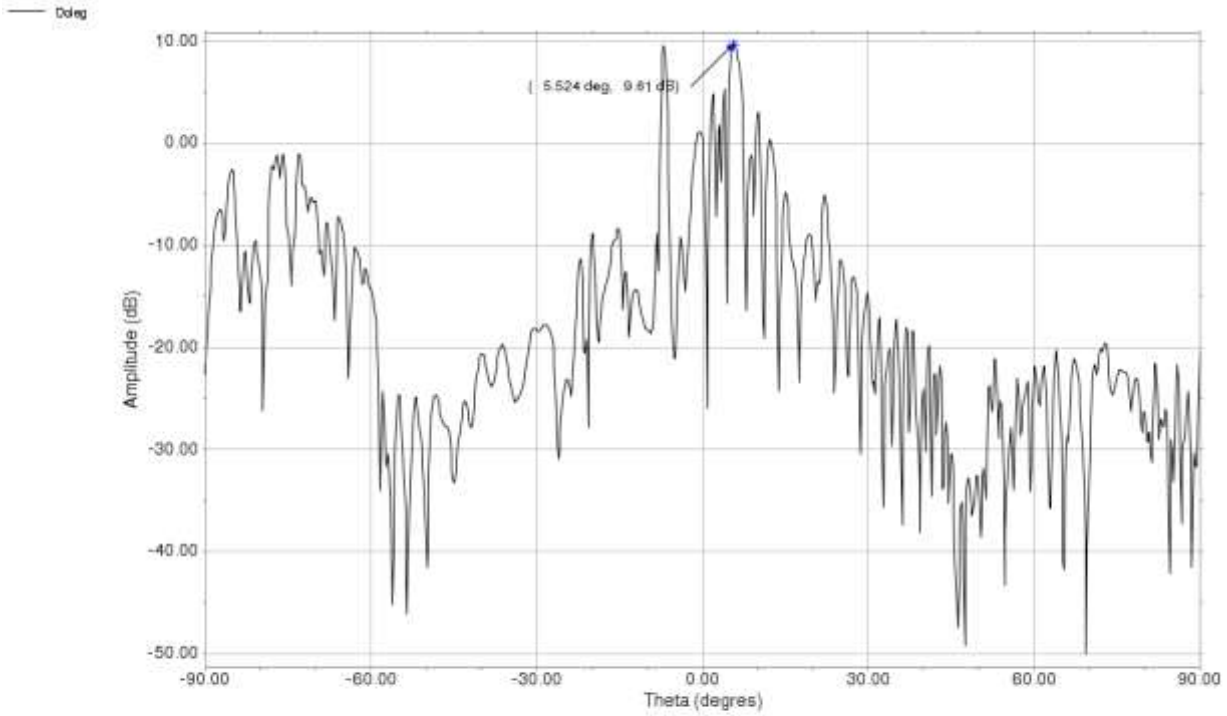
CX max :9.51 dB



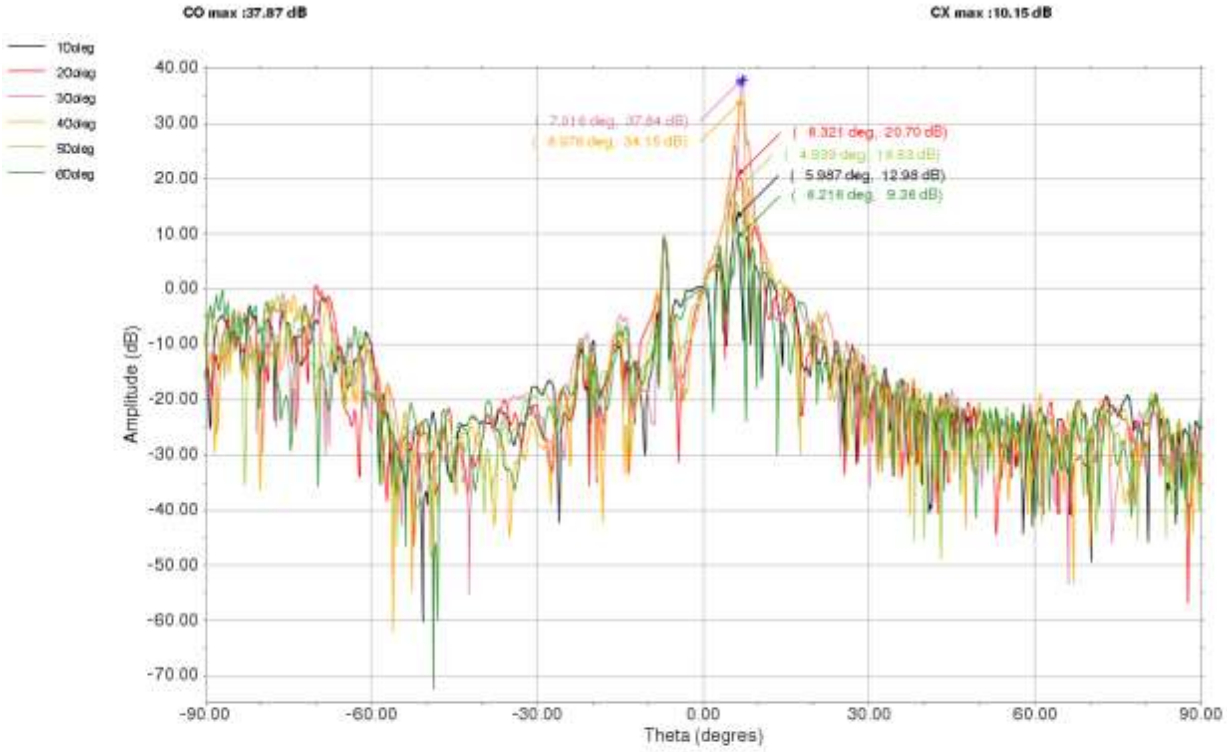
BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :37.93 dB

CX max :9.51 dB

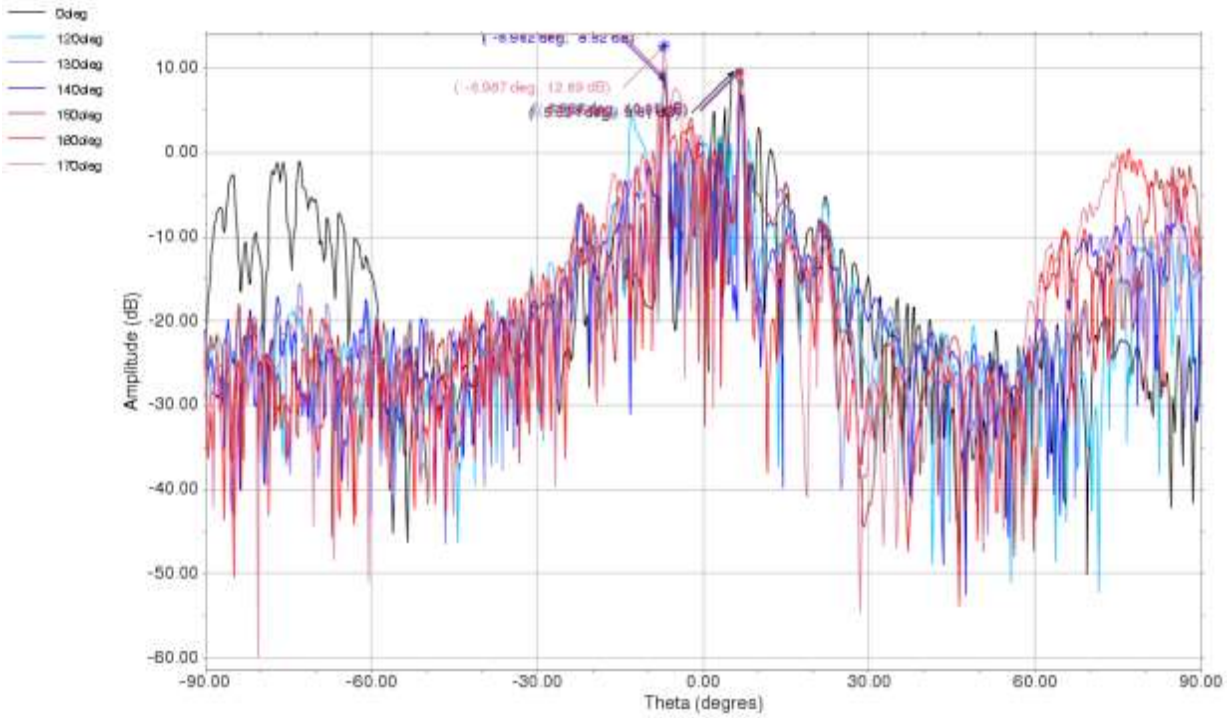


BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp



BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

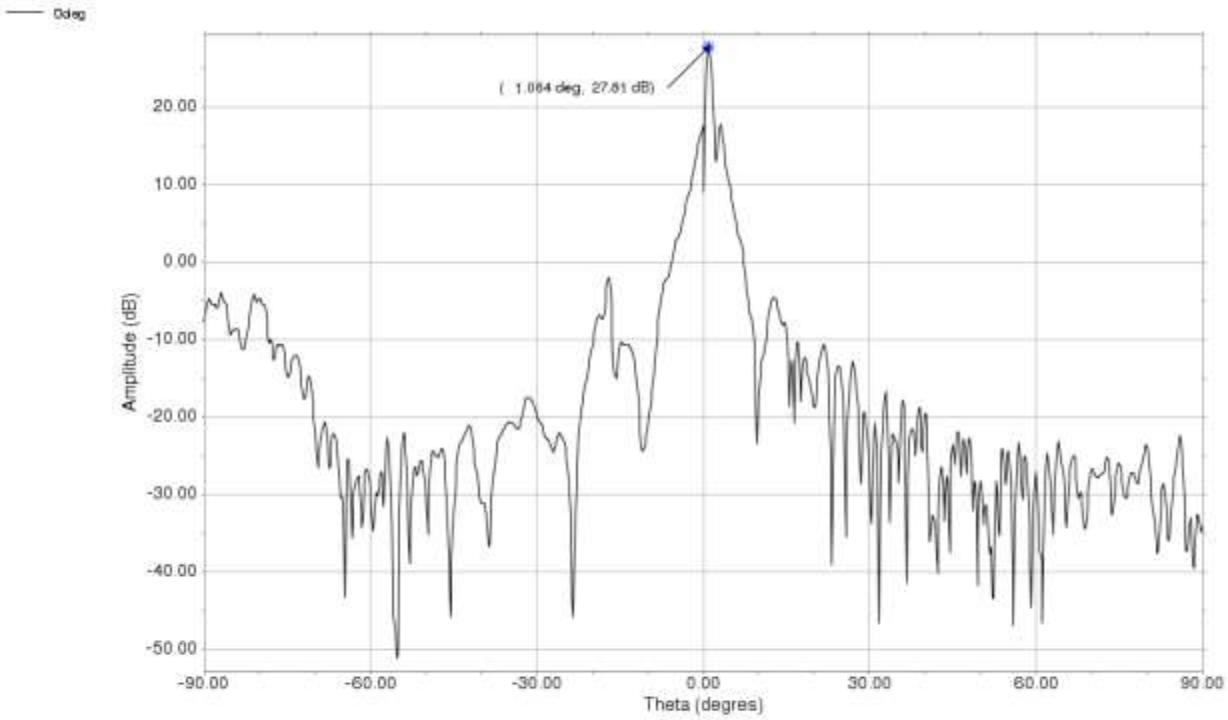
CO max :37.87 dB
CX max :10.15 dB



BEAM GW No10 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

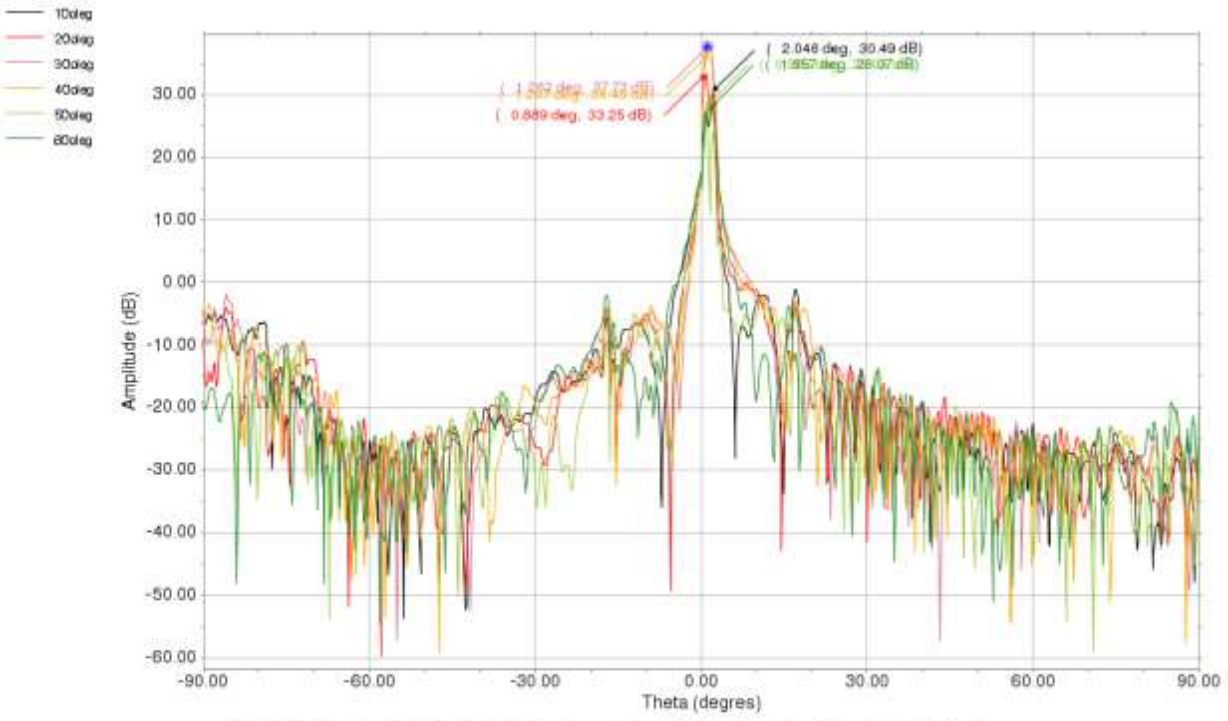
CO max :37.87 dB

CX max :10.15 dB



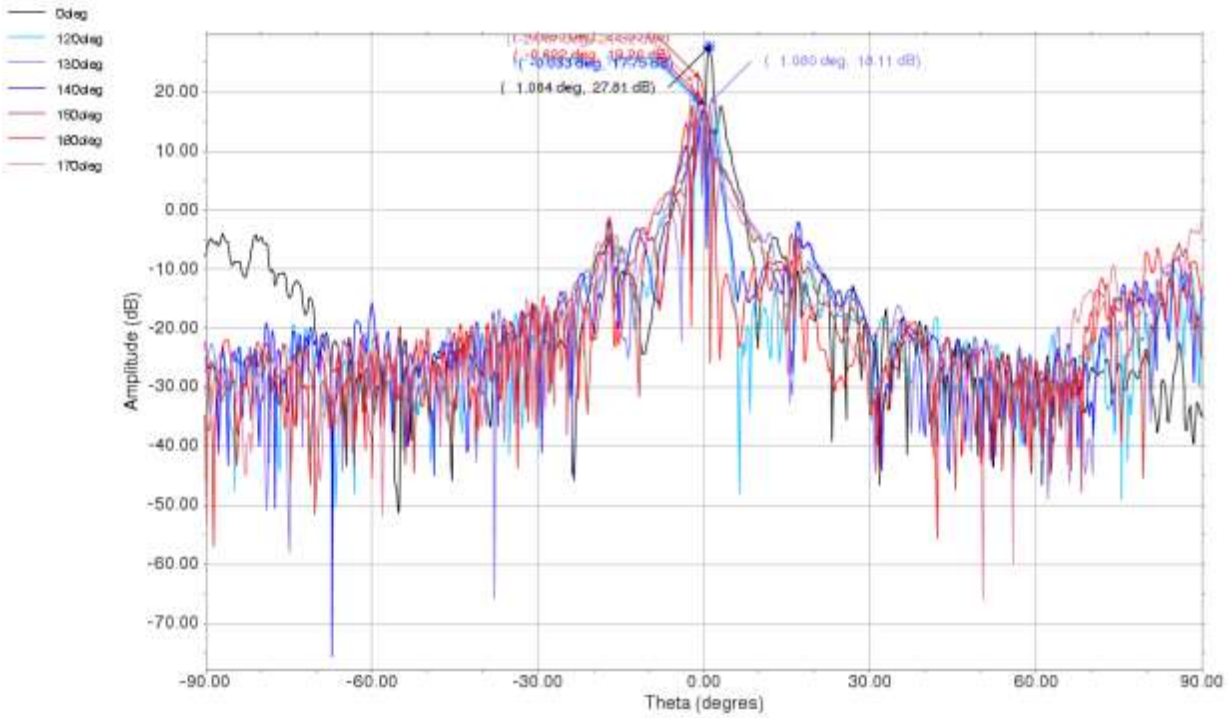
BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :38.15 dB CX max :11.50 dB



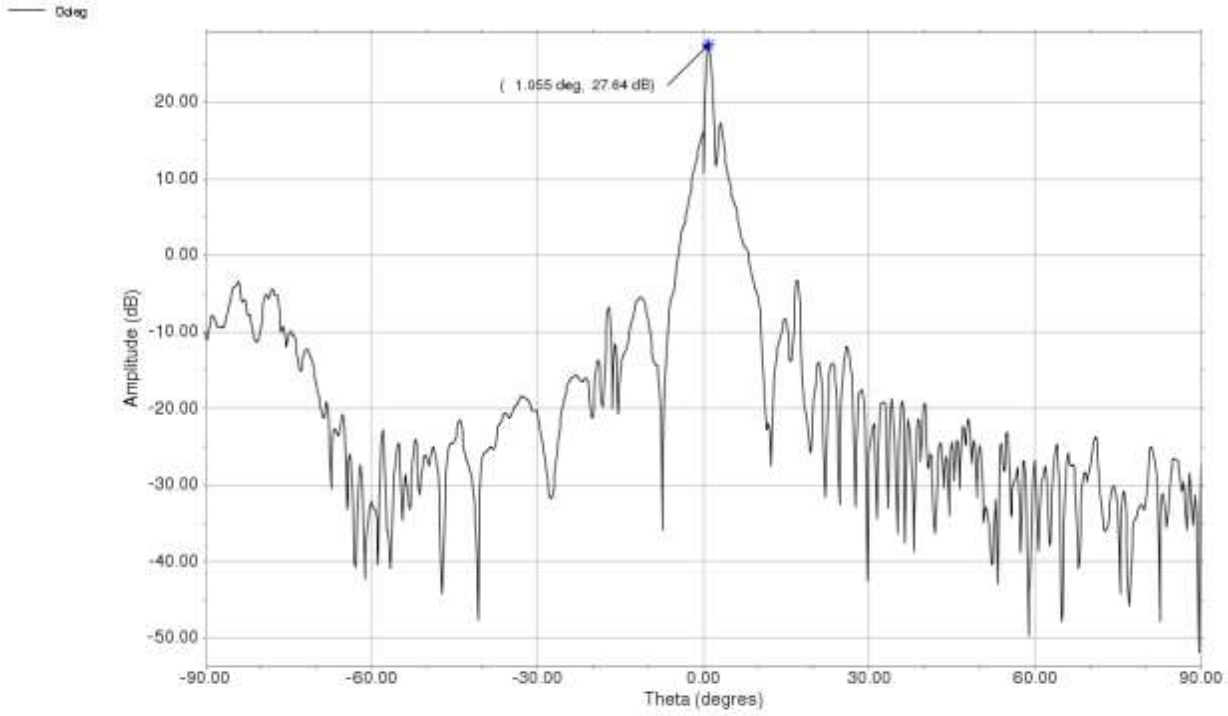
BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :38.15 dB CX max :11.50 dB



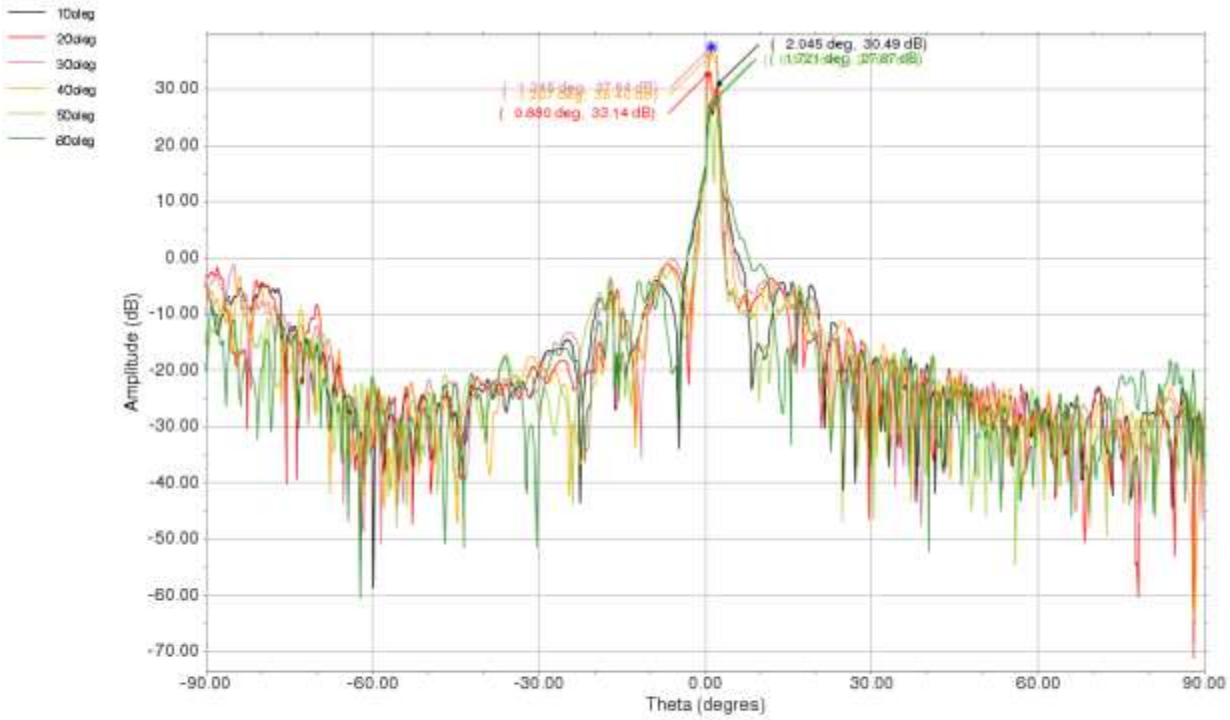
BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :38.15 dB **CX max :11.50 dB**



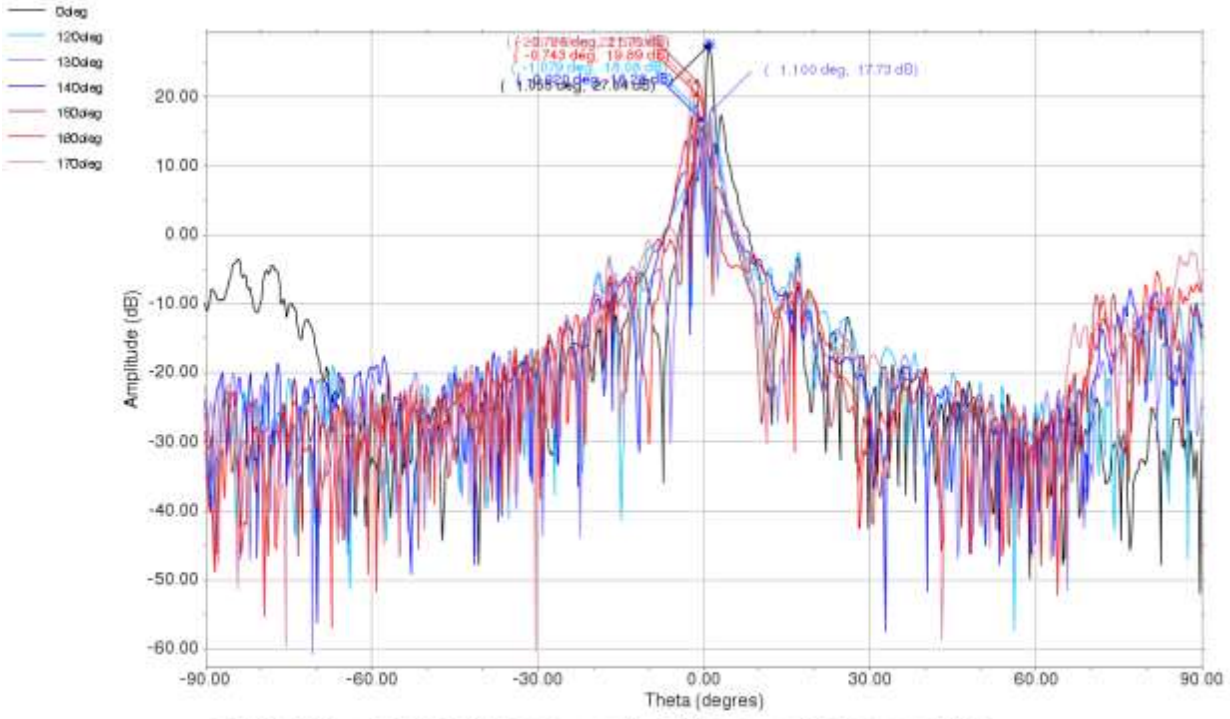
BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :38.00 dB **CX max :9.85 dB**



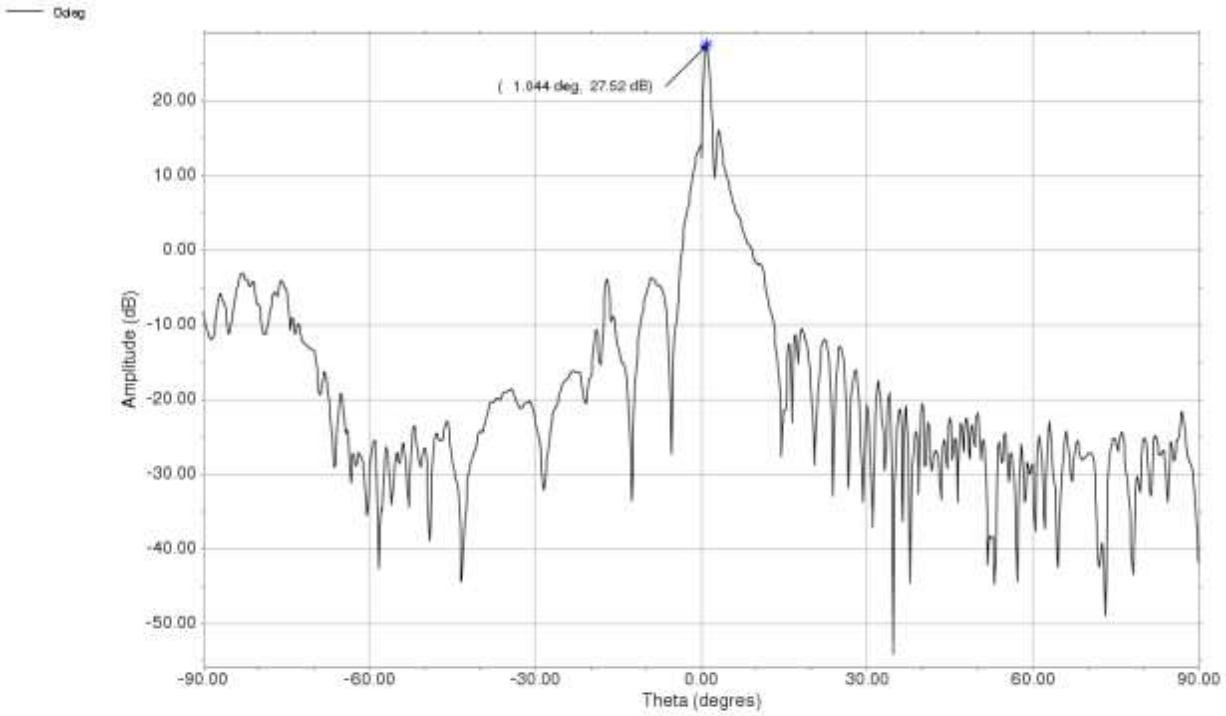
BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :38.08 dB **CX max :9.85 dB**

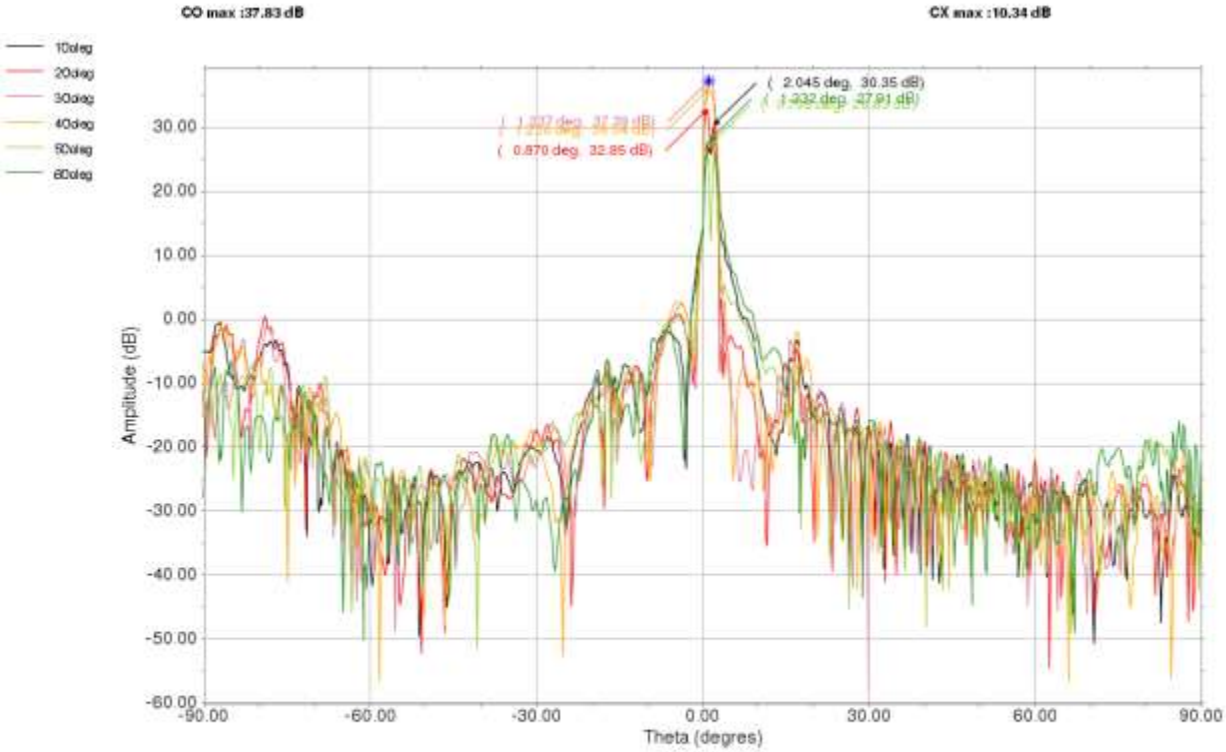


BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :38.08 dB **CX max :9.85 dB**

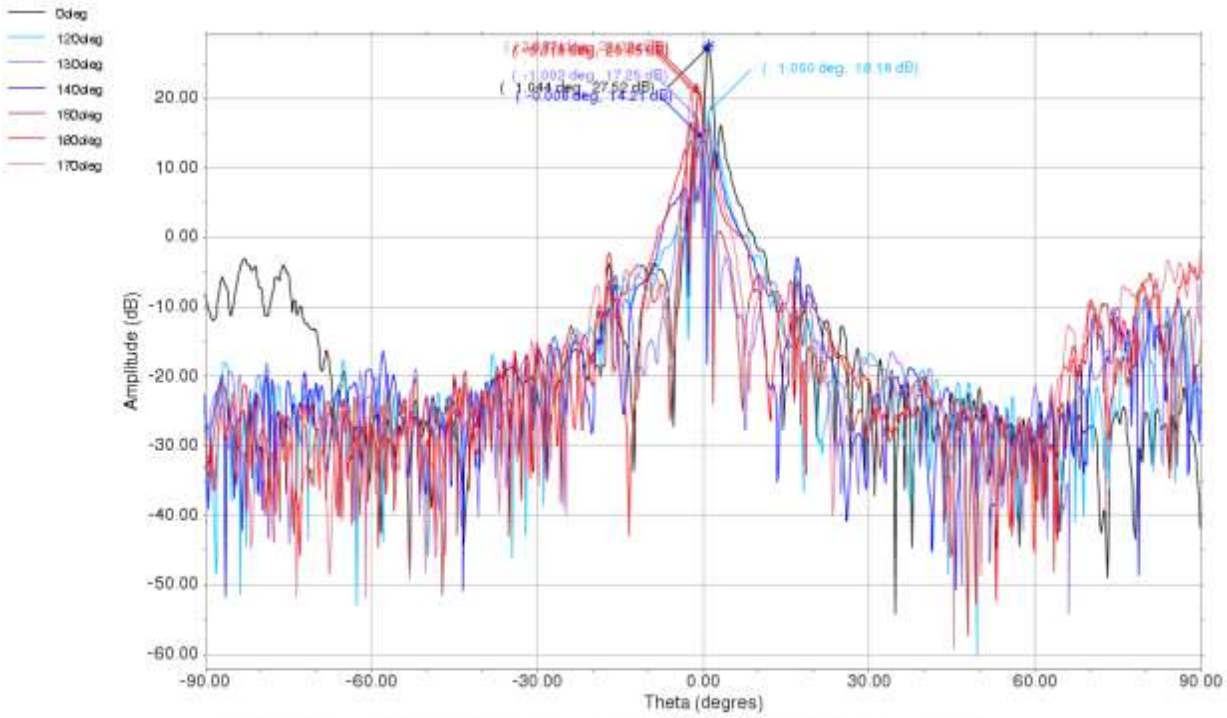


BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp



BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

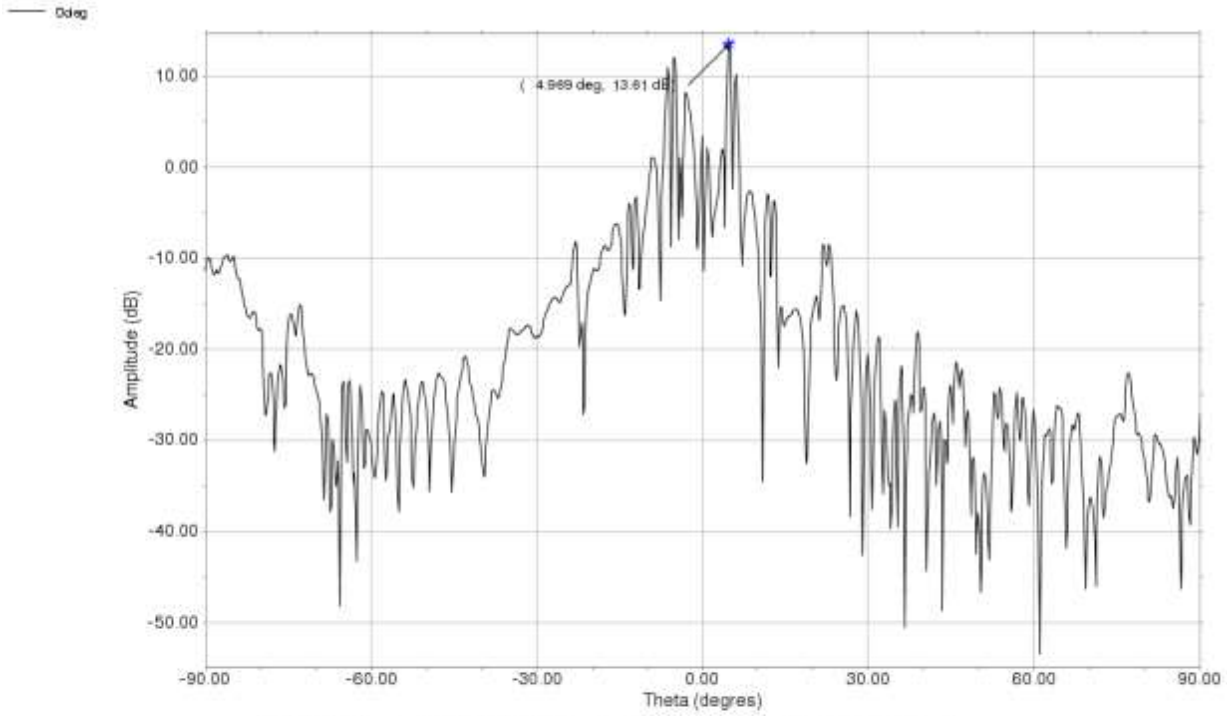
CO max :37.83 dB
CX max :10.34 dB



BEAM GW No11 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

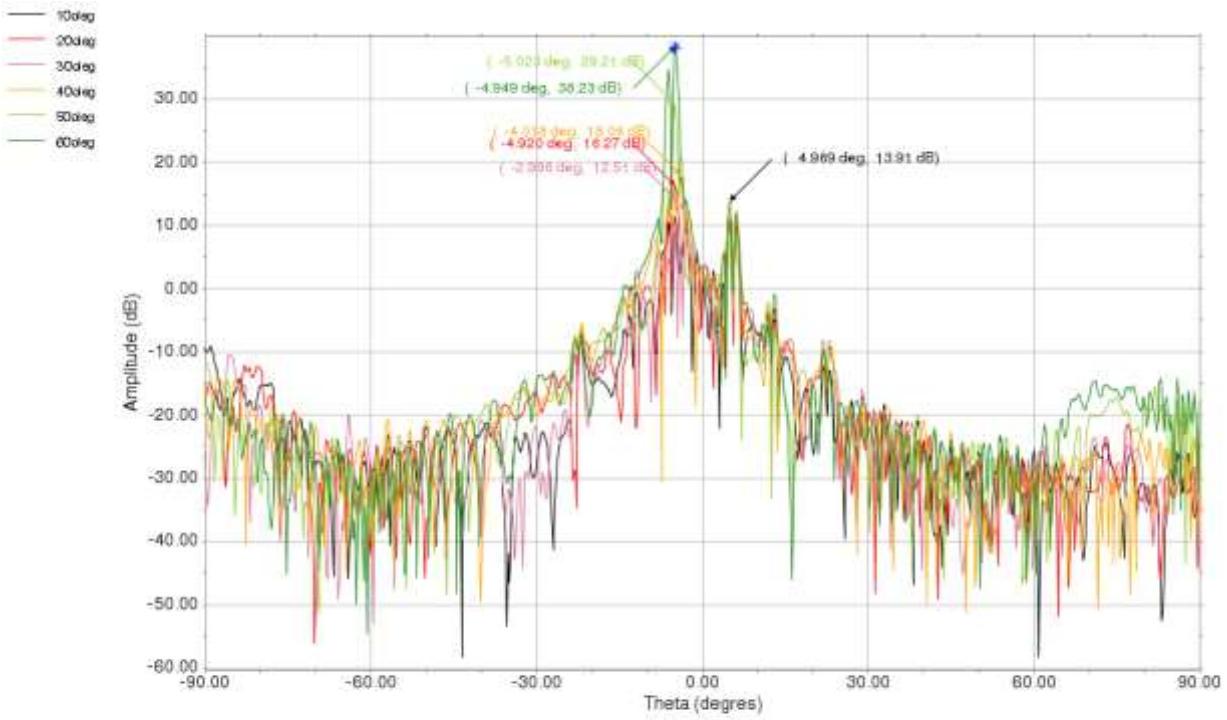
CO max :37.83 dB

CX max :10.34 dB



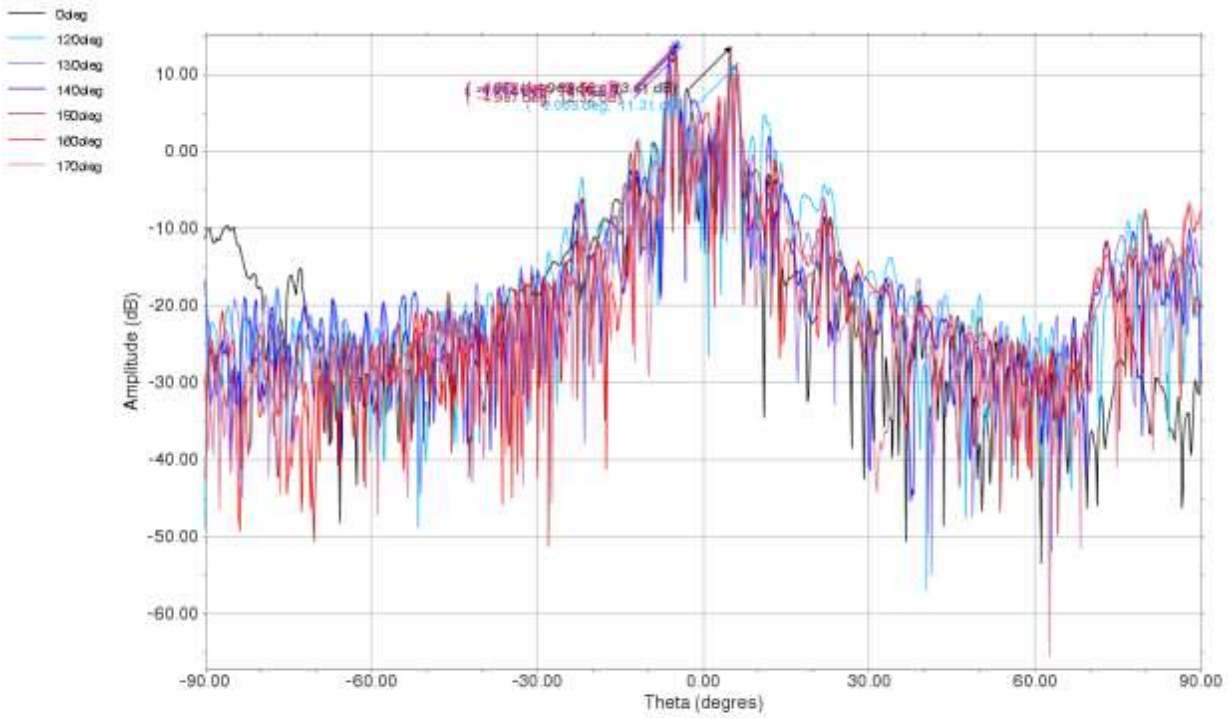
BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :38.30 dB **CX max :12.57 dB**



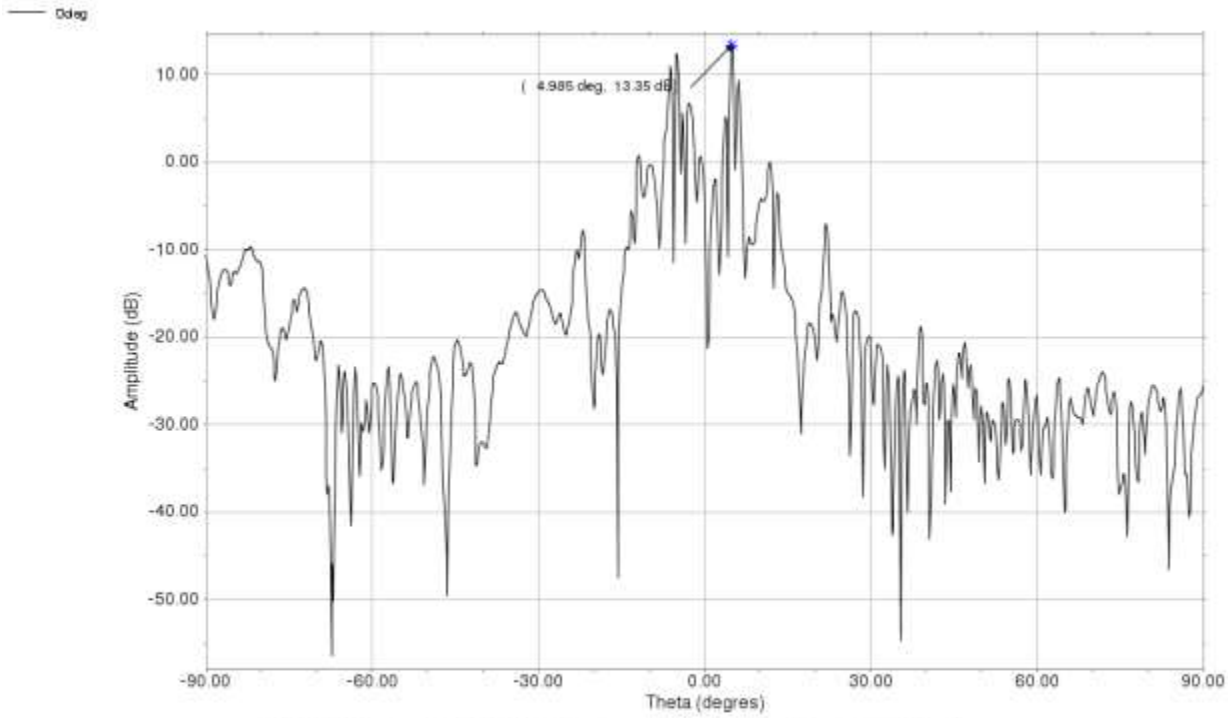
BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :38.30 dB **CX max :12.57 dB**



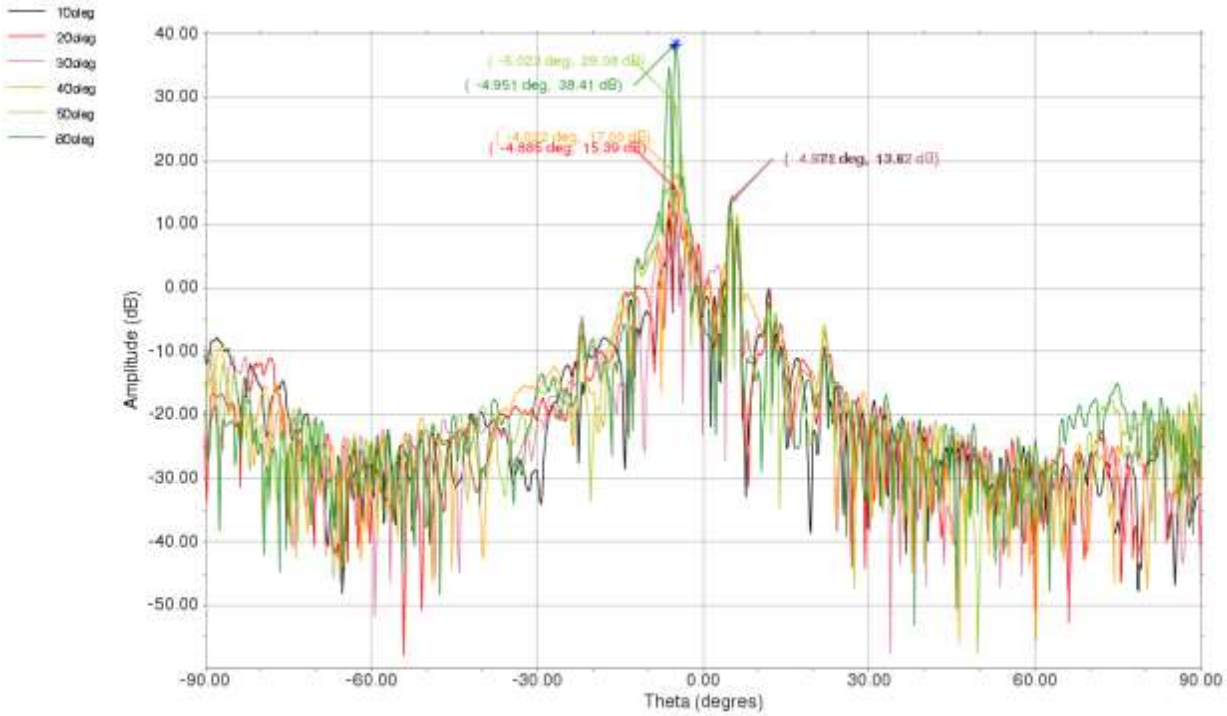
BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :38.30 dB **CX max :12.57 dB**



BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

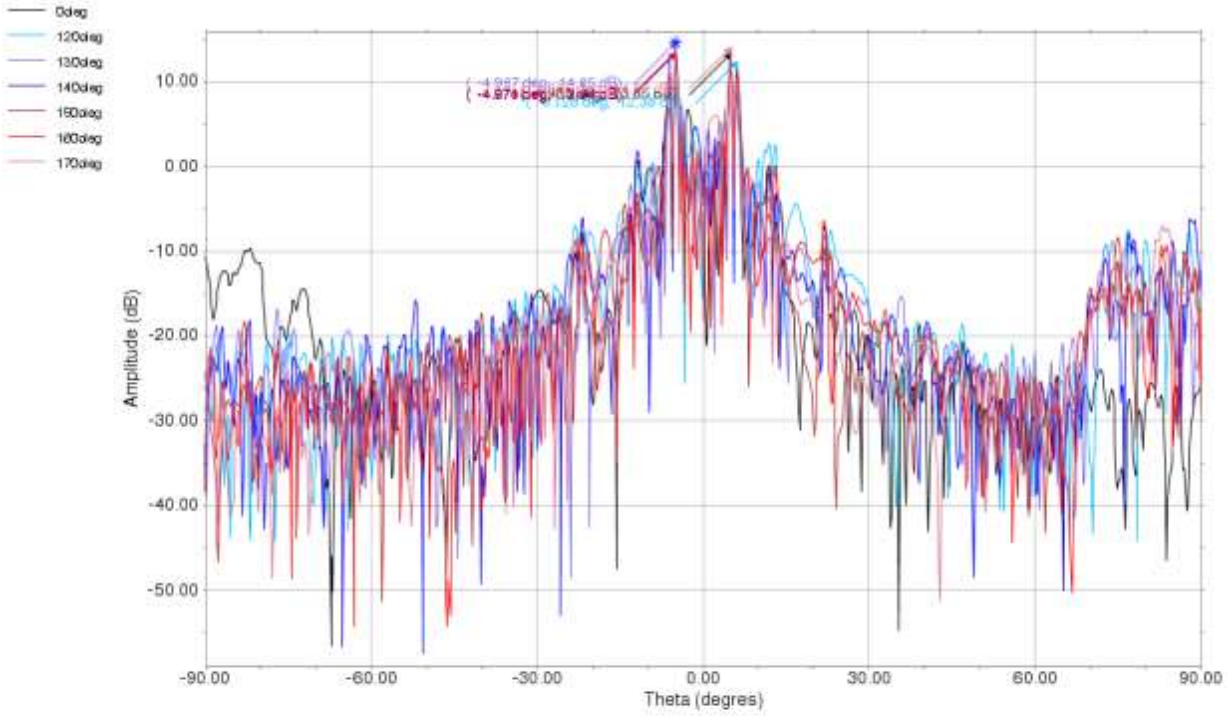
CO max :38.50 dB **CX max :9.00 dB**



BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :38.50 dB

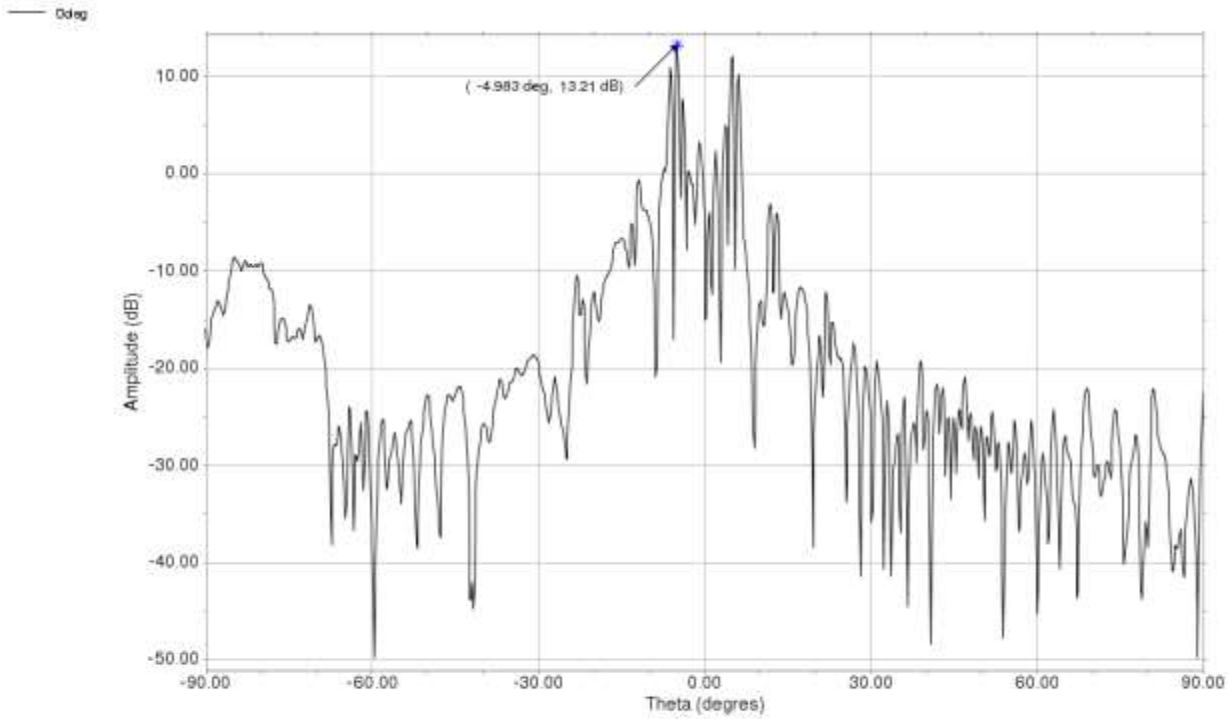
CX max :9.00 dB



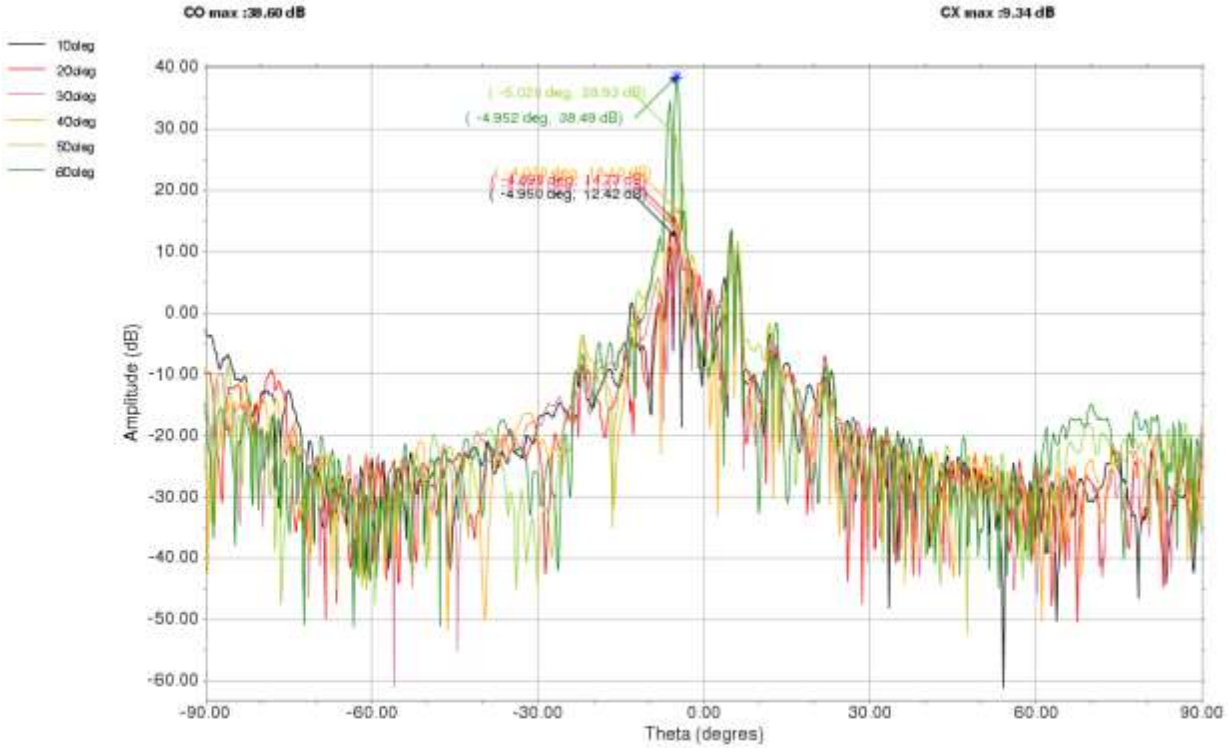
BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :38.50 dB

CX max :9.00 dB

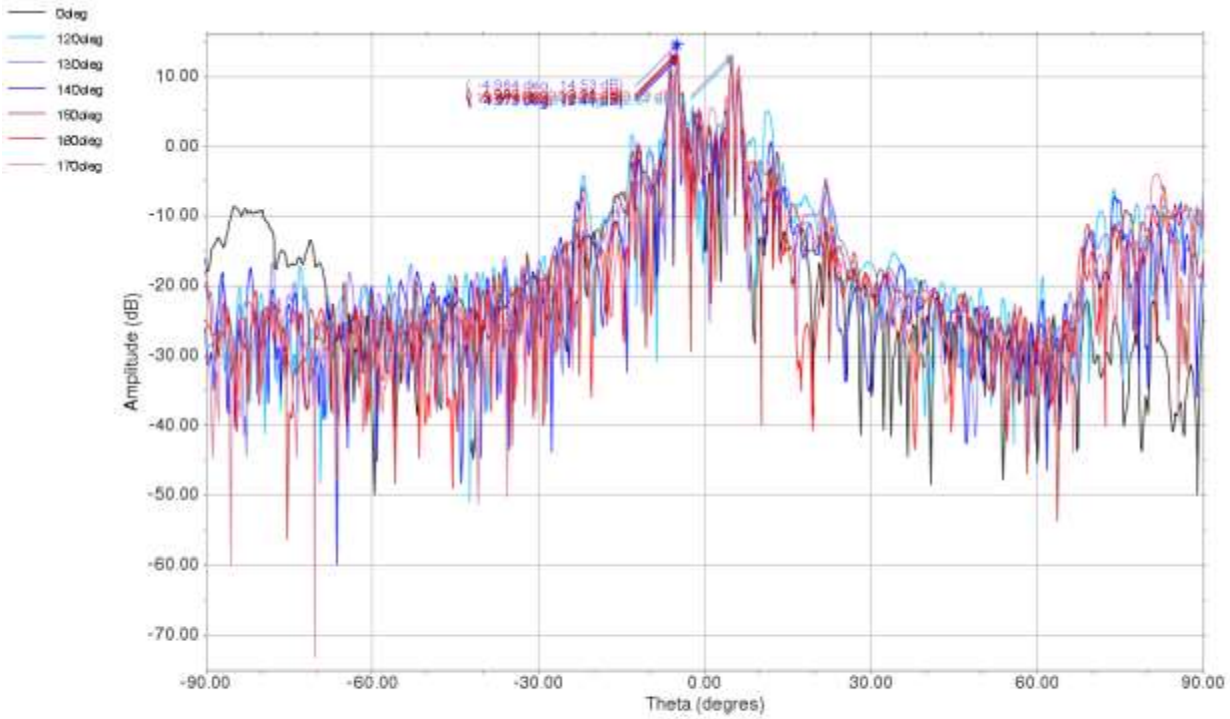


BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp



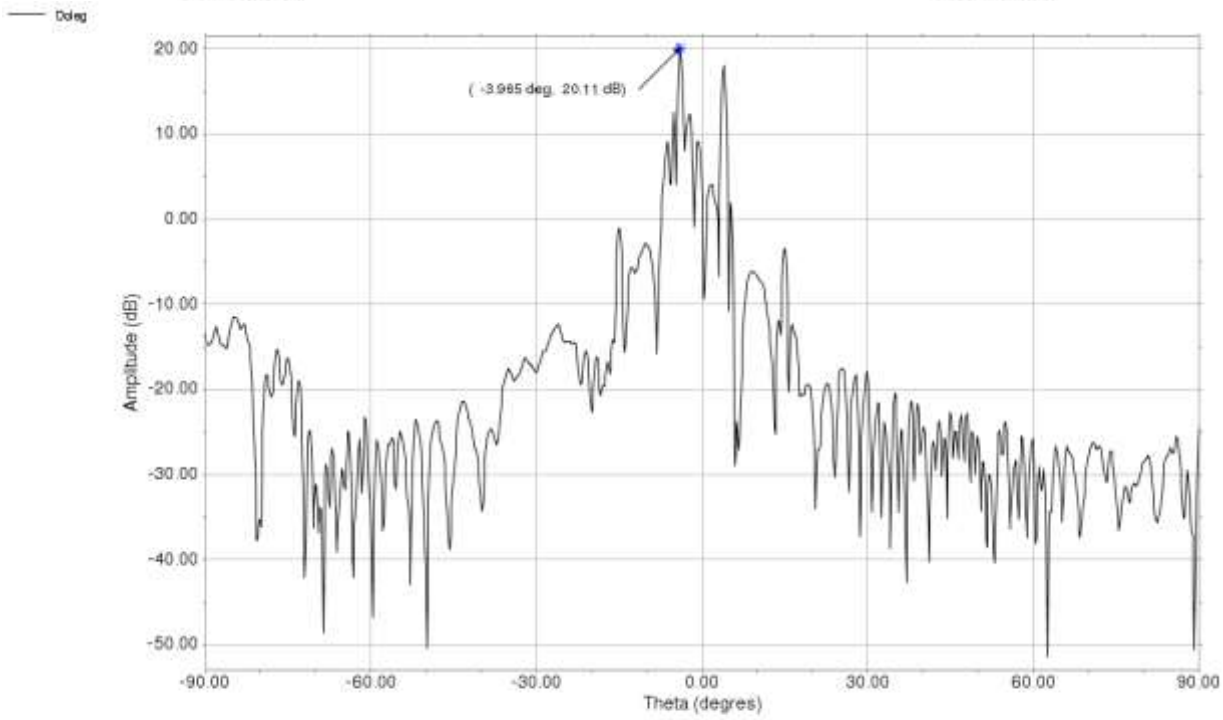
BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :38.60 dB
CX max :9.34 dB



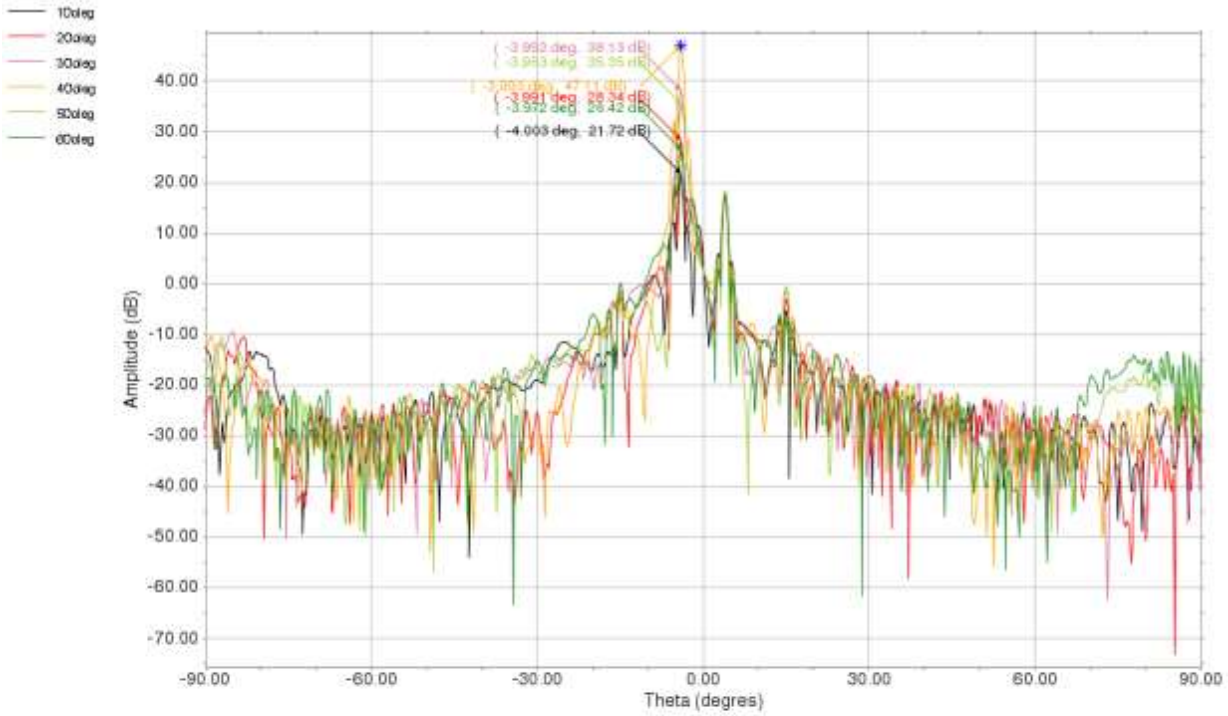
BEAM GW No12 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :38.60 dB **CX max :9.34 dB**



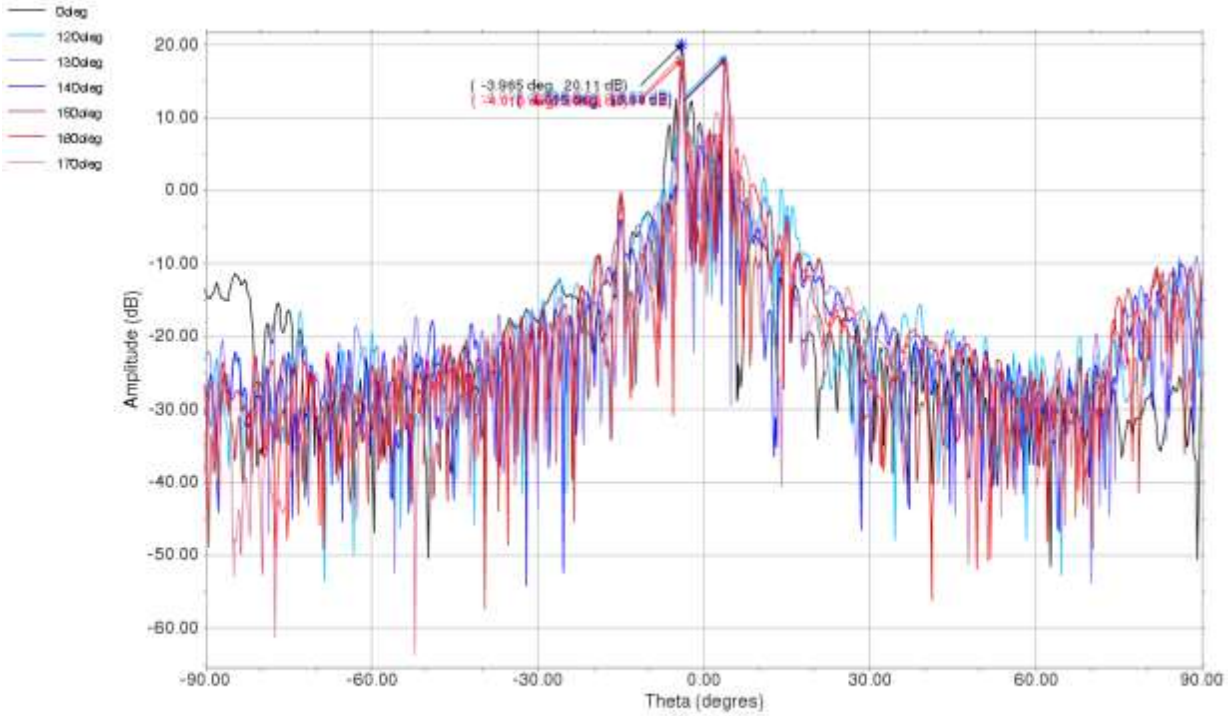
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz rhcp

CO max :47.11 dB **CX max :18.67 dB**



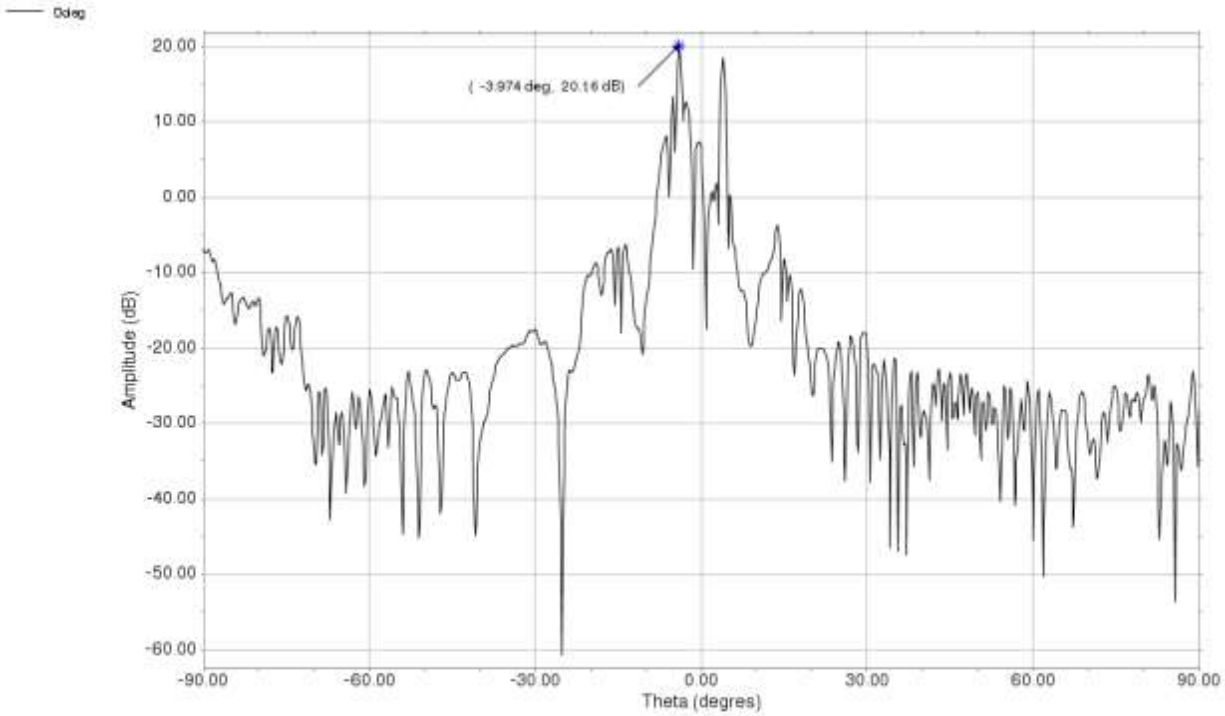
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz rhcp

CO max :47.11 dB **CX max :18.67 dB**



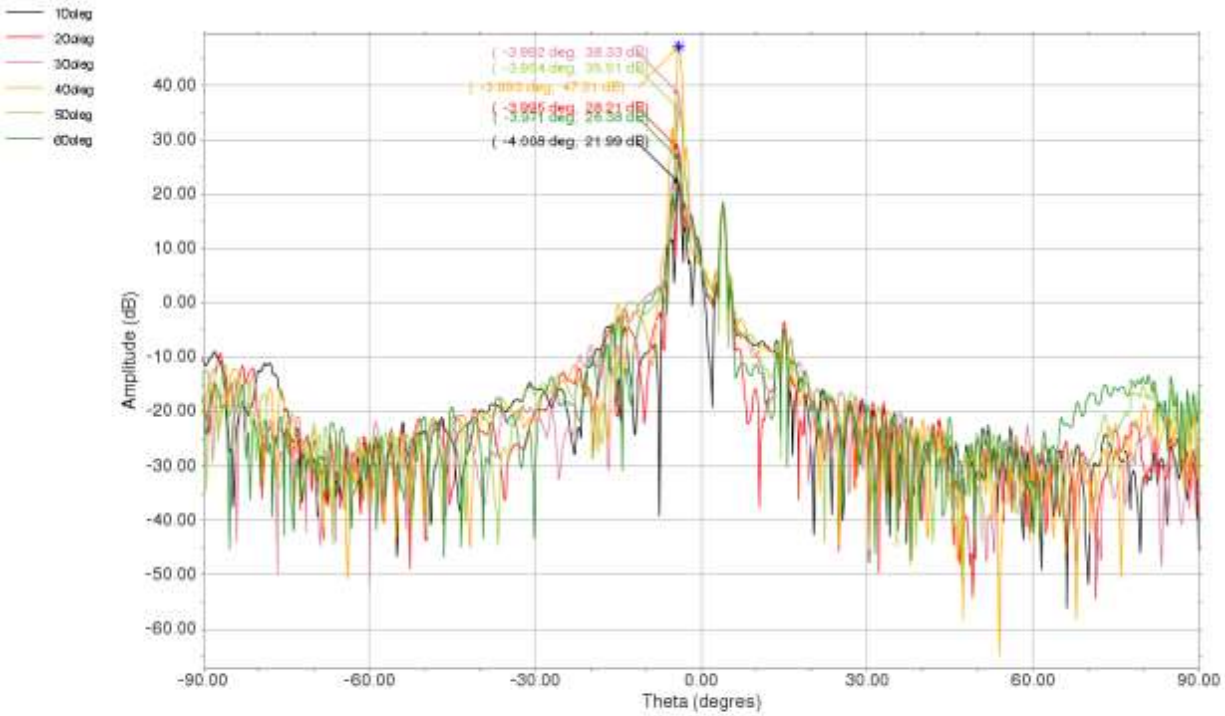
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz rhcp

CO max :47.11 dB **CX max :18.67 dB**



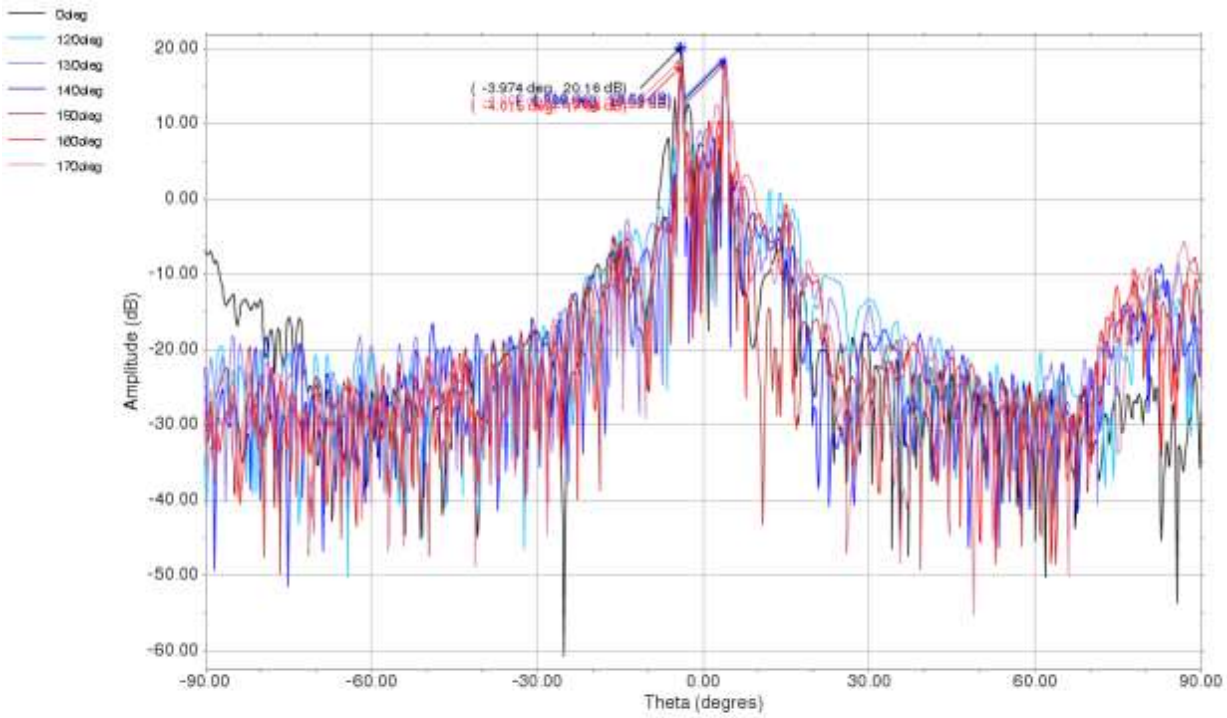
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz rhcp

CO max :47.32 dB **CX max :18.55 dB**



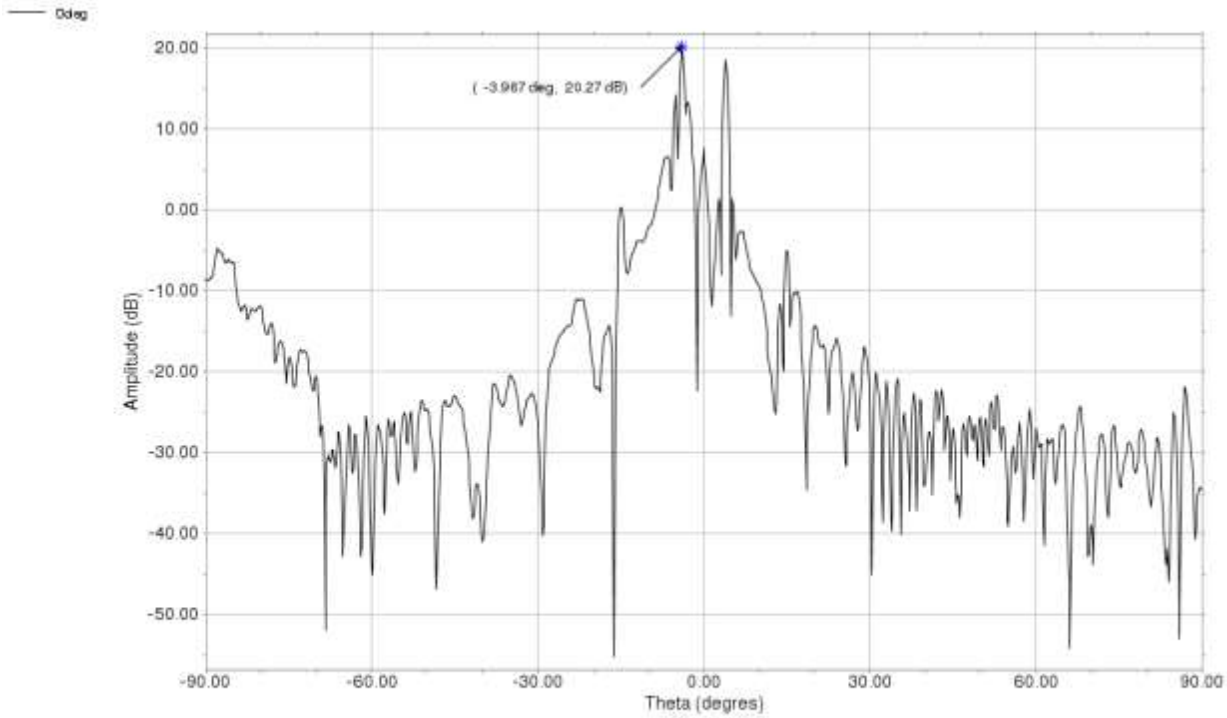
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz rhcp

CO max :47.32 dB **CX max :18.55 dB**



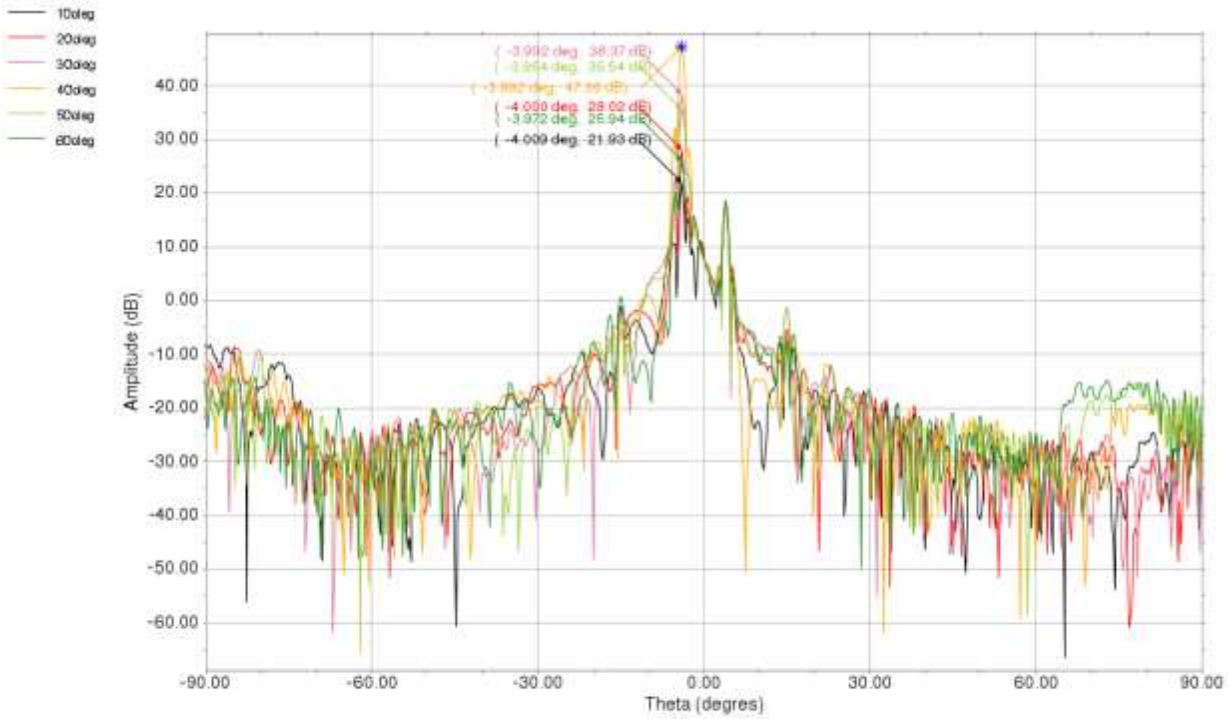
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz rhcp

CO max :47.32 dB **CX max :18.55 dB**



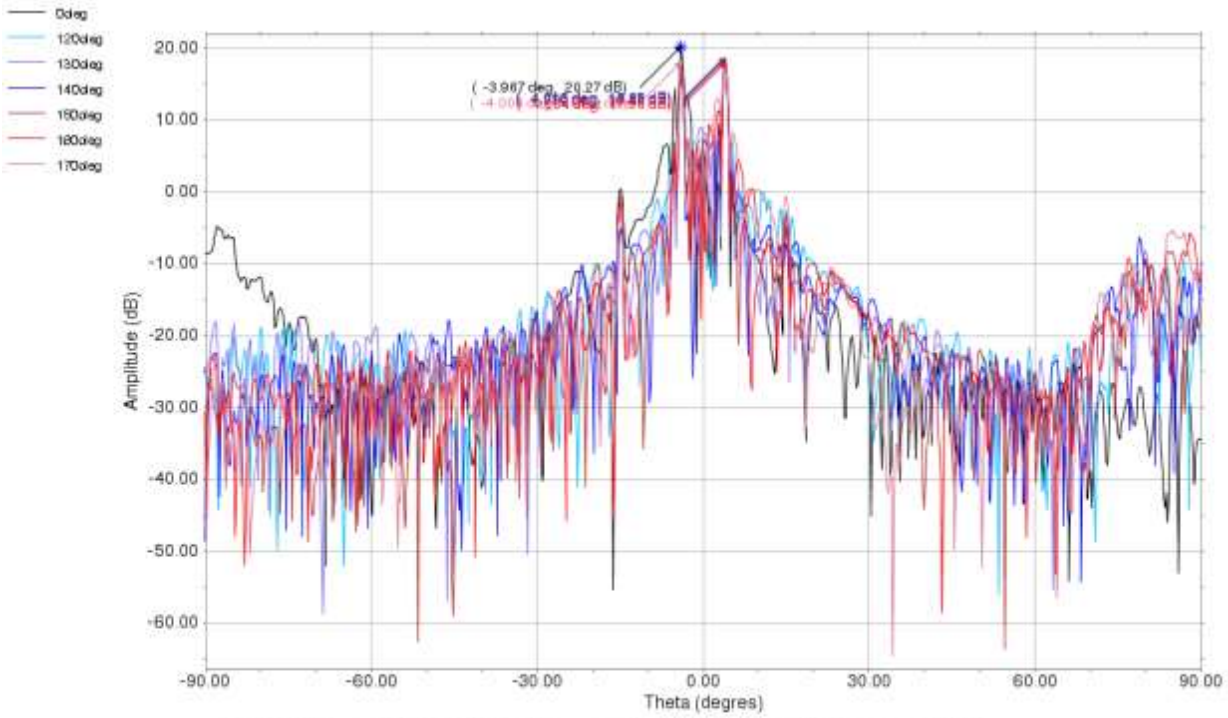
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :47.37 dB **CX max :18.70 dB**



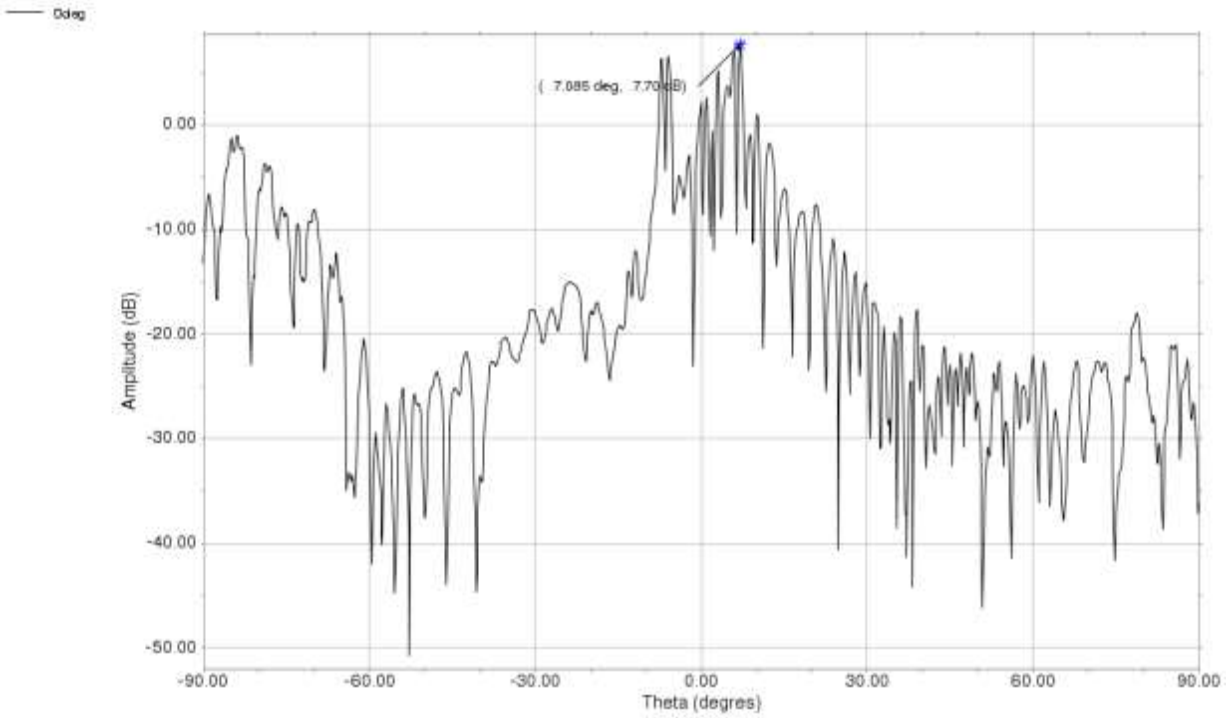
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :47.37 dB **CX max :18.70 dB**



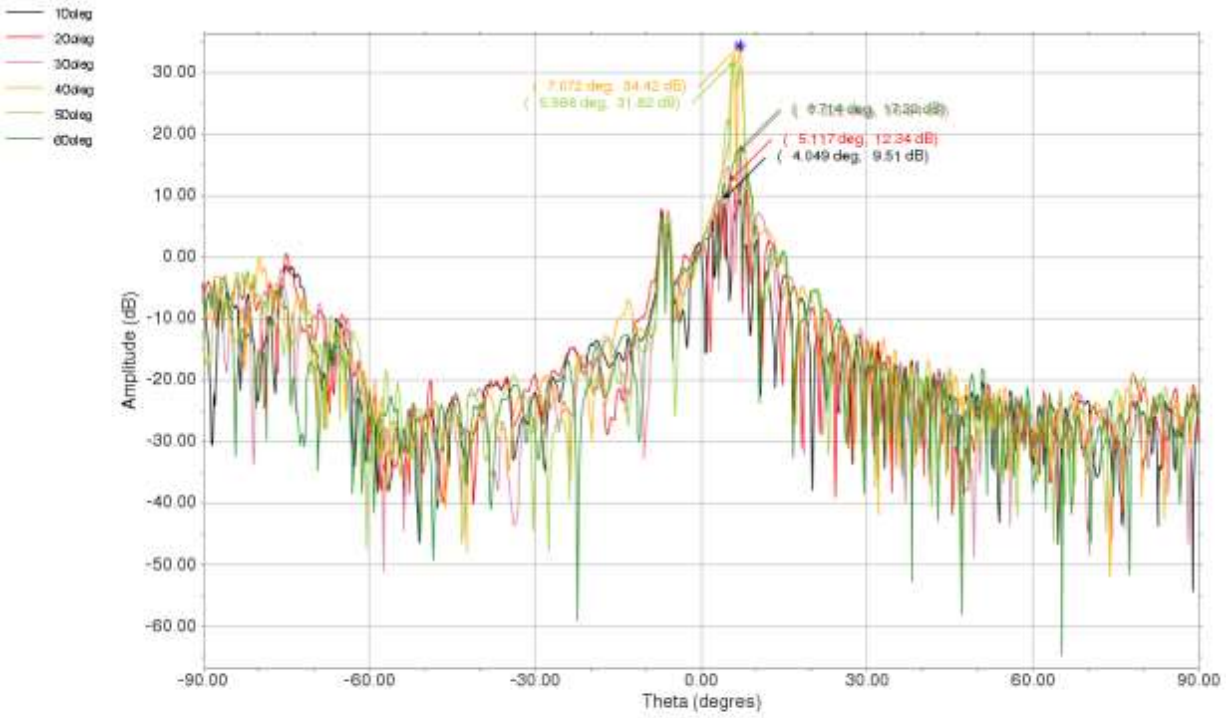
BEAM GW No13 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :47.37 dB **CX max :18.70 dB**



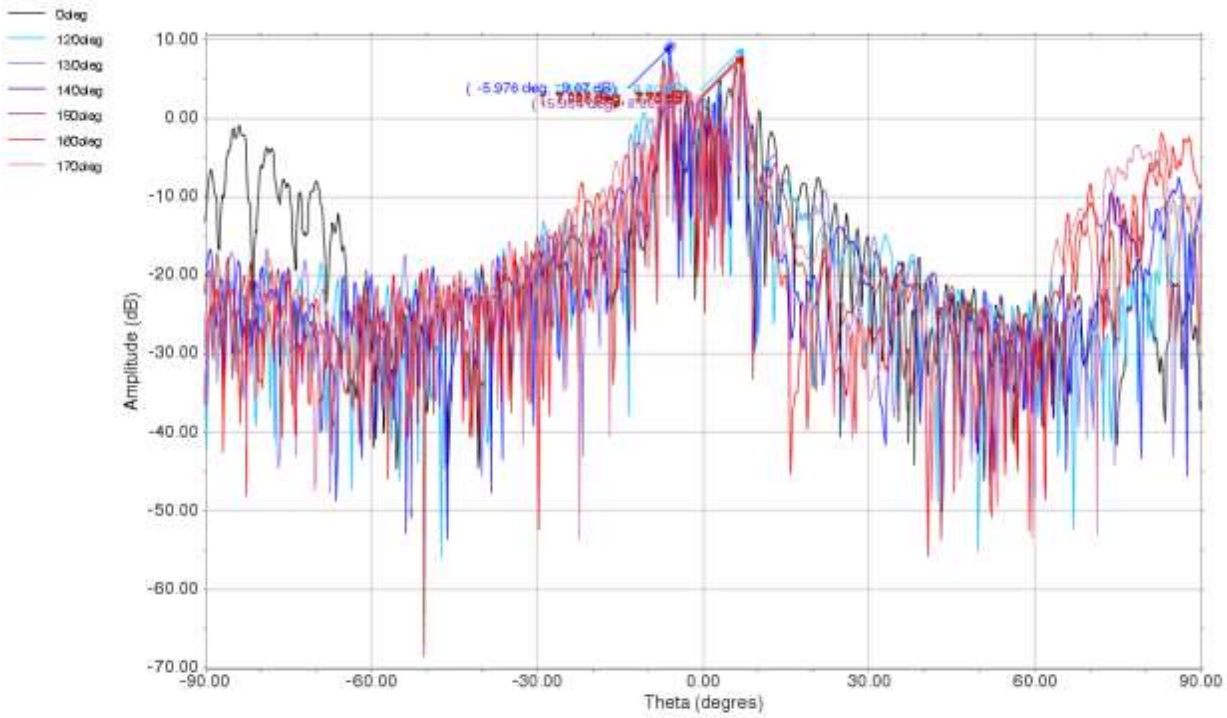
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17305.0 MHz lhcp

CO max :34.61 dB **CX max :11.32 dB**



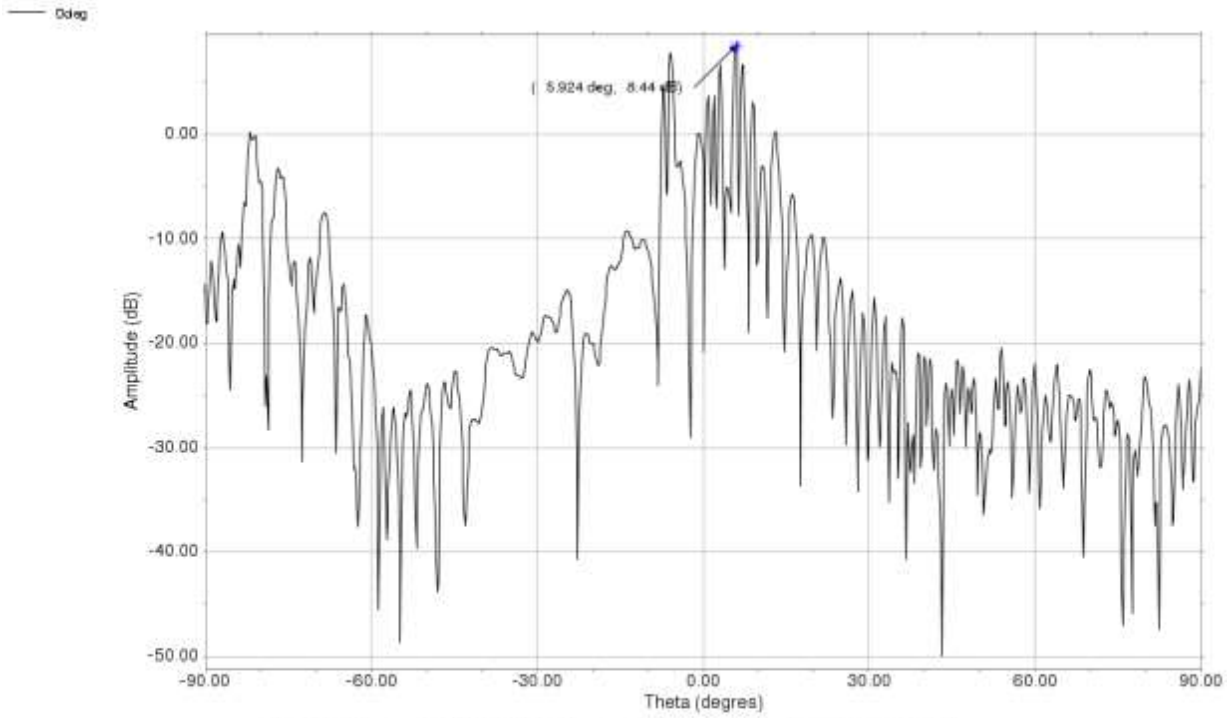
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17305.0 MHz lhcp

CO max :34.61 dB **CX max :11.32 dB**



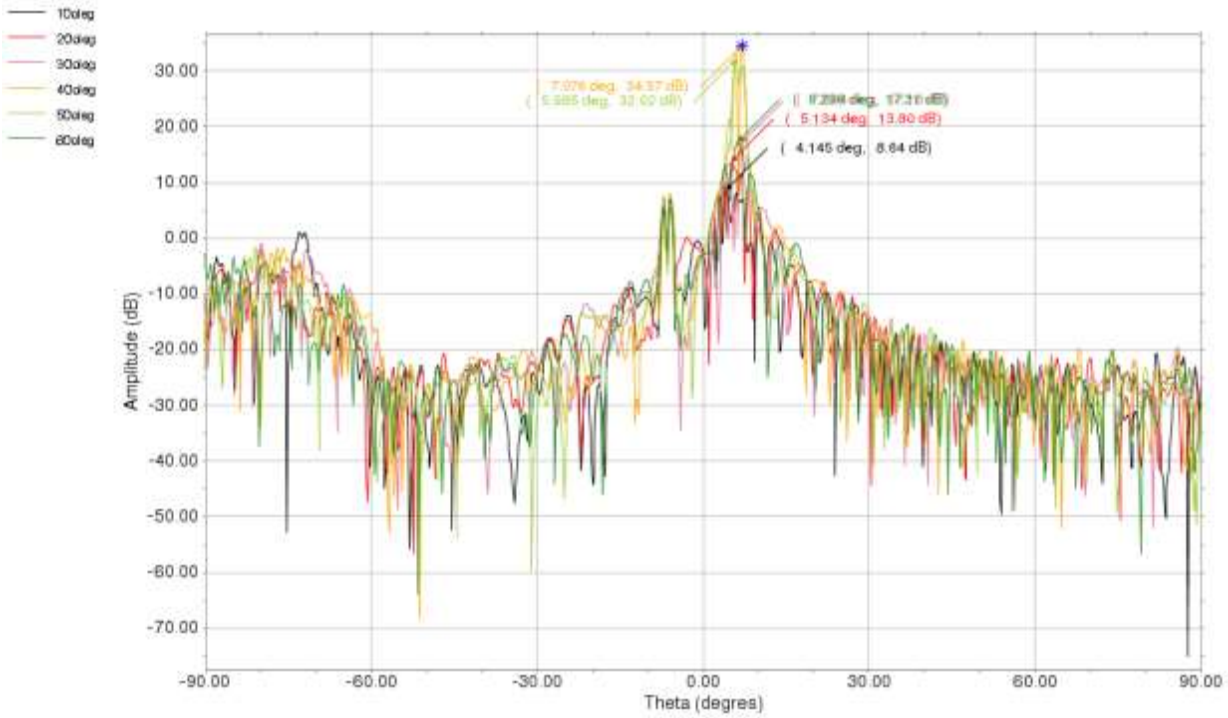
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17305.0 MHz lhcp

CO max :34.61 dB **CX max :11.32 dB**



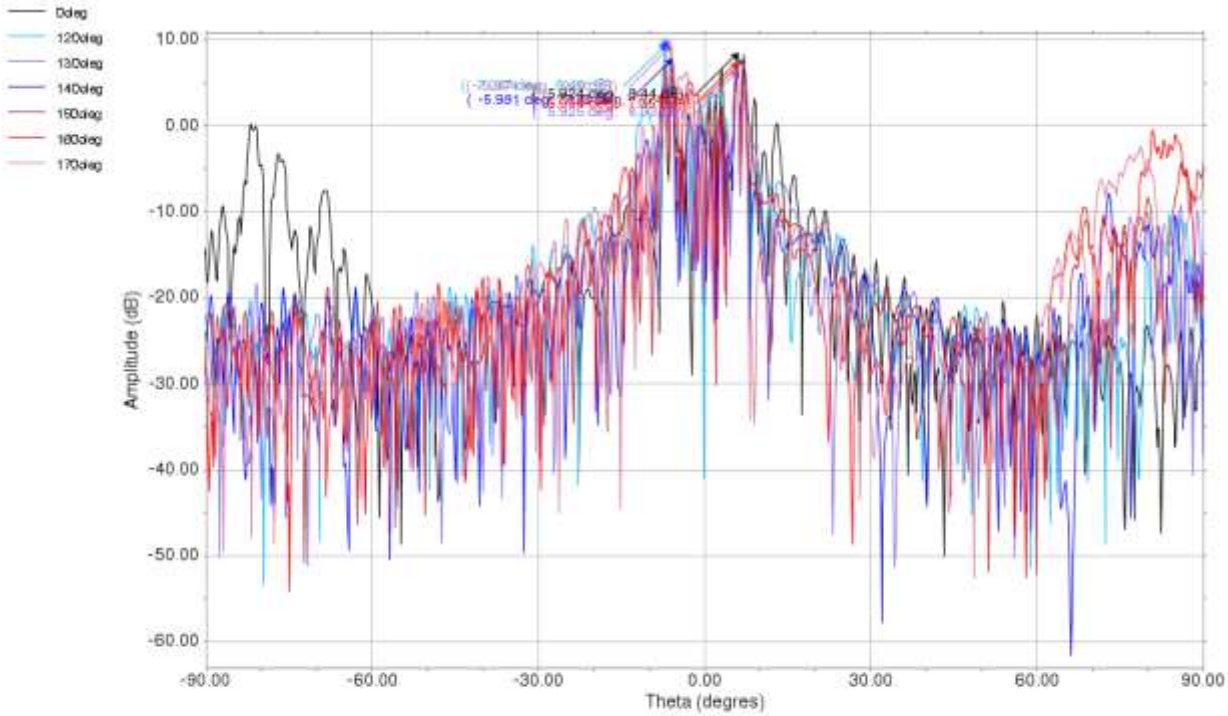
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17550.0 MHz lhcp

CO max :34.75 dB **CX max :8.89 dB**



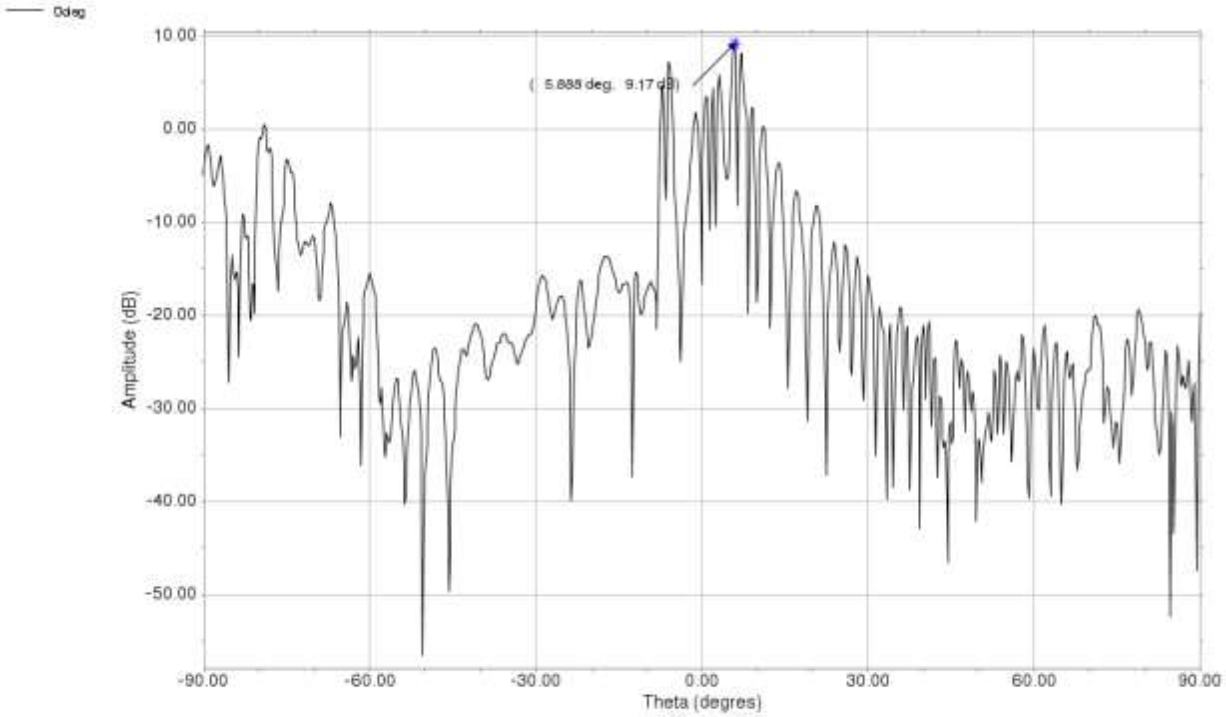
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17550.0 MHz lhcp

CO max :34.75 dB **CX max :8.89 dB**

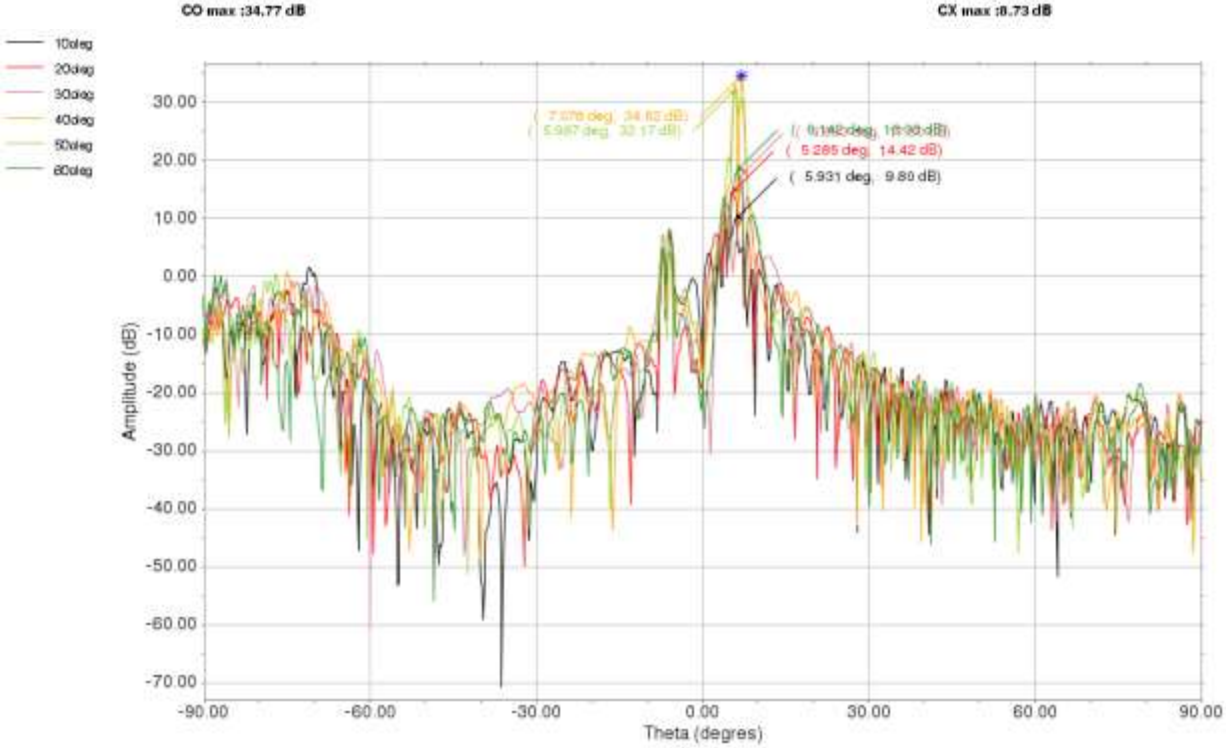


BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17550.0 MHz lhcp

CO max :34.75 dB **CX max :8.89 dB**

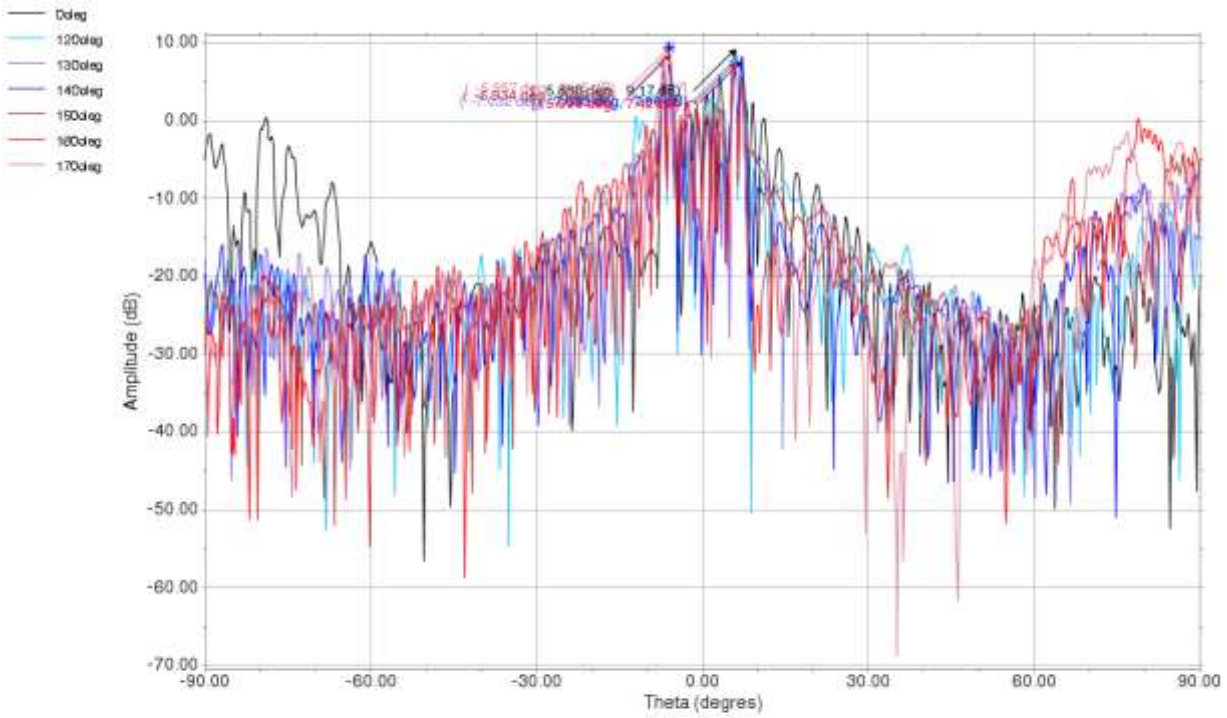


BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp



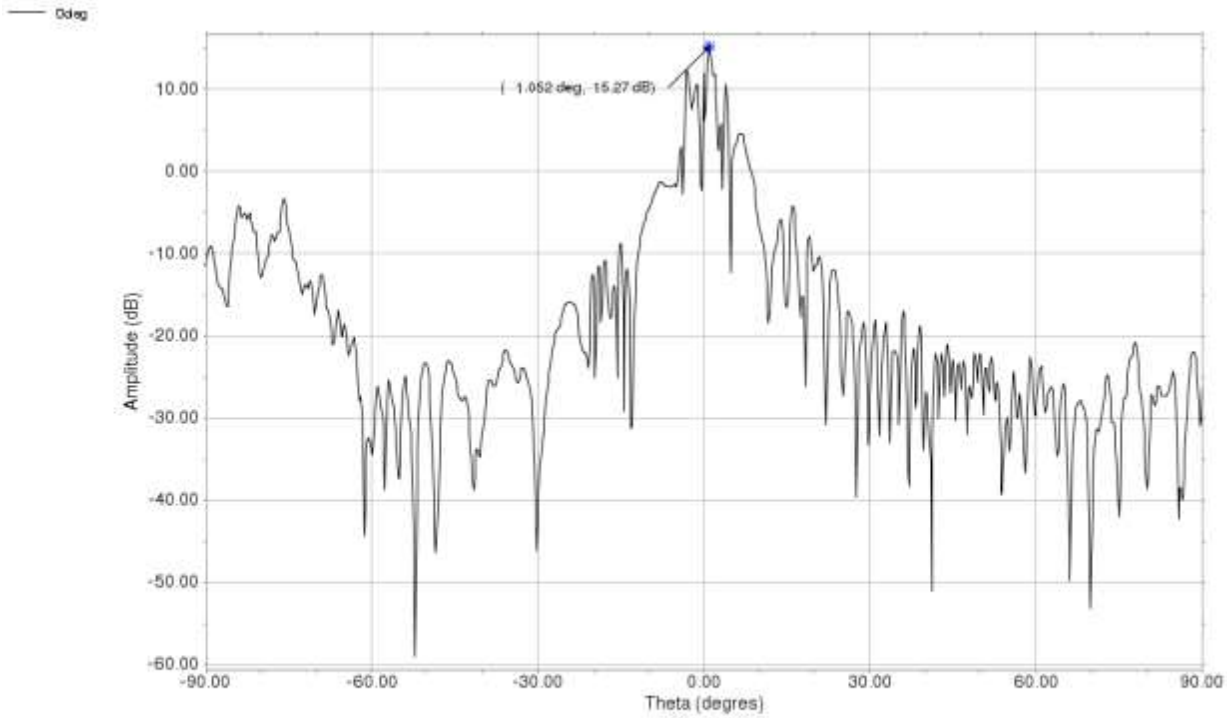
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :34.77 dB
CX max :8.73 dB



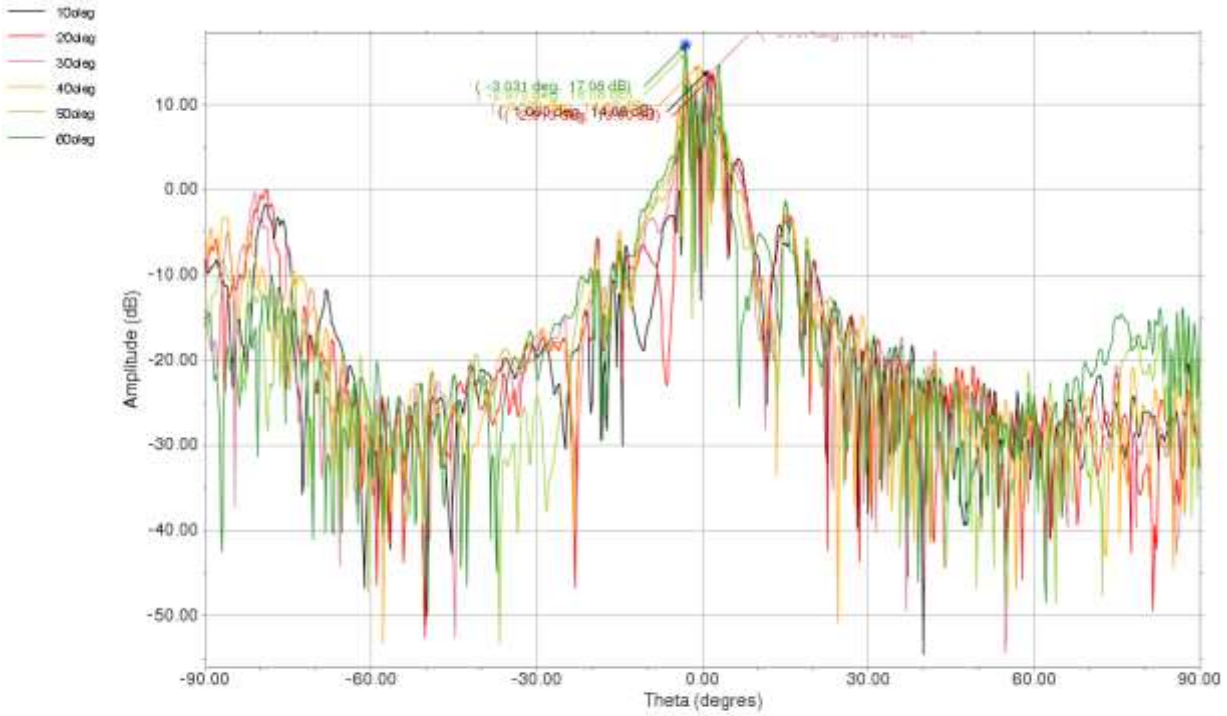
BEAM GW No14 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :34.77 dB **CX max :8.73 dB**



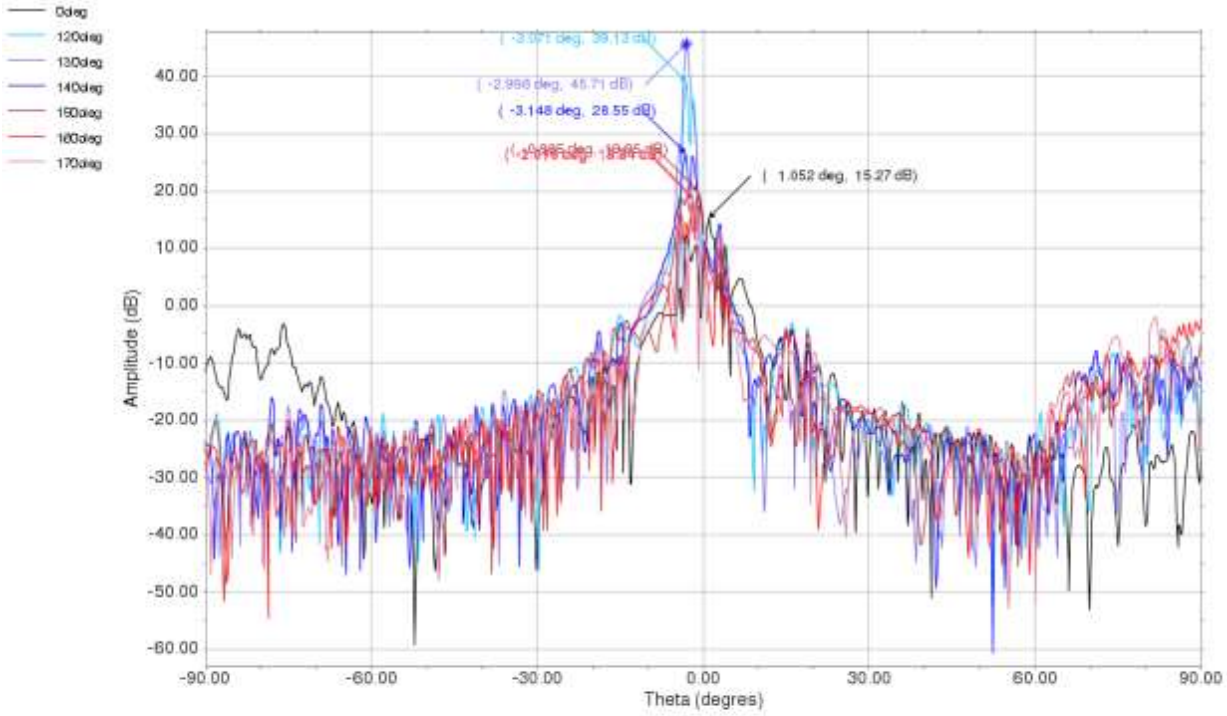
BEAM GW No15 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz rhcp

CO max :45.80 dB **CX max :16.29 dB**



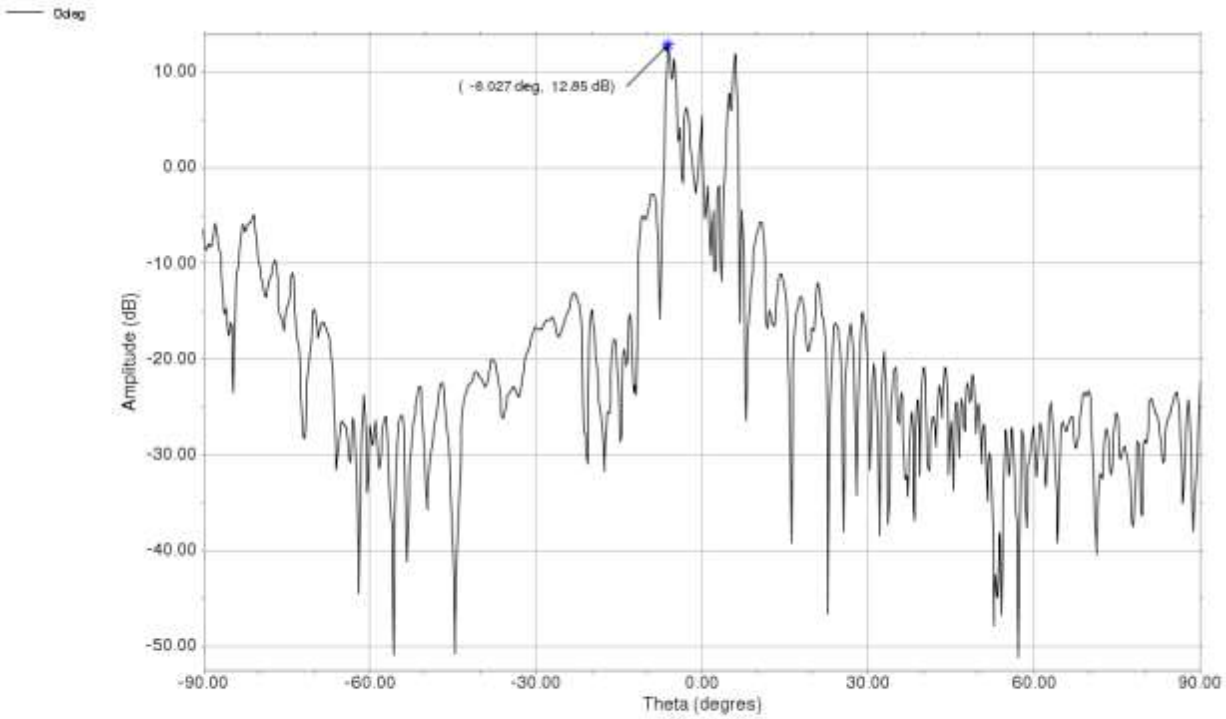
BEAM GW No15 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz rhcp

CO max :45.80 dB **CX max :16.29 dB**

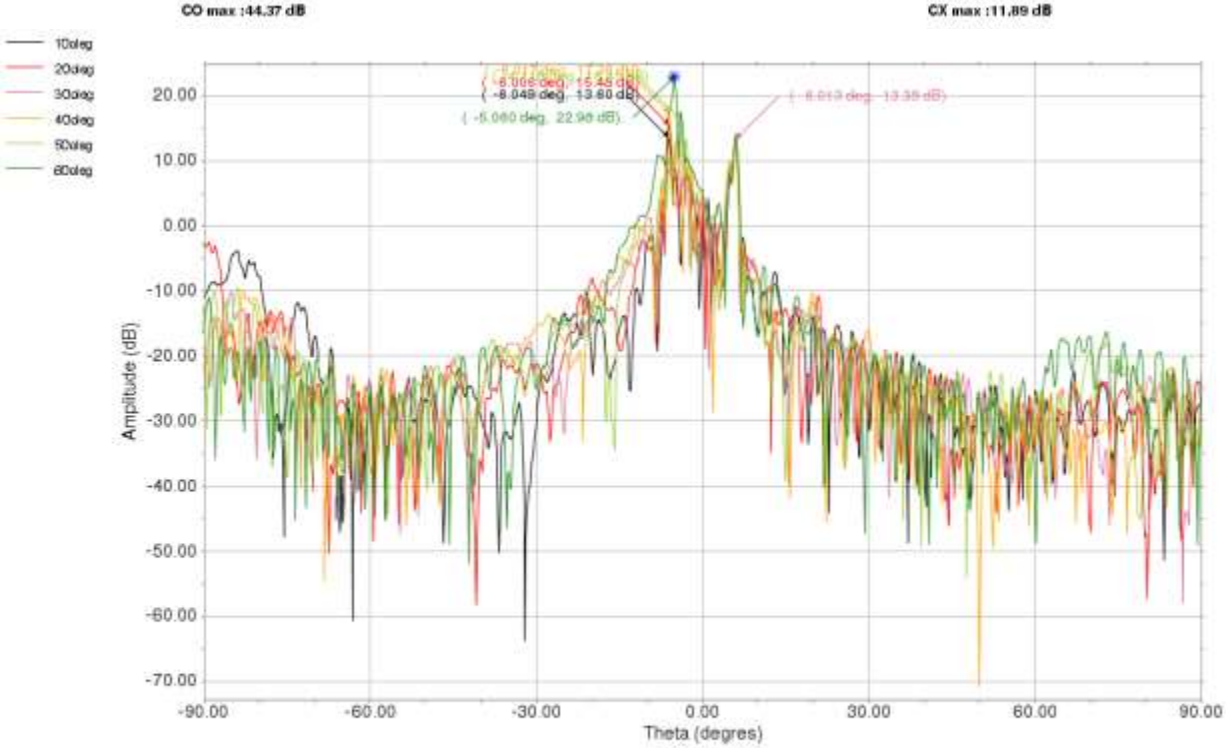


BEAM GW No15 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz rhcp

CO max :45.80 dB **CX max :16.29 dB**

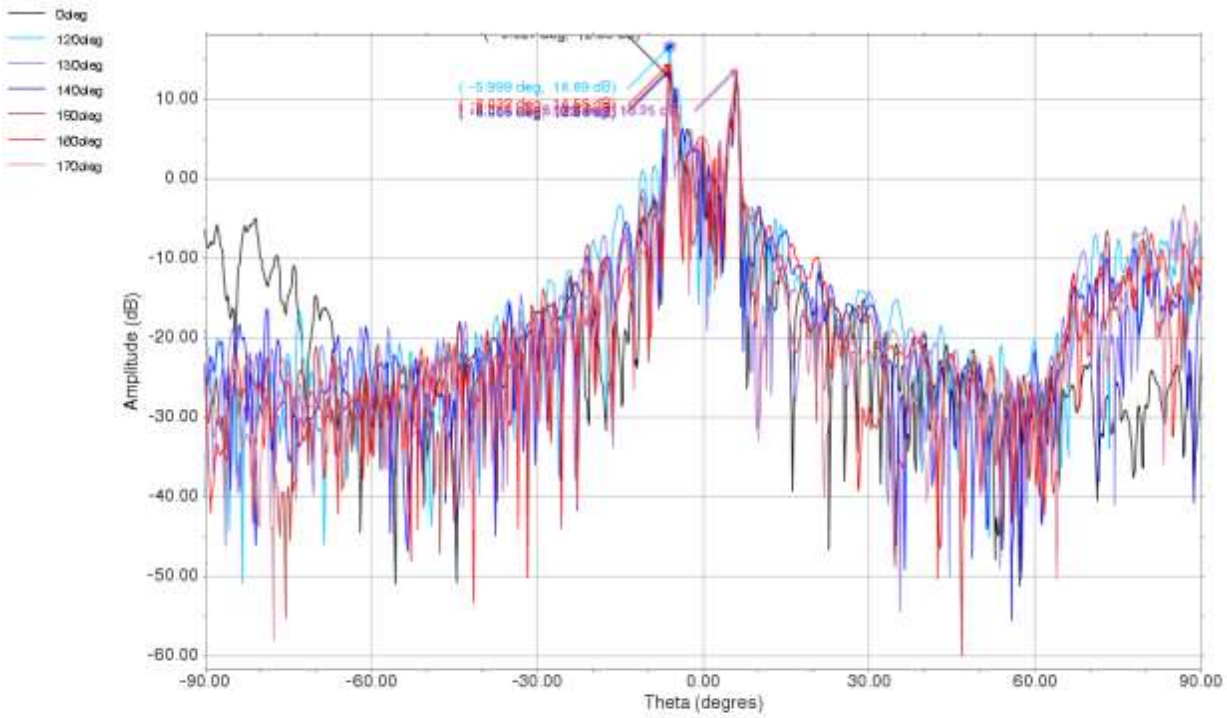


BEAM GW No16 - EQUAT. CUTS [Theta +/-90deg , Phi 0deg] at 17795.0 MHz lhcp



BEAM GW No16 - EQUAT. CUTS [Theta +/-90deg , Phi 10 to 60deg] at 17795.0 MHz lhcp

CO max :44.37 dB
CX max :11.89 dB



BEAM GW No16 - EQUAT. CUTS [Theta +/-90deg , Phi 120 to 170deg] at 17795.0 MHz lhcp

CO max :44.37 dB

CX max :11.89 dB