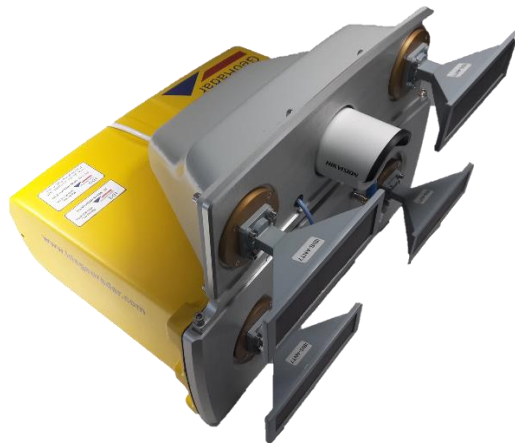


IBIS KU ETH

User Guide



October 2021



1. Important Information about your Instrument



Read and follow the User Manual before using the product or the accessories delivered with the product.



Keep for future reference!

Intended use

Radar sensor used in several IDSGeoradar products with the main purpose of performs remote displacements monitoring of structure and land.



The product must not be disposed with household waste.

Conformity to European regulations

The equipment is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/UE.

The full Declaration of its Conformity is sent separately together with the shipping documents of the product.

This equipment is destined for use in industrial environments (Class A apparatus). In residential, commercial and light industry environments, this apparatus may generate radio interference: in this case, the user may need to take adequate measures

**Conformity to U.S regulations.
FCC Use limits**

The IBIS KU ETH sensor is granted by FCC approved, according to the Code of Federal Regulations, Title 47, Chapter I, Subchapter D, part 90, Subpart F, Private land mobile radio services; Radiolocation Service. In order to use the sensor in the US territory, a license of utilization must be obtained by FCC.FCC Statements:

- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

- This product complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 26 cm between the radiator and your body.

**Conformity to
Canada
regulations.**

This product poses no health and safety risk when operated in the normal manner of the intended use.

The IBIS KU ETH sensor is granted by ISED as a license exempt low power device, according to RSS-210 Issue 10, Annex B, B.11. Within the above mentioned limitation in terms of band and emitted power, IBIS KU ETH can be used in Canada, without any license.

For more information about licensing procedure contact IDS GeoRadar personnel.

ISED Statements:

. This device complies with Health Canada's Safety Code. The installer of this device should ensure that RF radiation is not emitted in excess of the Health Canada's requirement.

Information can be obtained at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php.

. Cet appareil est conforme avec Santé Canada Code de sécurité 6. Le programme d'installation de cet appareil doit s'assurer que les rayonnements RF n'est pas émis au-delà de l'exigence de Santé Canada. Les informations peuvent être obtenues: http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

. Les changements ou modifications non expressément approuvés par la partie responsable de la conformité pourraient annuler l'autorité de l'utilisateur à utiliser cet équipement.

. This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.

2. This device must accept any interference, including interference that may cause undesired operation of the device.

. L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;

2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

. Cet appareil est conforme aux limites d'exposition aux rayonnements de l'ISED pour un environnement non contrôlé. L'antenne doit être installée de façon à garder une distance minimale de 26 centimètres entre la source de rayonnements et votre corps.

Canadian Representative:

Company Name: Leica Geosystems Ltd

Company Number: 3177B

Company Address: 1-3761 Victoria Park Ave

City: Scarborough

Province/State: Ontario

Postal Code: M1W 3S2

Country: Canada

Contact Name: Sudha Sachdeva

Phone Number: +1 416 497 2463

Email: sudha.sachdeva@leicaus.com

1.1 Symbols

Warning messages are an essential part of the Safety Concept of the instrument. They appear wherever hazards or hazardous situations can occur.

**WARNING**

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**DANGER**

Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

**CAUTION**

Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.

Supplementary safety information may be placed as notice message with the symbol indicated below.



Note text/to keep in mind.

2. Hazard of use



NOTICE: Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

Precautions:

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.



NOTICE: Only IDS GeoRadar authorized technical service are entitled to repair this product.



DANGER

Improper use of the sensor can, unforeseen installation can create dangers if the user does not pay attention to the recommendations given in the user manual of the system in which the sensor is used

Precautions

Before carrying out any operation on the sensor, follow the instructions given in the user manual of the system to which it belongs.

DANGER

During the transport, unpackage or setup of the sensor on the system user must be aware of the dangers associated with the possible fall of the sensor

**Precautions**

Before carrying out any operation on the sensor, follow the instructions given in the user manual of the system to which it belongs.

DANGER

During surveys there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

**Precautions**

During operations, the user of the product must be fully aware of the existing dangers.

DANGER

IBIS KU ETH when operates emits non-ionizing radiations that can cause interference with implanted electrical or ferromagnetic devices (such as a pacemaker).



**DANGER**

The use of the sensor in explosive environments such as gassy mines is strictly forbidden. The non-ionizing radiations can interfere with devices such as detonators and cause explosions.

**DANGER**

During the maintenance of the system always switch off the system and disconnect it from the power source.

**DANGER**

Always perform the maintenance and regulation of the system with steady Acquisition Unit. Performing these operations with the system moving can cause hazards.

3. Product Components

IBIS KU ETH is basically a radar sensor with range distance measure capabilities and give the possibility, with interferometric technique, to measure the displacement information from the phase variation of the backscattered signals from the area of interest thanks to its phase stability. The IBIS KU ETH is the radiating element used in the following IDS Georadar products:

- IBIS ARCSAR
- IBIS FM EVO
- IBIS FS/FB

These products are particularly suitable for terrain and structural monitoring applications by a capability of measure slow displacement at an accuracy great as a tenth of a millimeter, the overall performance depends on the type of system in which the sensor is installed.

3.1 General description

The sensor is a yellow box present in two configurations depending on the destination product:

- Standard configuration (two antennas – 1 Transmitting antenna, 1 Receiving antenna)
- MIMO configuration with DEM KIT (four antennas – 2 Transmitting antenna, 2 Receiving antenna)



Fig. 1 – IBIS KU ETH sensor

The unit contain all the parts for the generation, transmission, reception and acquisition of the radar signal. It features the following interfaces:

- **1 - ETH RJ45 connector** on the rear of the box;
- **1 - 23 pole Male connector** to provide power and sync. On the rear of the box;
- **2 - waveguide WR62 (4 - in MIMO configuration)** for the antennas on the front of the box
- **4 - fixing point (M5)** on the bottom of the box
- **1 - central point** that it is used to fix the centering cylinder or the hexagonal head for the tripod

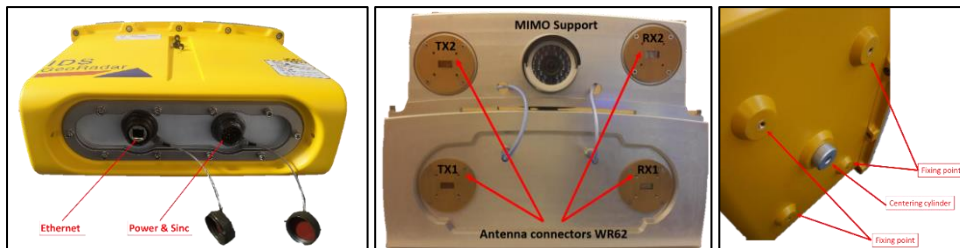


Fig. 2 - IBIS KU ETH rear, front and bottom view

The operations to be performed on the sensor for installation on the system will be:

- Fixing to the system using the appropriate fixing points
- Connection to the multipolar connector of the power and sync. cable present on the system
- Connection to the RJ45 Ethernet connector of the data cable present on the system

The sensors is delivered typically with antennas mounted, otherwise connect the antennas to the waveguides using appropriate screws.



Fig. 3 – Example of antennas with screw

The operations of installation must follow the procedures reported in the system user manual.

3.2 How the sensor is delivered

The sensor is delivered inside a peli case.



Fig. 4 – IBIS KU ETH case

4. Installation Procedure

**DANGER**

For the sensor installation procedure follow the instructions given in the system user manual

5. Switching the system ON/OFF



DANGER

Do not power the sensor with sources other than the systems supplied by IDSGeoradar. Follow the instructions given in the system user manual

6. Technical Specifications

6.1 Sensor specifications

Parameter	Value
Temperature range	-40 °C ÷ +55 °C
Encloser Class	IP65
Dimension	Standard version 40 cm x 17 cm x 29 cm MIMO version 40 cm x 28 cm x 29 cm
Weight	Standard version 11 Kg MIMO version 12 Kg
Input voltage range	12 V DC – 24 V DC
Power Consumption	Standard 27W MIMO 30W

Table 1 – Environmental specifications

Parameter	Value
Operating Range	50m – 5000m
RF operating band	EU:17.1 – 17.3 GHz USA: 17.1 – 17.3 GHz Canada: 17.1– 17.3 GHz
Emission bandwidth	EU/USA 200 MHz Canada 200 MHz
Maximum power at the antenna connector	It depends on the regulation and on the antenna installed
Antenna Type	Horn
Antenna Gain	See Table 3
Max Equivalent Isotropic Radiated Power (EIRP)	EU: 26 dBm USA: 36 dBm Canada: 24.7 dBm
Signal modulation	FMCW
Certifications	CE, FCC, ISED

Table 2 - IBIS KU ETH radio specifications.

6.2 Antenna specifications

The sensor mount horn antennas type. It is typically supplied with IBIS-ANT7-H50V31 antenna type but for particular applications it can mount different antenna types.

Antenna Type	Gain [dB]	Azimuth Beamwidth (-3dB)	Elevation Beamwidth (-3dB)
<i>IBIS-ANT1-H38V18</i>	15	38	18
<i>IBIS-ANT2-H29V25</i>	14	29	25
<i>IBIS-ANT3-H17V15</i>	19	17	15
<i>IBIS-ANT4-H11V10</i>	22	11	10
<i>IBIS-ANT5-H12V39</i>	18	12	39
<i>IBIS-ANT6-H51V20</i>	14	50	20
<i>IBIS-ANT7-H50V31</i>	13.5	50	31

Table 3 – IBIS KU ETH horn antennas.



Fig. 5 – IBIS-ANT7-H50V31 Antenna

7. Care and Transport

In the present section information for IBIS KU ETH system maintenance are provided. For further details please contact IDS GeoRadar Customer Care.

All maintenance operations need to be performed with the system stopped and disconnected from the power source. Different behavior can lead to injuries due to mechanical or electrical hazards. For each check refer to the system manual, however particular attention must be taken in verifying the following (but not limited to):

- Check that the sensor is well tightened to the system installation bracket
- Visually check the integrity of the antennas and the sensors case
- Visually check that all the connectors, are well fastened and intact.
- Visually check the integrity of all the cables and cable pins.

8. Disclaimer

1. Generals.

- i. The present Disclaimer applies to all products designed, produced and distributed by IDS GeoRadar s.r.l., its Subsidiaries, Affiliated and authorized Distributors (the "Products"). IDS GeoRadar s.r.l. reserves full ownership and intellectual property rights of any "Information" contained in this Disclaimer including Trade Marks and Graphics. No part of this Disclaimer may be used or reproduced in any forms without the prior written agreement of IDS GeoRadar s.r.l.
- ii. In the event that any provision of this Disclaimer may be invalid, unlawful or incapable of being enforced by a rule of law, all other provisions shall, nonetheless, remain in full force and effect. Failure to either enforce or exercise any right, privilege, or legal remedy at any time, any provision contained in this Disclaimer, shall not be deemed a waiver of such provisions or right, remedy, or privilege.
- iii. This Disclaimer shall be interpreted, governed, construed and enforced in accordance with the laws of Italy. User/Buyer hereby consents to the exclusive jurisdiction of Pisa.

2. Initial Precautions for Setting-up and Use of the Products.

- i. The User/Buyer, for setting-up and using the Products, shall consult the official documentation provided by IDS GeoRadar s.r.l. for the Products ("Reference Documentation") and carefully ascertain the compliance with national laws and requirements, which may limit or even forbid their use.
- ii. For Products which shall operate by circulation in Public Areas/Roads, with or without moving traffic, Buyer/User shall verify the approval of local authority and/or site's owner according to their specific procedures. IDS GeoRadar s.r.l. shall not be liable for any direct, indirect, special, incidental or consequential damages or injuries, including without limitation, lost revenues or lost profits, resulting by un-authorized use of the Products in Public Areas/Roads.
- iii. Buyer/User further warrants:
 - o that these Products are not being used, in the design, development, production or use of chemical, biological, nuclear ballistic weapons. Buyer/ User will defend, indemnify and hold IDS GeoRadar s.r.l. harmless against any liability (including attorney's fees) for non-compliance with the terms of this article.
 - o That, if IDS GeoRadar s.r.l. requires that Buyer/User shall carry out a training with reference to some Product categories, no operation or use of the Products shall be started before its designated Operator/s has got the User Certificate, as defined by IDS GeoRadar s.r.l. specific procedure which the Buyer confirms to know and accept.

- iv. For Products which include specific “Operational” software with automatic data processing and analysis “Tools”, e.g. the IBIS Products and Hydra Products, User shall be aware that the results provided by these “Tools” may be not error free. User that completely relies on the outcomes provided by these Tools only, does it at his own risk.
- v. In no event IDS GeoRadar s.r.l. shall be liable for special, direct, indirect, incidental, exemplary, punitive or consequential damages including, but not limited to, loss of profits or revenue, caused by the use of the Products, either separately or in combination with other products or relied upon the results provided by the above “Tools”.

3. Disclaimer for the “Use” of the Products.

- i. The User shall follow the instructions provided by IDS GeoRadar s.r.l. in its official “Reference Documentation” for the Product, in particular the User’s Technical Manual which contains all the specific steps and recommendations for a correct setting-up and use of the Product.
- ii. In no event IDS GeoRadar s.r.l. shall be liable for special, direct, indirect, incidental, exemplary, punitive or consequential damages including, but not limited to, loss of profits or revenue, caused by the missed or incomplete observance of the instructions and prescriptions for the use of the Products, either separately or in combination with other products, including but not limited to the following main aspects:
 - a. Use of IDS GeoRadar s.r.l. Products outside its limitation of use, without proper and adequate scientific/technical knowledge or without specific training.

- b. Use of results/outcomes of the measurements performed by the Product aimed to safety aspects without using adequate control procedures and assessment by skilled personnel.
- c. Opening of the Equipment (for HW Products) without express written authorization of IDS GeoRadar s.r.l.;
- d. Unauthorized changes and additions to the Products (i.e. the user is not authorized to replace the installed antennas without contacting the authorized personnel/manufacturer).
- e. Use of the Products connected to suspected non-working equipment or with equipment (mainly PC) having characteristics not in compliance with the required specifications of IDS GeoRadar s.r.l. not expressly authorized by IDS GeoRadar s.r.l.;
- f. Poor or faulty operation of the electrical and telecommunication networks not directly managed by IDS GeoRadar s.r.l. or its delegates.
- g. Poor or faulty operation Software/Hardware of the third parties connected with IDS GeoRadar s.r.l. Equipment.
- h. Poor or faulty operation of the Products due to Software Virus which infected the Products after their delivery.
- i. Use of the Products which have encountered suspected manumissions, accidents, electrostatic shocks, flashes, fire, earthquake, flooding or other natural disasters or unexpected events.
- j. Use or storage of the Products outside the limits of the "Operational Temperature Range" specified by IDS GeoRadar S.r.l.

4. Monitoring Products.

- i. IBIS and Hydra Products (the Monitoring Products”) use a leading-edge technology for monitoring slope movements and has proven as an effective tool for the early detection of critical movements, possibly leading to slope failures. Especially in situations where people and machinery are located or working in proximity of unstable slopes, the technology used by Monitoring Products, in addition to other suitable monitoring technologies, maximizes the probability of detecting early signs of slope failures, thus permitting the prompt evacuation of people and assets at risk.
- ii. Monitoring Products have been designed and developed to cope with very harsh environments. Should the system may become temporary unavailable due to an unexpected hardware failure, monitoring data will not be available until the instrument is repaired
- iii. Monitoring Products are a monitoring instrument that works like other monitoring instruments and cannot cause or prevent a collapse to happen. As a monitoring instrument, it helps professionals in providing measurements of movements of the monitored area, which according to the geological context can be interpreted as a sign of a potential collapse. Generally, the radar is also operated in conjunction with other monitoring instruments to have the largest information and for complementing pros and cons of each technology. The interpretation of data provided by the multiplicity of monitoring sensors has then the purpose of detecting movements that can be interpreted as precursors of a collapse.

- iv. Monitoring Products include specific “Operational” software with data processing which may give outcomes/results for helping User in the monitoring of “the stability conditions” of a specific area. We remind however that the setting of the alarm thresholds is uniquely an expert User’s responsibility and that this setting must be done according to the accurate knowledge of the particular geological context.
- v. Nevertheless, (even though the radar technology employed by Monitoring Products, is deemed among the most reliable for the monitoring of instable slopes) IDS GeoRadar s.r.l. has the obligation to remind the Users that the technology used by Monitoring Products transmits and receives an electromagnetic signal that by its nature is influenced by many factors such as: the parameters introduced by the User/s, the distance, the ground material, the surface roughness and the electromagnetic wave incidence, which may distort its outcomes, thus giving rise to false or missing alarms.
- vi. In particular the following aspects must be considered when working with Monitoring Products:
 - o Due to the very short time of activation and minimum deformation before a sudden rockfall event, it may be not always possible to generate proper alerts prior to the collapse.
 - o Even if the technology used provides state-of-the-art performance in terms of spatial resolution and accuracy of measurement, movements affecting portions of the slope below the radar resolution could go beyond the minimum detectable movement.

- Although the radar can measure differential displacements (between two successive acquisitions) with sub-millimeter precision it must be reminded that errors in the displacement measurement cumulate with the observation time and its effective value is dependent on many factors, such as reflectivity of the monitored surface, atmospheric variations etc.
- The technology used measures the displacement along the line of sight only. The number of radars to be installed and their locations must be then carefully chosen to reduce the presence of uncovered or not properly covered areas (e.g. movement vectors occurring perpendicularly or close to a perpendicular to the line of sight).
- Monitoring Products measure the relative line of sight displacement between the radar and the monitored surface. In case the radar is installed on an unstable location, the movement of the radar setup could be interpreted as deformation of the monitored surface.
- The accuracy of the Monitoring Products in deformation measurement is dependent on the strength of the signal reflected back by the variable ground surface; performance cannot be uniform on the entire monitored scenario; e.g. some areas may not produce a signal strong enough to enable a proper early detection of collapses. Particularly, the radar signal can be affected by the presence of vegetation on the slope.
- Movement of portions of terrain which are (or are close to) perpendicularly oriented with respect to the radar line of sight, could be underestimated or, even, undetected.

- The propagation of electromagnetic signals generated by the radar, is affected by atmospheric conditions along the travel path. IDS GeoRadar Radar technology incorporates state-of-the-art algorithms for the correction of those atmospheric-induced variations. However, modeling of real phenomena (like atmospheric variations) always leads to an approximation of real-world physics, which in some circumstances may introduce spurious data, thus limiting the radar performance.
- Due to the complex physics of electromagnetic wave propagation some slope scenarios could generate multiple reflections of radar waves which cannot be totally predicted or detected. In these circumstances a proper evaluation by radar expert may be necessary to assess the origin of the interference. Furthermore, the proper alarming on impending slope failures relies on the selection of hazard thresholds, which must be done by skilled and properly trained operators. The selection of the thresholds is solely an User's responsibility and must be based on geotechnical considerations, risk evaluation, in-situ operational procedures and, possibly, on the past records of the slope's movement. As such, the procedure is not inherently able to predict new, unprecedented movement behaviors that could happen in the future and that can result in missing alarms. Therefore, when Monitoring Products are used in critical monitoring for safety purposes, like real time monitoring of unstable slopes, User must be aware that the the assessment of the stability conditions of the observed targets must be tasked to skilled and certified operator/s able to understand data supplied by either Monitoring Products or other equipment employed to such purpose; only operators officially trained and regularly updated by IDS GeoRadar S.r.l. (holding an "User Certificate" thereof) are allowed to use Monitoring Products. IDS GeoRadar S.r.l.

assumes no liability for any direct, indirect special, incidental or consequential damages or injuries caused by such reliance or for the use of Monitoring Products by Users not holding an "User Certificate" issued by IDS GeoRadar S.r.l. Any Buyer or User that completely relies on information obtained from the automated data processing/analysis tools only does so at his own risk and, in the event that Monitoring Products have been purchased by User, possible damages caused to Monitoring Products during operations performed by not-certified operators are not covered by the applicable Warranty Terms in force.

- Machinery, such as trucks, shovel etc., standing along the radar line of sight will mask portions of the scenario or produce spurious effects that may generate false alarms. Monitoring Products performance for those zones in those situations could be partly or totally affected, so that detection of movements may be reduced or even impossible.

9. CUSTOMER SUPPORT

For questions please, feel free to contact our Customer Support Service at the following e-mail address:

GEO BU Customer Care: support.geo@idsgeoradar.com

MIN BU Customer Care: support.mining@idsgeoradar.com



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A. Appendix A

In this appendix the datasheet of TX and RX antennas are reported. In particular the Elevation and Azimuth patterns are shown for ANT1-ANT2-ANT3-ANT4-ANT7 Antennas.

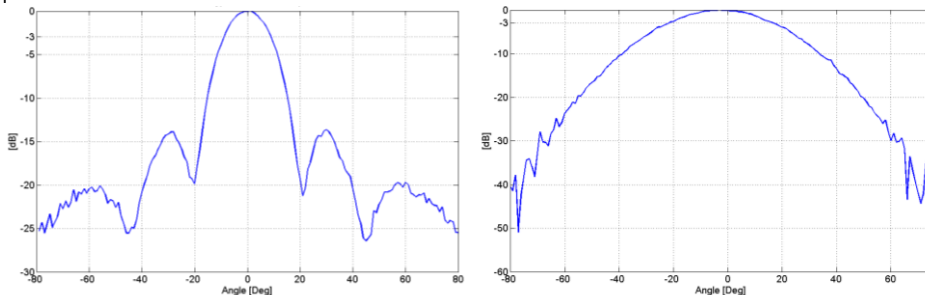


Figure A – Elevation and Azimuth ANT1 Pattern

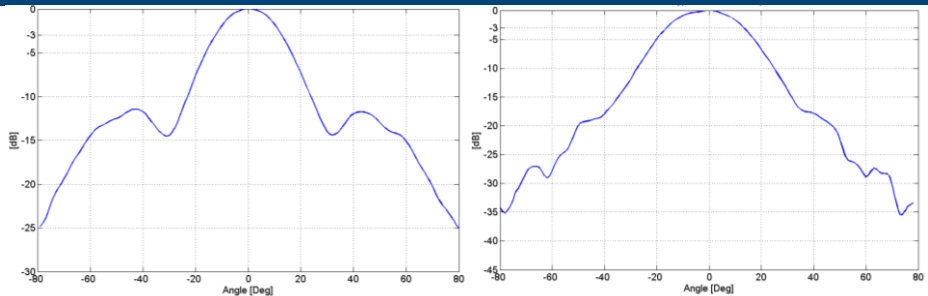


Figure B – Elevation and Azimuth ANT2 Pattern

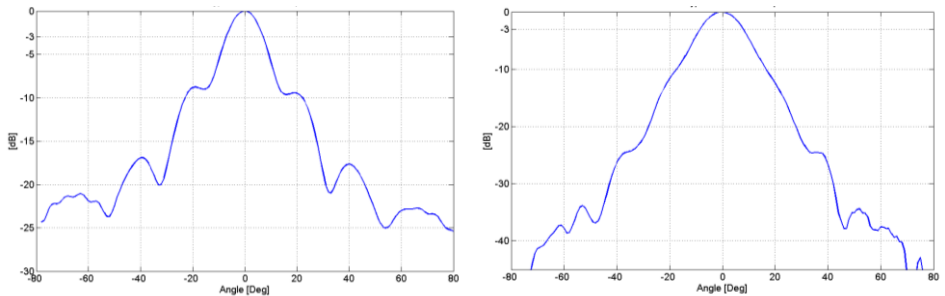


Figure C – Elevation and Azimuth ANT3 Pattern

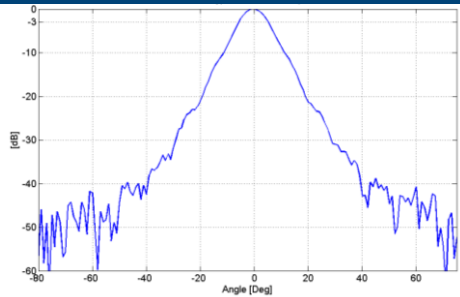
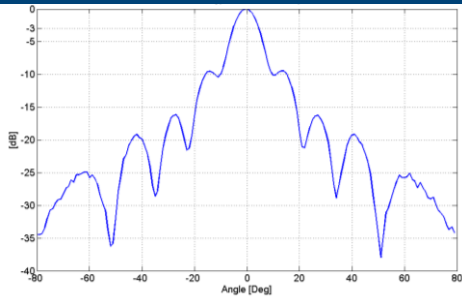


Figure D – Elevation and Azimuth ANT4 Pattern

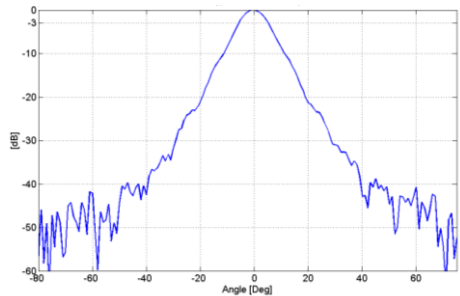
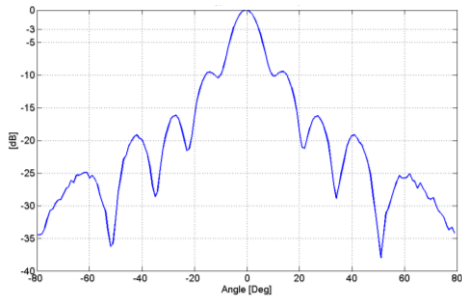


Figure E – Elevation and Azimuth ANT4 Pattern

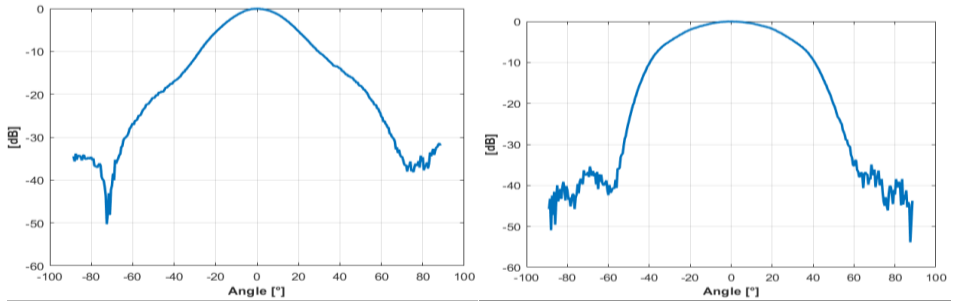


Figure F – Elevation and Azimuth ANT7 Pattern