

*Rev. 1.1*

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*Config.: IBIS-S-PRCS-OUT-MN*

# ***IBIS-S System***

## **IMAGE BY INTERFEROMETRIC SURVEY**

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## ***IBIS-S v. 1.0 - User Manual***

*Pisa, June 2010*

**KEY WORDS**      IBIS-S, INTERFEROMETER, INSTALLATION

**SUMMARY**      IBIS-S system user manual. This document illustrates the contents of the package and the procedures the operator must perform to set up and dismantle the IBIS-S system.

<i>Document Evolution</i>		
<i>Revision</i>	<i>Date</i>	<i>Reason for change</i>
Rev. 1.0	October 2009	First Edition with Battery information (according to DL 188 dated 20/11/2008)
Rev. 1.1	June 2010	Document revision for declarations for US and Canada (see RNC 201005097)

<i>Document change record</i>		
<i>RNC</i>	<i>References</i>	<i>Change description</i>
201005097	Before index	Declarations for US and Canadian customers

<i>HW and SW versions covered by this document</i>
IBIS-S apparatus v. 1.0.

<i>Warnings</i>
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We,

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via Livornese, 1019, 56122 PISA (loc. S. Piero a Grado), ITALY

declare under our sole responsibility that the product

Short Range Device  
Model No(s): **IBIS-S Ku band**

To which this declaration relates is in conformity with the following standard(s) or other normative document(s)

Test	Standard
Radiated Emissions	ETSI EN 301 489-3 V.1.4.1 ETSI EN 301 489-01 V.1.6.1
Radiated Susceptibility	ETSI EN 301 489-3 V.1.4.1 ETSI EN 301 489-01 V.1.6.1
Electrostatic discharges (ESD)	ETSI EN 301 489-3 V.1.4.1 ETSI EN 301 489-01 V.1.6.1
Radio Requirements	ETSI EN 300.440-1 V.1.4.1 ETSI EN 300.440-2 V.1.2.1
Safety	CEI EN 60950-1:2004

Following the provisions of EC Council Directive(s) including the latest amendments and of the national legislation implementing these directives:

*1999/05/EEC R&TTE Directive*

Notified Body 0648 has been involved during the conformity assessment procedure and issued a positive Statement of Opinion. The product will be marked with the symbol **CE 0648**.

Issued on: 2008, November the 20<sup>th</sup>

Signed by the manufacturer

Franco Bardelli:

Chief Executive Officer

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Model No(s): **IBIS-S X band**

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Test	Standard
Radiated Emissions	ETSI EN 301 489-3 V.1.4.1 ETSI EN 301 489-01 V.1.6.1
Radiated Susceptibility	ETSI EN 301 489-3 V.1.4.1 ETSI EN 301 489-01 V.1.6.1
Electrostatic discharges (ESD)	ETSI EN 301 489-3 V.1.4.1 ETSI EN 301 489-01 V.1.6.1
Radio Requirements	ETSI EN 300.440-1 V.1.4.1 ETSI EN 300.440-2 V.1.2.1
Safety	CEI EN 60950-1:2004

Following the provisions of EC Council Directive(s) including the latest amendments and of the national legislation implementing these directives:

*1999/05/EEC R&TTE Directive*

Issued on: 2009, January the 30<sup>th</sup>

Signed by the manufacturer

Franco Bardelli:

Chief Executive Officer

Warning: 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 be required to operate while taking appropriate countermeasures.

The apparatus is sensitive to the presence of external electromagnetic fields, which may reduce its performance.

### IMPORTANT NOTE FOR THE US CUSTOMERS

Model No.: **IBIS-KU**

FCC ID: **UFW-IBIS-KU**

This device complies with part 90 of the FCC Rules.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum 20 cm between the radiator and your body. This transmitter must not be collocated or operating in conjunction with any other antenna or transmitter unless authorized to do so by the FCC.



### IMPORTANT NOTE FOR THE CANADIAN CUSTOMERS

Model No.: **IBIS-KU**

IC ID: **8991A-IBISKU**

This device has been designed to operate with the antennas listed below, and having a maximum gain of 22 dB. Antennas not included in this list or having a gain greater than 22 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

IBIS-ANT1-H38V18

IBIS-ANT2-H29V25

IBIS-ANT3-H17V15

IBIS-ANT4-H11V10

IBIS-ANT5-H12V39

IBIS-ANT6-H51V20

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.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.





## CLEANING INFORMATION

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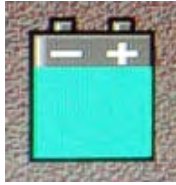
Before cleaning any external parts of the apparatus, make sure that all cables have been disconnected, including the power supply cable. If a damp cloth is used, make sure it is not too wet, to avoid any damage to the electrical components of the equipment. Wait until the equipment is totally dry before reconnecting the cables.

The IBIS-S should be cleaned periodically using a damp cloth.

Do not use solvents or abrasive detergents.

Do not apply liquid directly to the electrical contacts of the various connectors. If a specific spray is used to clean the PC TFT monitor, make sure it is not flammable; in any case, do not spray it directly on the screen, instead, spray it onto the cleaning cloth.





## BATTERIES REMOVAL INFORMATION

**NOTE:** Batteries must be recycled according to national regulations. Read carefully the warnings and information on the batteries.



### **Laptop Batteries:**

Manufacturer: PANASONIC

Type: Li-ion Ni

Characteristics: 10.65V 5.7Ah

Removal instructions:

1. turn off the laptop;
2. open the drawer marked with the battery symbol;
3. extract the battery pack by pulling the tab.



### **Radar batteries:**

Manufacturer: FIAMM FG21202

Type: rechargeable lead acid, non spillable batteries

Characteristics: 12V & 12Ah

Removal instructions:

1. disconnect the battery from the instrument:
  - a. pull the connector wings;
  - b. separate the connectors;
2. remove the battery from the cover (optional) by opening the strap.





## RECICLYING

The crossed out wheeled bin symbol shown on the equipment indicates that the product must be recycled separately from other waste at the end of its useful life.

Separate waste disposal of this product at the end of its useful life will be organised and managed by IDS. When you decide to dispose of the equipment, contact IDS and follow the system that IDS has set up to permit the separate collection of the apparatus at its life end.

Adequate separate collection for its subsequent recycling, treatment and environmental friendly disposal contribute towards avoiding any unnecessary effects on the environment and to health and favour the reuse or recycling of the materials that make up the equipment. Unauthorised disposal of this product as unsorted waste by its possessor will lead to an administrative penalty foreseen by national regulations.

## **WARRANTY CERTIFICATE CONDITIONS**

- 1) IDS Ingegneria dei Sistemi S.p.A, hereinafter referred to as IDS, warrants hardware/software products for a period of 12 months from the delivery date to the original customer;
- 2) The delivery date is certified by the “Warranty Registration Form”;
- 3) IDS’s hardware products will be free from defects in materials workmanship under normal use and service;
- 4) IDS’s obligation is limited to repairing or replacing parts or equipment which are returned to IDS, without alteration or further damage, and which in IDS s judgment, were defective or became defective during normal use;
- 5) IDS’ software will have to be installed on a PC according to the requirement of the IDS hardware ( see IDS User’s Guide the Software Data Acquisition);
- 6) IDS’ s software products designed by IDS for use for IDS hardware products are warranted not to fail to execute their programming instructions due to defects during the warranty period, provided they are properly installed on IDS hardware products. IDS does not warrant if the IDS software will be used and operated in hardware and software combinations not selected by IDS;
- 7) IDS does not assumes any liability for any direct, indirect, special, incidental or consequential damages or injuries caused by proper or improper operation of its equipment whether defective or not defective;
- 8) This software may include automated data processing and analysis tools. While every effort is made to ensure the accuracy of the information provided by those tools, they must not be intended as a substitute for intelligent analysis; rather, they have to be intended as an advisor and the user must not completely rely on the results provided by them to give the complete answer. IDS assumes no liability for any direct, indirect special, incidental or consequential damages or injuries caused by such reliance on the accuracy, reliability, or timeliness of the information provided by those tools. Any person or entity who relies on information obtained from the automated data processing/analysis tools only, does so at his or her own risk;
- 9) IDS’s warranty does not extend and shall not apply to:
  - a) Products which have been repaired or altered by other than IDS personnel;
  - b) Products which have been subjected to misuse, neglect, accident or improper installation;
  - c) Products in which have been installed Hardware/Software accessories not supplied by IDS and/or without any approval by IDS;
  - d) Products which have been connected to equipment different from the ones supplied by IDS (except the PC data Logger which must conform to IDS specifications;
  - e) Products which have been damaged by natural disaster or calamities.
- 10) Before returning any equipment to IDS , you have to contact the IDS Customer Care Office that will authorize you to return the material to be repaired;
- 11) Once the parts/equipment to be repaired arrive to IDS, IDS may inspect the defective products to verify they are eligible for repair or replacement. All packing must be saved for inspection purpose in order to assist IDS to understand the cause of the defects. IDS, will not be obliged to repair, or replace for products returned as defective but damaged from abuse, misuse, negligence , accident loss or damage in transit;
- 12) The final clients, is responsible for ensuring the defective products returned to be properly packaged;
- 13) The above warranty are sole and exclusive, and no other warranty, whether written or oral, is expressed or implied.

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## **1. INTRODUCTION**

This document provides an introduction to the IBIS-S system (Image By Interferometric Survey-S), with particular reference to the concepts the user must learn before starting to use this device. Therefore we recommend that you read the entire document before starting the system.

If technical assistance is required, please use the contact numbers provided on page 3 of this manual.

### **1.1 Scope**

This document will provide the operator with all the necessary knowledge to install and maintain the IBIS-L system. In particular, the manual describes:

- The contents of the cases;
- The procedure for installing and dismantling the system;
- Information for the safe use of the system.

### **1.2 Field of application**

This document applies to the installation and dismantling of the of the IBIS system in S configuration and its use in the field for monitoring quasi static or dynamic phenomena.

### **1.3 Authorisation for use – national restriction**

#### *European countries*

IBIS-S system has been classified by the CEPT Administrations as SRD – Short Range Device - i.e. a device that doesn't cause interference to other systems operating in the same frequency band. IBIS-S has so been included in the ERC/REC 70-03 which defines the SRD equipment.

#### *For Ku band system*

While the European countries update their national frequency allocation table applying the new recommendations, currently the use of IBIS-S system outside a laboratory can still be subject to authorisation by the Competent Ministry of the country where the system will be used. Please refer to the country's Competent Ministry to know whether there is the need of an authorisation.

#### *For X band system*

Almost all the European countries have applied the ERC/REC 70-03 for the X band system. Please refer to the Competent Ministry of the country where the system will be used to know if there are limitations in the use of X band IBIS-S equipment.

## ***1.4 CE Marking***

This equipment is in compliance with the essential requirements and other relevant provisions of the Directive 1999/5/EC.

**CE 0648** 

The full Declaration of Conformity can be found either on the CD or a separate document included with this product.

This is a Class A product. In a domestic environment it may cause radio interference, in which case the user may be required to take adequate measures.

## ***1.5 Acronyms***

**IBIS-S:** Image By Interferometric Survey - S;

**SF-CW:** Stepped Frequency - Continuous Wave.



## **2. OVERVIEW**

### **2.1 How to use this manual**

This manual consists of the following chapters:

- Chapter 3 - contents of the cases
- Chapter 4 - IBIS-S system hardware configuration
- Chapter 5 - IBIS-S system installation and dismantling procedure
- Chapter 6 - Useful Tips
- Appendix A - Restrictions
- Appendix B - Technical Specifications
- Appendix C - Elements of Radar Technology

### **2.2 General description of the IBIS-S system**

The IBIS-S system is designed to remotely measure displacements with a sampling frequency up to 200 Hz with an accuracy as fine as a hundredth of a millimetre.

The performance of the IBIS-S system depends on the type of configuration used and on the operative measurement conditions; however, the best performance characteristics can be defined as follows:

- Maximum operational distance: 1000 m;
- Maximum image resolution in distance: 75 cm;
- Accuracy in measuring displacements in the viewing direction: 0.01 mm;

The time required for instrument installation is about 20 minutes, and the same time is required for its dismantling.

The instrument has been specifically designed for outdoor use and is equipped with IP65 level protection and is supplied with a notebook PC specifically designed for outdoor use in extreme conditions.

The IBIS-S system offers the following advantages over currently available monitoring systems (GPS, extensometers, accelerometers ):

- remote monitoring without the need to access the structure to be monitored
- Resolution of 0.75 m which permits IBIS-S to identify a large number of “virtual displacement sensors” on the area under investigation, simply by remotely targeting the scenario;
- Acquisition frequency of the entire measurement area up to 200Hz;
- Directly measure the displacements in real time: IBIS-S can process acquired data and display the displacement of a point selected from the scenario in real time. This IBIS-S characteristic permits the monitoring of damaged structures with real time generation of alarm signals in case of collapse danger;

- Displacement measurement accuracy up to 1/100 of a millimetre: the interferometer technique permits IBIS-S to measure movements with a high degree of accuracy and precision, never seen before in a remote monitoring system;
- Quick to install;
- Functioning conditions suitable for long term monitoring :
  - Automatic functioning (presence of an operator not necessary while functioning);
  - Can operate night and day;
  - Can operate in any weather conditions;

The IBIS-S system is particularly suitable for all applications where it is important to measure displacements of a structure without the need to have direct access to it , or when short investigations must be performed quickly.

By performing long range measurements, without the need for direct contact with the structure to be monitored, IBIS-S permits measurements to be performed even when:

- The area of interest is not accessible;
- The structure is very tall such as a large antenna or a tower;
- The structure is covered by paintings or sculptures and it is not feasible to perform contact monitoring.

In addition, in emergency situations when monitoring activities are required to guarantee safety, the possibility of performing remote monitoring may be an essential condition towards saving lives.



**Fig. 2.1 – IBIS-S**

### **3. PACK CONTENTS**

The packing cases contain the following items:

**Tripod Bag:** Black shoulder bag with tripod inside: size 20x20x80cm, total weight 6Kg., (see Tab. 3.1).



**Fig. 3.1 – Tripod bag**

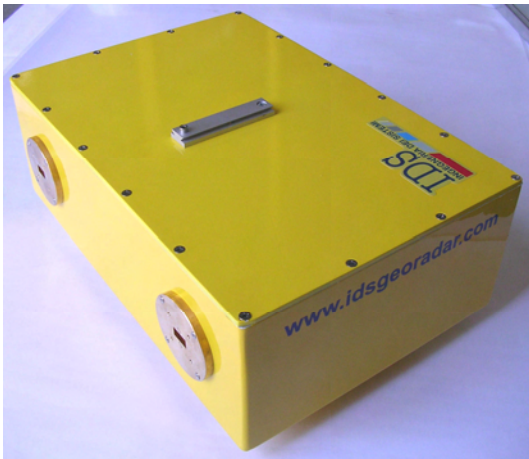


	<p>N°1 tripod</p>
--	-------------------

**Tab. 3.1 – Tripod bag contents**





**IBIS-S case:** Black trolley containing material listed in Tab. 3.2: size 55x30x80 cm, weight 40 kg.



**Fig. 3.2 – IBIS-S case**

	
	N°1 IBIS sensor
	N°1 Optical telescope

	<p>N°1 pair of antennas with four fixing screws for each</p>
	<p>N°1 USB cable to connect IBIS-S sensor to the computer (length: 3m).</p>
	<p>N°1 power cable used to connect IBIS-S sensor with the battery (length: 3m).</p>
	<p>N°1 three axial support for IBIS-S sensor</p>
	<p>N°1 PC PANASONIC CF19 (the original package with warranties and software licences is provided separately)</p>

	<p>N°2 12V batteries with one yellow bag each</p>
	<p>N°1 battery charger</p>
	<p>N°1 PC power supplier from electrical network</p>
	<p>N°1 PC power supplier from batteries</p>
	<p>N°1 IBIS-S user manual N°1 IBIS-S Controller manual</p>

**Tab. 3.2 – IBIS-S case content**

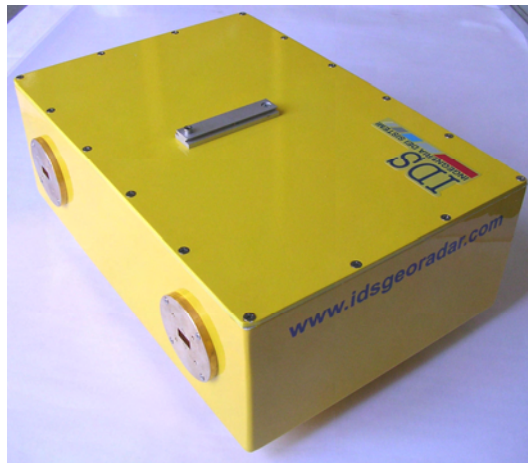
## **4. IBIS-S SYSTEM HARDWARE CONFIGURATION**

IBIS-S components description is provided in this section of the manual:

- Cap.4.1 IBIS-S sensor;
- Cap.4.2 IBIS antennas;
- Cap.4.3 control and acquisition PC;
- Cap.0 power supply batteries IBIS-BAT;
- Cap.4.5 power supply cables kit IBIS-C KIT;
- Cap.4.6 tripod (IBIS-TR) and three axial head(IBIS-H3).

### **4.1 IBIS-S Sensor**

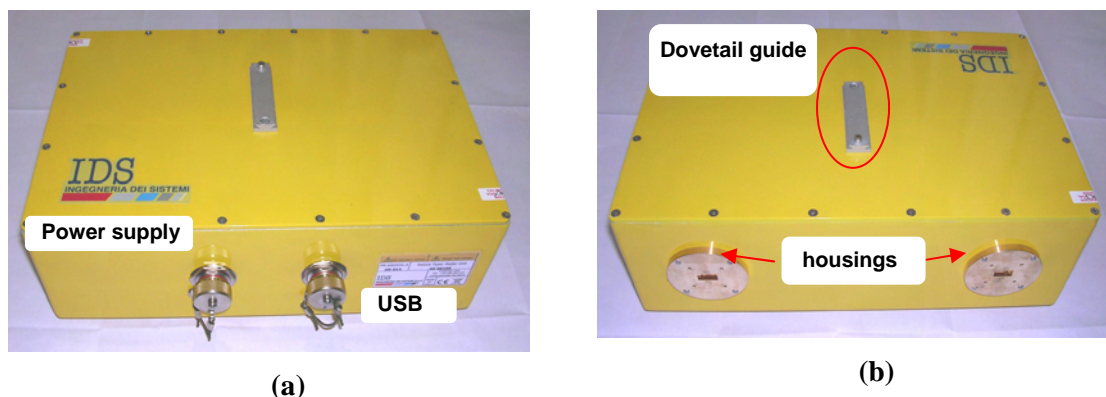
The IBIS-S sensor is the unit containing all the parts for the generation, transmission, reception and acquisition of the radar signal. The sensor (see Fig. 4.1) is a yellow box having 375x270x115 mm dimensions.



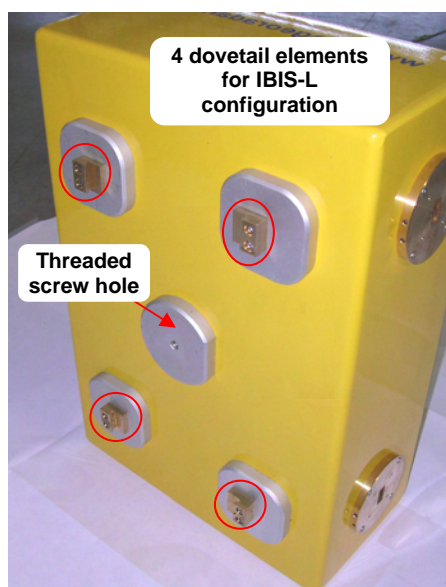
**Fig. 4.1 – IBIS-S sensor**

It features the following interfaces (see Fig. 4.2 and Fig. 4.3):

- **1 type A USB Female connector** on the rear of the box;
- **1 12 pole Male connector** to provide power on the rear of the box;
- **2 housings** for the antennas on the front of the box.
- **1 dovetail guide** to be used to fix the optical telescope to the sensor (see par.5.2) on the top of the box;
- **1 threaded screw hole** to permit the sensor to be fitted onto the tripod (see par. 5.2) on the bottom of the box;
- **4 dovetail elements** to permit the sensor to be fitted onto the pointing system positioning module (for IBIS-L configuration).



**Fig. 4.2 – Rear (a) and front (b) view of IBIS-S sensor**



**Fig. 4.3 – Bottom view IBIS-S sensor**

## **4.2 Antennas**

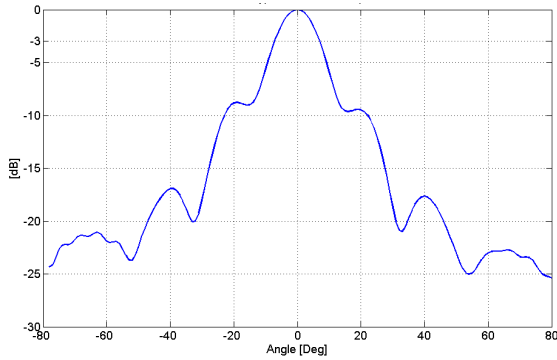
### **4.2.1 Ku band system antennas**

The Ku band IBIS-S system is provided with two identical IBIS-H20 antennas operating in vertical polarisation and characterised by a maximum gain of 20dBi. The amplitude characteristics of the antenna main lobe at -3 dB and -10 dB are provided in Tab. 4-1 and its vertical and horizontal patterns are shown in Fig. 4.4 and Fig. 4.5. For further details see appendix 6.2C.1 - .

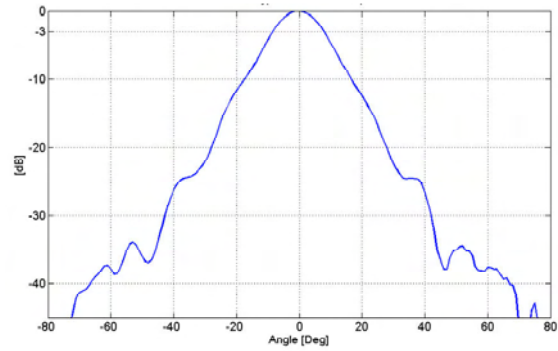


IBIS-H20	HORIZONTAL PLANE	VERTICAL PLANE
-3 dB	17°	15°
-10 dB	34°	45°

**Tab. 4-1 – Width of the main lobes of the IBIS-H20 antennas at -3 dB and -10 dB**

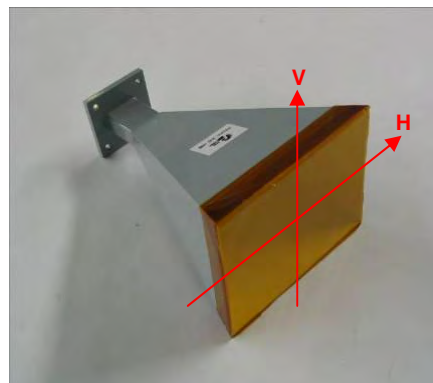


**Fig. 4.4 – IBIS-H20 vertical plane pattern**



**Fig. 4.5 – IBIS-H20 horizontal plane pattern**

The sensor is fitted with two flanges, each with four filleted holes for the installation of the pair of antennas (see paragraph 5.2).



**Fig. 4.6 – IBIS-H20 antenna**

If desired as an optional or a substitution, the IBIS-H20 antennas can be replaced by a pair of three other antennas whose characteristics are reported below:

IBIS-H23 antennas (Type 1) having the following characteristics:

- Maximum gain of 23.5 dBi;
- Horizontal antenna beam width at -3dB: 11deg.
- Vertical antenna beam width at -3dB: 10deg.

IBIS-H15 antennas (Type 3) having the following characteristics:

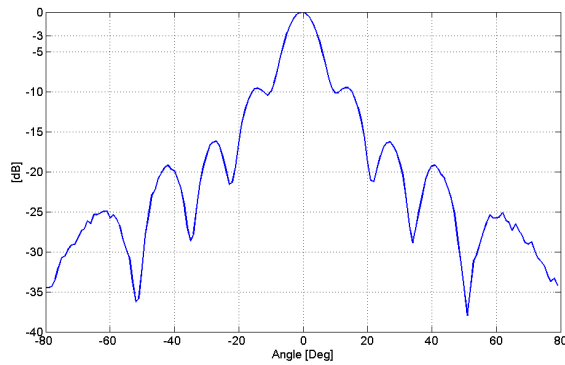
- Maximum gain of 15 dBi;
- Horizontal antenna beam width at -3dB: 29deg.

- Vertical antenna beam width at -3dB: 25deg.

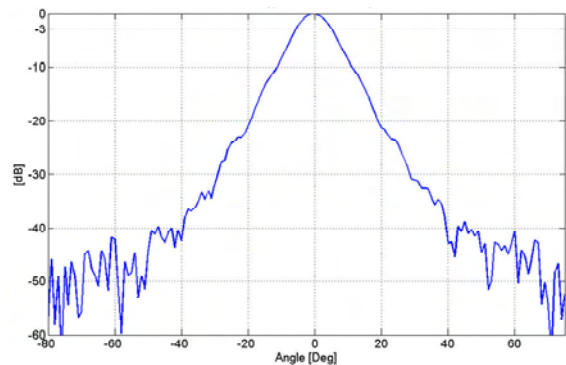
IBIS-H13 antennas (Type 4) having the following characteristics:

- Maximum gain of 13.5 dBi;
- Horizontal antenna beam width at -3dB: 38deg.
- Vertical antenna beam width at -3dB: 18deg.

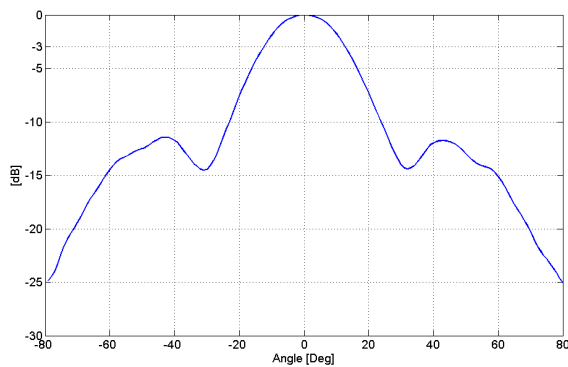
Figure from Fig. 4.7 to Fig. 4.12 show the vertical and horizontal patterns of antenna Type 1, 3 and 4 and Tab. 4-2 summarizes the information for the all four antenna types.



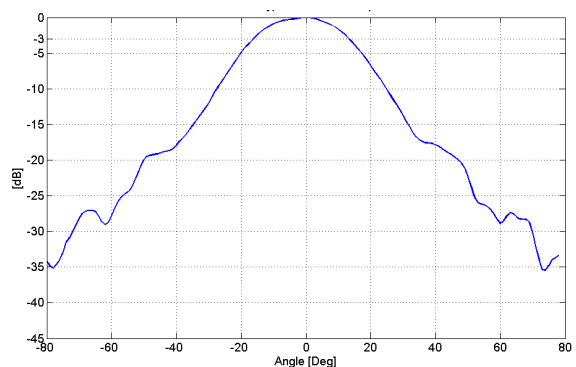
**Fig. 4.7 – IBIS-H23 vertical plane pattern**



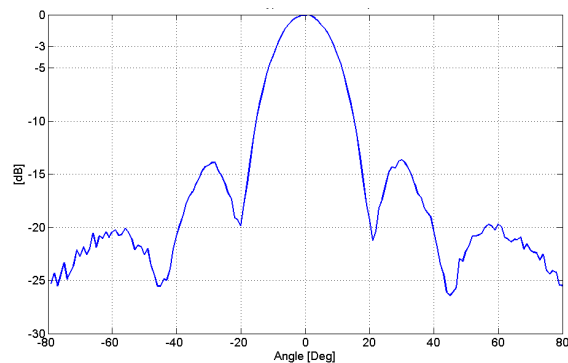
**Fig. 4.8 – IBIS-H15 horizontal plane pattern**



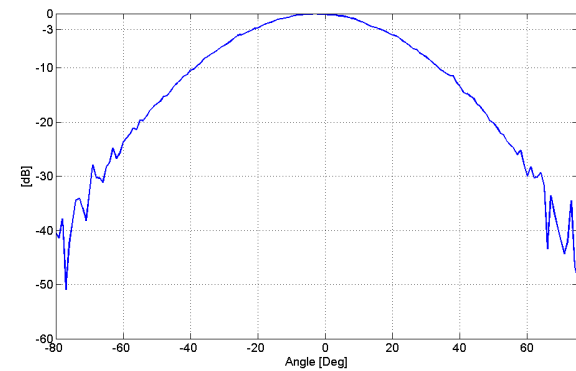
**Fig. 4.9 – IBIS-H15 vertical plane pattern**



**Fig. 4.10 – IBIS-H15 horizontal plane pattern**



**Fig. 4.11 – IBIS-H13 vertical plane pattern**



**Fig. 4.12 – IBIS-H13 horizontal plane pattern**

Antenna Type	Gain	Elevation	Azimuth
	[dBi]	[deg]	[deg]
<b>1 - IBIS-H23</b>			
-3 dB azimuth beamwidth	23,5	10	11
-10 dB azimuth beamwidth		30	23
<b>2 - IBISH20</b>			
-3 dB azimuth beamwidth	20	15	17
-10 dB azimuth beamwidth		45	34
<b>3 - IBIS-H15</b>			
-3 dB azimuth beamwidth	15	25	29
-10 dB azimuth beamwidth		49	53
<b>4 - IBISH13</b>			
-3 dB azimuth beamwidth	13,5	18	38
-10 dB azimuth beamwidth		30	70

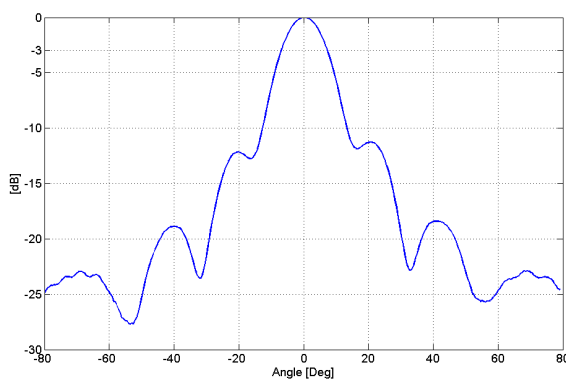
**Tab. 4-2 – Ku band Antennas characteristics**

#### 4.2.2 X band system antennas

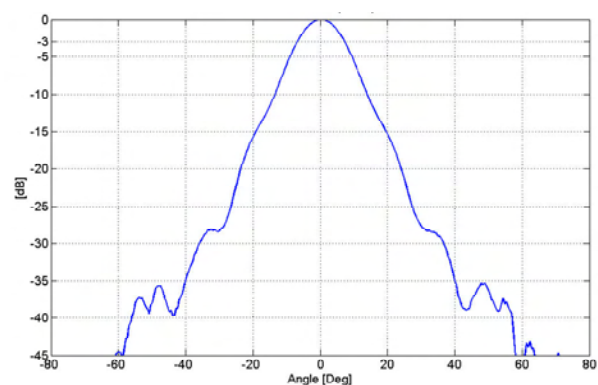
The X band IBIS-S system is provided with two identical antennas operating in vertical polarisation and characterised by a maximum gain of 21dBi. The amplitude characteristics of the antenna main lobe at -3 dB and -10 dB are provided in Tab. 4-3 and its vertical and horizontal patterns are shown in Fig. 4.13 and Fig. 4.14. For further details see appendix 6.2C.1 - .

X band antenna	HORIZONTAL PLANE	VERTICAL PLANE
-3 dB	15°	15°
-10 dB	27°	25°

**Tab. 4-3 – Width of the main lobes of the X band antennas at -3 dB and -10 dB**



**Fig. 4.13 – X band antenna vertical plane pattern**



**Fig. 4.14 – X band antenna horizontal plane pattern**

The sensor is fitted with two flanges, each with four filleted holes for the installation of the pair of antennas (see paragraph 5.2).

### **4.3 Control and acquisition PC**

The IBIS-S system is supplied with a notebook PC, model PANASONIC CF-19 (see Fig. 4.15). It contains the operative system windows XP and the pre-installed control and data acquisition software **IBIS-S Controller v. 02.01.004**.



**Fig. 4.15 – PC Panasonic CF-19**

Characteristics of the supplied model are:

- **Intel Core Duo Processor U2400;**
- 100 Mb/s Ethernet card;
- **RAM 512 MB** memory ;
- max monitor resolution 1024x768 pixels;
- max number of colours 16 777 216 colours;
- **Windows XP Professional** operative system;
- HDD 80 GB, shock-proof (mounted on gel support or equivalent);
- Protection from atmospheric agents (conforms with IP54);
- No communication software such as Firewall, WiFi or antivirus must be installed to avoid any conflict with the **IBIS-S Controller** software.



**NOTA:** IDS takes no responsibility for malfunctioning if there is a functional conflict between its software and any software installed on the notebook PC by the user. IDS does not guarantee that the performance of its equipment will be maintained using a configuration different to that recommended.

The notebook is supplied with a network power supplier (220V) and a battery power supplier (12V). The latter permits to supply the notebook using the battery or the 12V plug of a car.

#### **4.4 Batteries**

IBIS-S is provided with two 12Vdc batteries and with one battery charger that can recharge a battery in about 6 hours.

The batteries can be used contemporarily:

- One to supply IBIS-S sensor;
- The other to supply the notebook using the battery power supplier.

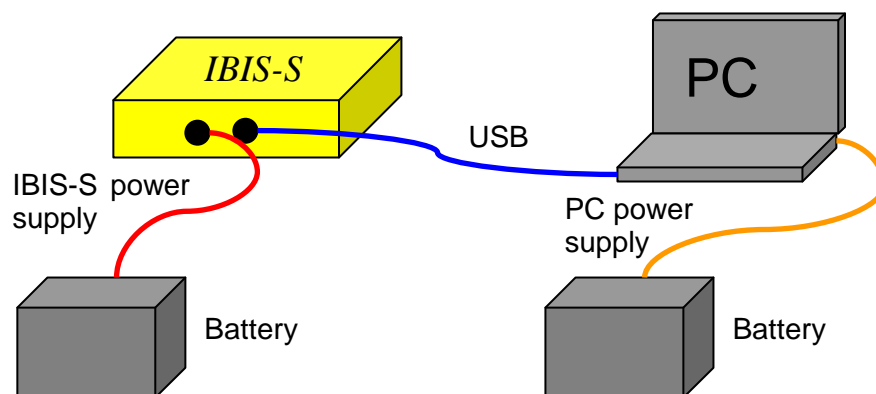
In both cases one battery lasts about 4 hours..

#### **4.5 Connection cable kit IBIS-CS KIT**

The IBIS-CS KIT includes:

- A 3 m long USB cable to connect IBIS-S sensor to the notebook;
- A 3 m long power supply cable to connect IBIS-S sensor to the battery;
- Two power supply cable for the notebook:
  - One to supply it with the battery (12 V);
  - The other to supply it with the network (220 V 50 Hz).

Fig. 4.16 shows the connections scheme.



**Fig. 4.16 – Connections scheme**

## ***4.6 Tripod and three axial head***

The IBIS-S standing device is composed of a tripod and a head with three rotational axes. The IBIS-S sensor stands fixed on the triaxial head which is screwed on the tripod providing stable support on the ground.

The triaxial head permits the operator to change the IBIS-S sensor pointing, simply acting on the axes blocking levers.

The tripod characteristics are listed below:

- weight: 4,3kg;
- minimum height: 43cm;
- maximum height: 188cm

Triaxial head characteristics are listed below:

- weight: 1,9 kg;
- azimuth allowable rotation: 360°;
- elevation allowable rotation: from -25 deg to + 90 deg;
- lateral rotation: from -30 deg to +90 deg.

## **5. IBIS-S INSTALLATION AND DISMANTLING PROCEDURE**

The IBIS-S system has been designed to be fast and simple to install. The complete procedure takes about 20 minutes to have the instrument ready for operation. The same time is required to dismantle it.

The following section describes all the material required (Para. 5.1) and the steps to follow to correctly install (Para. 5.2) and dismantle(Para. 5.3) IBIS-S.

### **5.1 Material required**

The material required for installation includes:

- IBIS-S case;
- Bag containing tripod;
- Small tapered cross slot screwdriver (not supplied).

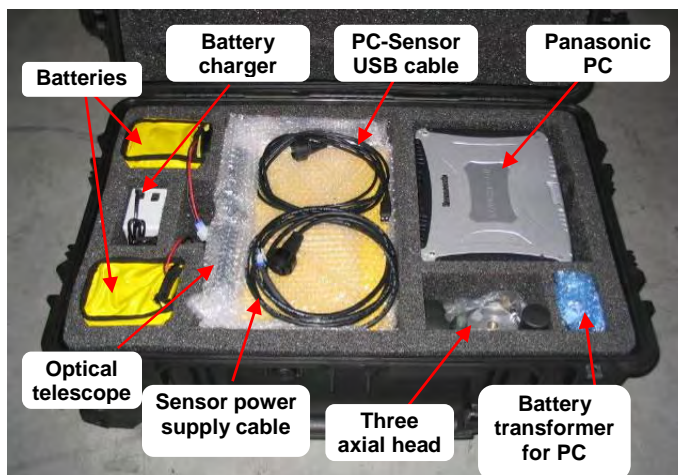
Proceed as follows to remove the various parts from the case:

1. sit the IBIS-S case on the ground;



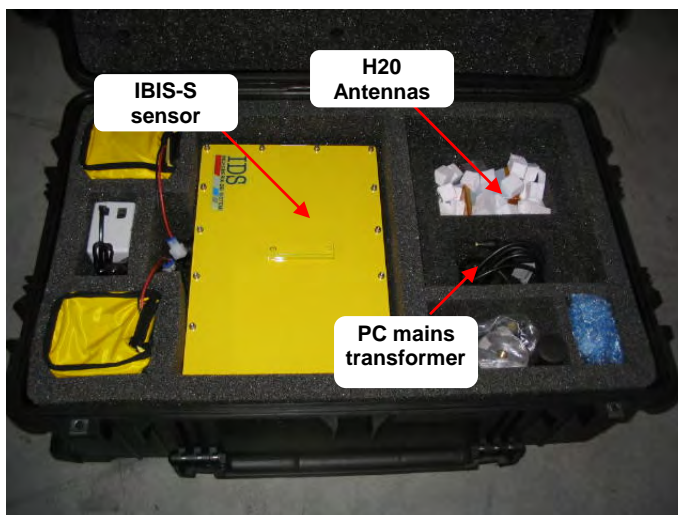
**Fig. 5.1 – The IBIS-S case**

2. open the 7 catches around the IBIS-S case and lift the lid;
3. after removing the protective layer, you will see:
  - a. 2 batteries;
  - b. 1 battery charger;
  - c. 1 three axial head;
  - d. 1 PC power supply converter for battery;
  - e. 1 optical telescope
  - f. 1 USB cable and 1 sensor power supply cable



**Fig. 5.2 – Contents of the IBIS-S case**

4. remove the Panasonic PC, the optical telescope, the USB cable and the sensor power supply cable;
5. you will see the second layer of equipment:
  - a. 1 pair of H20 antennas;
  - b. 1 mains transformer for the PC;
  - c. 1 IBIS-S sensor



**Fig. 5.3 – Second layer of IBIS-S case contents**



## **5.2 IBIS-S installation**

In order to simplify system installation, the area where the IBIS-S is to be installed must be chosen carefully. The selected area must satisfy the following requirements:

- The scenario of interest must be visible and the view must be uninterrupted by the presence of obstacles from the chosen point (trees, fences, buildings);
- The area must be sufficiently large to mount the tripod, manoeuvre with the case and for the operator to work from (the tripod covers at most a circular surface 1.5 m in diameter while the case has a base of 85x55 cm);
- The surface must be compact and stable to avoid any subsidence under the weight of the instrument.

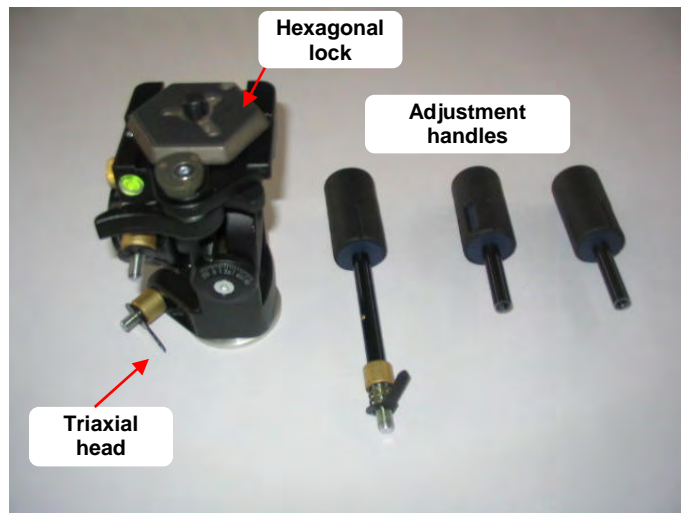
Once the optimal installation point has been chosen, proceed as follows:

1. Remove the tripod from its bag.
2. Open the tripod and fix it at the desired height using the levers and blocking screws.
3. Ensure that all the joints have been firmly tightened to optimise the rigidity and stability of the tripod.
4. Position the tripod on the ground being careful that the area chosen is stable.
5. Level the tripod using its spirit level, adjusting the length of the individual legs if required



**Fig. 5.4 – Installed tripod**

6. Remove the triaxial head and handles from the case.



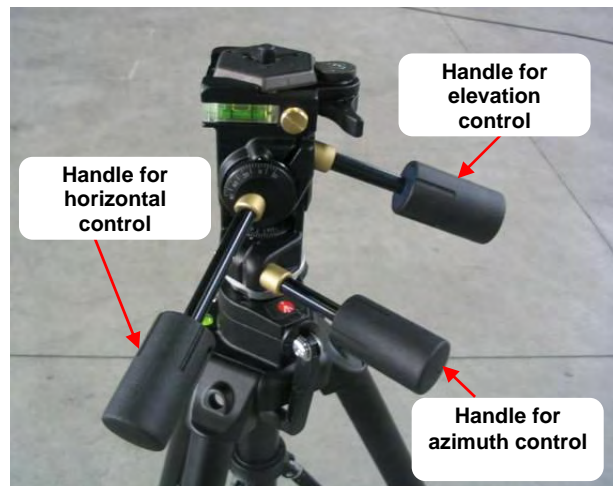
**Fig. 5.5 – Composition of the triaxial head**

7. Remove the plastic tags from the long handle and the triaxial head.
8. Screw in the two short handles in the yellow coloured nut covers.
9. Screw the long handle into the threaded hole on the side of the triaxial head.
10. Tighten the three handles.



**Fig. 5.6 – Mounted triaxial head**

11. Screw the triaxial head onto the filleted pin on the top of the tripod;



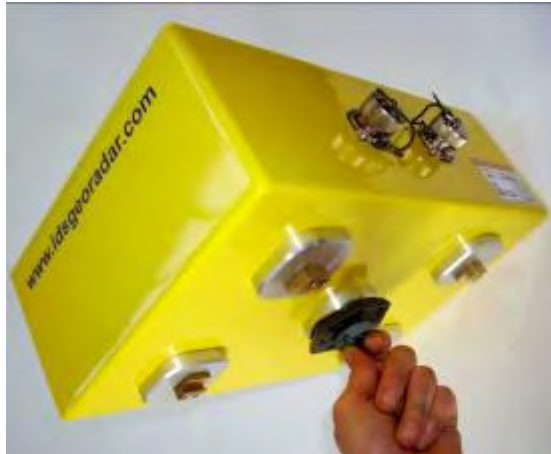
**Fig. 5.7 – Triaxial head fixed to the tripod**

12. rotate the three axial head, working on the three handles until it perfectly is levelled with the two spirit levels positioned near the top of the three axial head (ensure that the handles are well tightened).
13. unblock the hexagonal quick lock from the three axial head by acting on the 2 levers as shown in Fig. 5.8.



**Fig. 5.8 – Unlocking the levers of the quick lock mechanism**

14. Remove the hexagon from the triaxial head and remove the plastic cap covering the hexagon screw.
15. Insert the quick lock hexagon screw into the threaded hole on the bottom of the sensor , working on the metallic nut (Fig. 5.9);



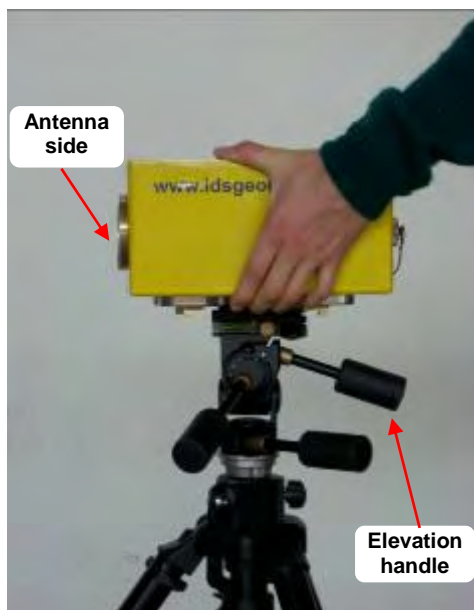
**Fig. 5.9 – Metallic nut**

16. Position the hexagon so that one side of the hexagon is parallel with the long side of the IBIS-S head base, then block the hexagon using the tightening nut (Fig. 5.10);



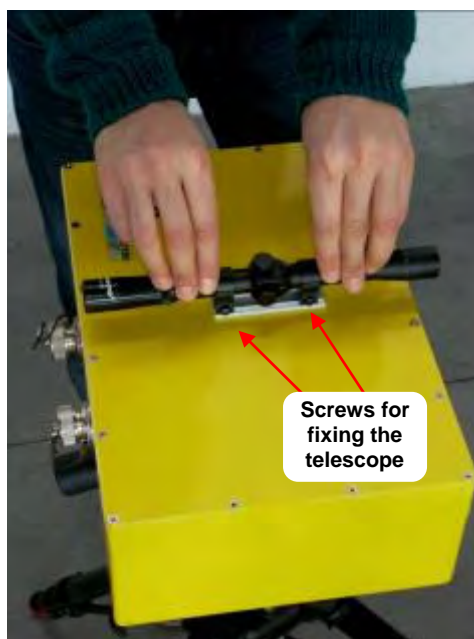
**Fig. 5.10 – Tightening nut**

17. Lift the sensor with the antenna side pointing forward.
18. Position yourself with the sensor behind the tripod on the side with the elevation control handle.
19. Lift the sensor over the tripod and slowly lower it making sure that the hexagon is positioned above the quick locking mechanism on the triaxial head.
20. Fix the sensor onto the tripod, ensuring the locking mechanism clicks into place.



**Fig. 5.11 – Sensor installation onto the tripod**

21. Retrieve the optical telescope and loosen the lower screws.
22. Install the optical telescope on the sensor, sliding it into the guide on the top of the sensor and fix it by tightening the screws (the writing on the telescope should face the side with the connectors).



**Fig. 5.12 – Mounting the optical telescope**

23. Retrieve the two antennas and their fixing screws from the case.
24. Mount the two antennas on the sensor (Fig. 5.13) using the screws provided (4 for each antenna).



**Fig. 5.13 – Mounting the antennas**

25. Acting on the two handles that block the azimuth and elevation axes, rotate the sensor until the optical telescope is pointing to the desired point of the scenario;



**Fig. 5.14 – Pointing the sensor**

26. Remove the protection caps covering the connectors on the back of the IBIS-S sensor;



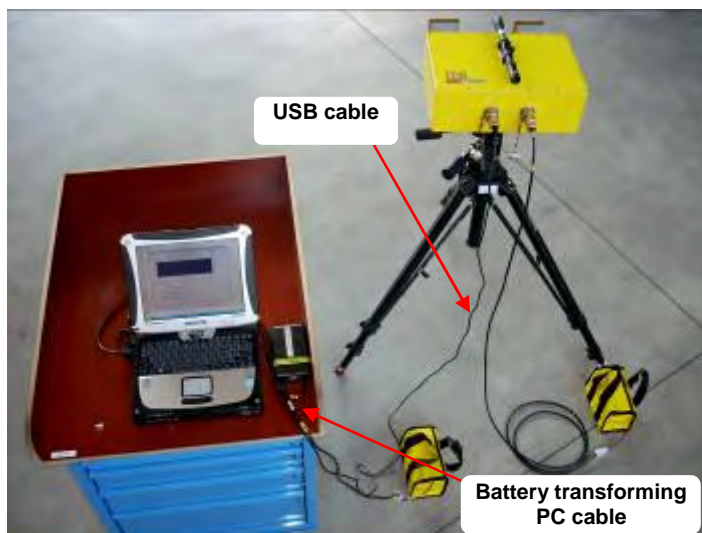
**Fig. 5.15 – Remove the protection caps**

27. Retrieve one of the batteries from the case.
28. Connect the power supply cable to the IBIS-S sensor then to the battery.



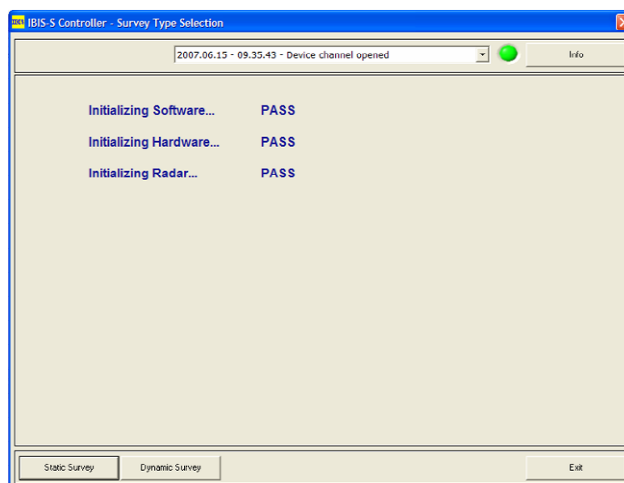
**Fig. 5.16 – Connecting the sensor to the battery**

29. Place the PC near the sensor (during operation we recommend using a portable table to sit the PC on).
30. Connect the PC to the second battery using the car transformer.
31. Start up the PC and log in as *administrator*.
32. Connect the USB cable to the IBIS-S sensor and then to the PC;



**Fig. 5.17 – Installed IBIS-S system**

33. Start up the **IBIS-S Controller** control and management software by double clicking on the icon shown on the desktop.
34. Check software has recognised the sensor.



**Fig. 5.18 – start up window of the IBIS-S Controller Software**

Once these operations have been completed, IBIS-S is active and ready to be used.

For the description of the control and management SW functions, refer to the specific manual.



### **5.3 Dismantling IBIS-S**

1. Close the **IBIS-S Controller** application and turn off the PC;
2. Disconnect the power supply cable from the sensor and then from the battery.
3. Disconnect the USB cable from the PC and then from the sensor.
4. Disconnect the transformer from the PC and then from the battery.
5. Screw the protection caps onto the two IBIS-S sensor connectors .
6. Remove the optical telescope from the IBIS-S sensor by loosening the screws and sliding it out of the guide;
7. Remove the two IBIS-H20 antennas from the sensor.
8. Reposition the antennas in the appropriate place in the IBIS-S case.
9. Keeping firm hold of the sensor, unblock the quick lock mechanism on the triaxial head (we recommend this operation is performed by two operators; one keeping hold of the sensor, the other unblocking the quick lock mechanism).



**Fig. 5.19 – Removing the sensor from the three axial head**

10. Remove the IBIS-S sensor, lifting it off of the triaxial head.
11. Place the sensor on one side and loosen the external fixing nut on the hexagon.
12. Unscrew the hexagon from the bottom of the IBIS-S sensor, acting on the metallic nut and screw on the back of the hexagon on the triaxial head.
13. Replace the IBIS-S sensor in its position in the IBIS-S case.
14. Remove the triaxial head from the tripod by rotating the azimuth control handle anticlockwise (the handle must be securely tightened).



**Fig. 5.20 – Position of the body of the three axial head when packing it away**

15. Close the tripod and place it in its bag.
16. Replace the remaining objects into the IBIS-S case (cables, PC and optical telescope).
17. Close the IBIS-S case after having fixed secure all parts.

Before closing the case check that the contents are complete and that all the parts have been secured, in order to avoid any damage during transportation.

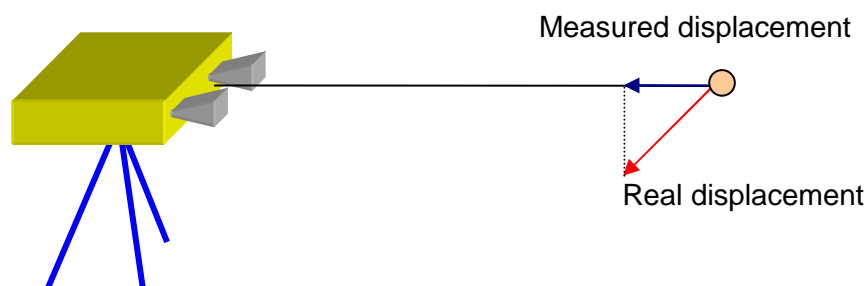
## 6. USEFUL TIPS

### 6.1 Installation

The successful performance of a field measurement campaign starts with the initial inspection survey. The scope of this survey is the evaluation of the following aspects:

- Identification of a suitable installation point for the IBIS-S in terms of scenario visibility and stability of the point the equipment will sit on. The characteristics of a good position can be summarised as:
  - direction of the displacement to be measured coincides with the ideal line traced between the sensor and the measurement point;
  - there being sufficient space to operate safely and to position the tripod, the IBIS-S case and for the operators to move around;
  - easily accessible to permit all the required material to be brought to the site.
- An evaluation beforehand of the quantity, quality and position of reflecting points present in the scenario;
- The possibility to install artificial reflectors if those present in the scenario are not sufficient. Installation of artificial reflectors eliminates one of the advantages of IBIS-S, because it means that there must be access to the site. However, the use of artificial reflectors allows a better accuracy in displacement measurement and identification of the point the displacement is measured for.
- The presence of possible disturbances due to vegetation, foliage or other sources, near to the intended displacement measurement points.
- The number of measurement points and their location in the scenario.

The IBIS-S sensor measures displacements along the ideal line joining the sensor to the point being examined (radial displacement), therefore if the real displacement occurs in another direction, the detected displacement must be projected on the basis of geometrical considerations (Fig. 6.1).



**Fig. 6.1 – Projection of displacement data**

To avoid making projection errors of the displacement data and when possible, we recommend positioning the sensor so that the displacement direction of the interested object occurs along the line that joins the point to the sensor.

If this is not possible, in order to minimise projection errors, an accurate georeferencing of the sensor must be performed with respect to the scenario/structure of interest.. Maps of the scenario and /or drawings of the buildings to be observed (in 3D if possible) should be obtained.

If the monitoring concerns a public building or infrastructure , make sure that all required authorisations have been obtained. It is always a good idea however to warn the responsible local authority before starting to perform measurements.

When extending the tripod to reach the desired height, the following basic precautions should be taken to optimise the rigidity of the structure:

- Adjust the height of the structure by first lengthening the middle section of the legs, then the thinner bottom sections;
- If possible, avoid extending the central column;
- Avoid opening the legs wide when they have been significantly extended in length.



**Fig. 6.2 – Tripod**

## **6.2 Use**

When the equipment is functioning, it is a good idea to ensure that nobody can pass or stop in front of the radar sensor to avoid a reduction in the quality of the radar acquisition.

When performing a field measurement campaign , it is very useful to have a folding table where the control and acquisition PC can be positioned.

## **APPENDIX A - RESTRICTIONS**

### **A.1 - Ku band system**

According to the CEPT Recommendation ERC 70-03 IBIS-L system working at Ku band is allowed to transmit on a band of 200MHz, between 17.1GHz and 17.3 GHz permitting a range resolution up to 0.75m.

### **A.2 - X band system**

According to the CEPT Recommendation ERC 70-03 IBIS-L system working at Ku band is allowed to transmit on a band of 100MHz, between 10.5GHz and 10.6 GHz permitting a range resolution up to 1.5m.



**NOTE:** A different configuration of the system is subject to the request of an authorization for use to the competent body of the country where the equipment has to be used. IDS takes no responsibility for the use of the system with a configuration not compliant with the recommendation and without the required permission.

## **APPENDIX B - TECHNICAL SPECIFICATIONS**

### **B.1 - Radar sensor**

<b>Ku band system</b>	
Frequency band	17.1 – 17.3 GHz
Maximum EIRP power	26dBm
<b>X band system</b>	
Frequency band	10.5 – 10.6 GHz
Maximum EIRP power	27dBm
<b>Power supply</b>	9-36 Vdc
<b>Power Consumption</b>	average: 27 W
<b>Dimensions</b>	width 375 mm length 270 mm height 115 mm
<b>Weight</b>	10 kg

## ***B.2 - Batteries / battery charger***

*Batteries:*

<b>Voltage supplied</b>	12 Vdc, 12 Ah
<b>Autonomy</b>	4 hours (in continuous operation)
<b>Dimensions</b>	width 150 mm length 100 mm height 100 mm
<b>Weight</b>	3.8 kg

*Battery charger:*

<b>Power supply</b>	230 V; 50 Hz
<b>Charging time</b>	6 hours

## ***B.3 - Panasonic CF-19 PC***

<b>Power supply</b>	16 Vdc
<b>Power absorbed</b>	Average: 11 W
<b>Dimensions</b>	Width 270 mm Length 220 mm height 55 mm
<b>Weight</b>	2.2 kg

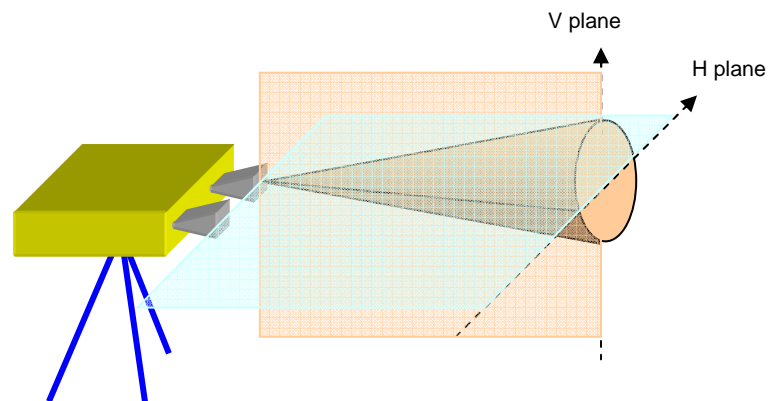
## **APPENDIX C - ELEMENTS OF RADAR TECHNOLOGY**

### **C.1 - Definitions**

#### *C.1.1 Main antenna lobe*

The term *antenna main lobe (or beam)* is intended as the angular area within which the antenna concentrates most of the power it is supplied with.

The main lobe of an antenna can be schematically represented as a truncated cone with an elliptic base, where the cone vertex is positioned in correspondence with the antenna. The base of the cone is elliptical since antennas typically have lobes with different angular amplitudes in the elevation (V) and azimuth (H) planes.



**Fig. C. 1 – Schematic diagram of the antenna beam**

The following parameters are normally defined to quantify the antenna beam amplitude:

- The beam at -3dB: angular area within which antenna gain is more than 50% of the maximum gain ( $-3 \text{ dB} = 10 \cdot \log_{10}(0,5)$ ).
- The beam at -10 by: angular area within which gain is more than 10% of the maximum gain ( $-10 \text{ dB} = 10 \cdot \log_{10}(0,1)$ ).

From an applicative point of view, this means that the sensor must be pointed so that the scenario of interest falls inside the antenna beam, preferably at -3dB. Therefore the distance at which the instrument should be positioned and its inclination should be chosen depending on the antenna beam being used.



**Fig. C. 2 – Area of the scenario covered by the antenna beam main lobe**