

# RockSpot

## User Guide



September 2020



# 1 Important Information about your Instrument



Read and follow the Quick Guide before using the product or the accessories delivered with the product.



Keep for future reference!

## Intended use

The intended use is the real time detection of fast-moving geological event, such as rockfall, debris flow, snow avalanche, etc. in one of the following possible environments:

- open pit mines and quarries
- natural landslides
- glaciers
- snowy slopes
- tailing dams.



The product must not be disposed with household waste.

**Conformity to European regulations**

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This equipment is compliant with the essential requirements and other relevant provisions of Directive 2014/53/UE.

The full Declaration of its 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. If so, the user may need to take adequate measures.

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

The RockSpot 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. The license application can be submitted to the following website: <http://wireless.fcc.gov/uls/index.htm?job=home>

Electronic

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

FCC statements:

. This device complies with FCC Part 15. 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.

. 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.

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Information can be obtained at [http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio\\_guide-lignes\\_direct-eng.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php).

. 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 30 cm between the radiator and your body.

### Conformity to Canada regulations.

The RockSpot sensor is granted by ISED as a license exempt low power device, according to RSS-210 Issue 10, Annex F, F.1. Operating band is 10.50-10.55 GHz, with a maximum EIRP of 32.7dBm. Within the above mentioned limitation in terms of band and emitted power, ROCKSPOT can be used in Canada, without any license.

For more information about licensing procedure contact IDS GeoRadar personnel.

#### ISED Statements:

. Cet appareil est conforme à FCC Partie15. Son utilisation est soumise à Les deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférences et (2) cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

. 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](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 30 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](mailto:sudha.sachdeva@leicaus.com)

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## 1.1 Symbols

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



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**WARNING**

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

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**DANGER**

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

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**CAUTION**

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

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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:** If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged.

**Precautions:**

When setting-up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position. Avoid subjecting the product to mechanical stress.



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



**DANGER**

During the setup and the use of the product, the user must take care of the danger related to the environment surrounding the product, such as obstacles, excavations, traffic etc...

**Precautions**

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

**DANGER:** During the setup of the product, the user must take care of the danger related to installing and working at height.

**Precautions:**

During the installation and setup of the product, the user must be fully aware of the existing dangers related to work at height such as the use of ladders, step-ladders, etc.

**DANGER:** Because of the risk of electrocution, it is dangerous to use poles and extensions near electrical installations such as power cables or electrical railways.

**Precautions:**

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

**DANGER:** If the product is used with accessories, you may increase the risk of being struck by lightning.



**Precautions:**

Do not use or maintain the product in a thunderstorm.

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**CAUTION:** High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.



**Precautions:**

Protect the batteries from mechanical influences and high ambient temperatures.  
Do not drop or immerse batteries into fluids.

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**DANGER**

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.



**Precautions:**

Always ensure that the working site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

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**DANGER:** During the transport, shipping or disposal of batteries, inappropriate mechanical influences can create a fire hazard.



**Precautions:**

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Before shipping the product or disposing of it, discharge the batteries by running the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.

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**DANGER:** During the setup of the product, the user must take care of the danger related to installing and working at height.



**Precautions:**

During the installation and setup of the product, the user must be fully aware of the existing dangers related to work at height such as the use of ladders, step-ladders, etc.

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**DANGER:** Do not install the system in closed or indoor environments and do not point the system on individuals or animals



**Precautions:**

Install the system only in open space environment and point the radar far from individuals and animals.

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**DANGER:** Do not install or maintain the system without wearing Personal Protective Equipment (PPE).



**Precautions:**

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Install the system using Personal Protective Equipment (PPE) as protective and high visibility clothing, hard helmets, rigger gloves safe goggles, safe steel-toe boots.

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**DANGER:** High voltage (110-230 VAC) in the CU

**Precautions:**



In order to operate on the internal components of the CU for maintenance purposes switch OFF the system, Unplug the AC cable and insert the LockOut-TagOut (LO-TO) device (metal bar) before opening the CU.

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**DANGER:** sharp- cutting edges

**Precautions:**



Apply isolating or Dutch tape on the sharp-cutting edge of the metallic ties that fix the CU and SU, after HW installation.

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**DANGER:** Because of the risk of electrocution and static currents, it is dangerous to use external AC generator without proper grounding.



**Precautions:**

Ensure proper grounding-earthing system to the AC generator.

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**WARNING:** the base of the pole is 45 cm large and needs a concrete block (80 kg of minimum weight) to be fixed using 8 chemical anchors, provided with the pole. Make sure pole is well stable and fixed on its concrete block.

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**DANGER:** High voltage (110-230 VAC) in the CU

**Precautions:**



In order to operate on the internal components of the CU for maintenance purpose switch OFF the system, unplug the AC cable and insert the LockOut-TagOut (LO-TO) device (metal bar) before opening the CU

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## 3 SYSTEM SPECIFICATIONS

### 3.1 Performance Specifications

Intrinsic system specifications are listed in this paragraph. Actual performance may strongly depend on external factors listed in Table 4.

#### 3.1.1 Detection

The following specifications refer to a system operating a single Survey Unit.

Parameter	Value
<b>Operating range</b>	50 m - 2000 m
<b>Azimuth FoV</b>	80°
<b>Elevation FoV</b>	40°
<b>Rockfall speed detection</b>	> 1 m/s

*Table 1– RockSpot detection specifications (single Survey unit configuration)*

RockSpot radar is able to detect single rockfalls with rock-sizes greater than 2 m at 1000 m. In the following table the approximative trend of detectable rock sizes versus the distance from the radar.

Distance from the radar	Rock size
500 m	0.6 m
1000 m	2.5 m
2000 m	10 m

*Tab. 1 – Rockfalls indicity rock size vs distance from the radar.*

It must be stressed that these figures must be intended as pure indicative values; actual performance can greatly differ, depending on many factors such as the radar-rock line of sight, rock material, number of rocks in the avalanche, angle of fall and velocity, weather conditions etc.



Event detection performance of RockSpot are highly dependent on the rock size and on their number (or on the size of the avalanche), distance, fall angle, velocity, maximum emitted power, atmospheric conditions, etc.

### 3.1.2 Tracking

Parameter	Value
<b>Tracking range resolution</b>	4 m
<b>Tracking azimuth accuracy</b>	Up to 1°
<b>Track update frequency</b>	Up to 2 Hz

*Table 2 – RockSpot tracking specifications (single Survey unit configuration)*



Tracking azimuth accuracy of Rockspot are highly dependent on the rock size and number (or size of the avalanche), distance, fall angle, velocity, maximum emitted power, atmospheric conditions etc.

### 3.1.3 Alarm Activation

Parameter	Value
<b>Physical alarm activation</b>	Can trigger up to 4 independent external alarm devices
<b>Remote alarm notifications</b>	e-mail and text-messages

*Table 3 - RockSpot alarm activation specifications*



### 3.1.4 Environmental Specifications

Parameter	Value
<b>Operating Temperature</b>	-40 °C ÷ +55 °C
<b>Protection</b>	IP65
<b>Operating conditions</b>	Designed to operate in any weather conditions. Detection, Tracking and Alarm activation performance functions may be affected by strong wind, presence of vegetation, heavy rain or snow falls.
<b>Dimension Control Unit</b>	62 cm x 47 cm x 22 cm
<b>Dimensions Survey Unit</b>	50 cm x 37 cm x 20 cm
<b>Weight Control Unit</b>	27 kg
<b>Weight Survey Unit</b>	12 kg
<b>Supply</b>	110/230 V AC – 24 V DC
<b>Supply autonomy</b>	Continuous AC or DC power input required. Integrated backup batteries prevent sudden system shut down in case of temporary lack of external power.
<b>Power Consumption CU</b>	70 W
<b>Power Consumption SU</b>	45 W (single unit)

*Table 4 – Environmental specifications.*

### 3.1.5 Radio-Equipment Specifications

Parameter	Value
<b>RF operating band</b>	EU: 10.50 – 10.60 GHz USA: 10.40 – 10.50 GHz Canada: 10.50 – 10.55 GHz
<b>Emission bandwidth</b>	EU/USA 100 MHz Canada 50 MHz
<b>Maximum power at the antenna connector</b>	EU: 17 dBm USA: 31 dBm Canada: 23.7 dBm
<b>Antenna Gain</b>	9 dB
<b>Equivalent Isotropic Radiated Power (EIRP)</b>	EU: 26 dBm USA: 40 dBm Canada: 32.7 dBm
<b>Signal modulation</b>	FMCW
<b>Certifications</b>	CE, FCC, ISED

*Table 5 - RockSpot radio-equipment specifications.*

## 4 System Breakdown

### 4.1 System Architecture

The RockSpot system architecture is depicted in Fig. A.

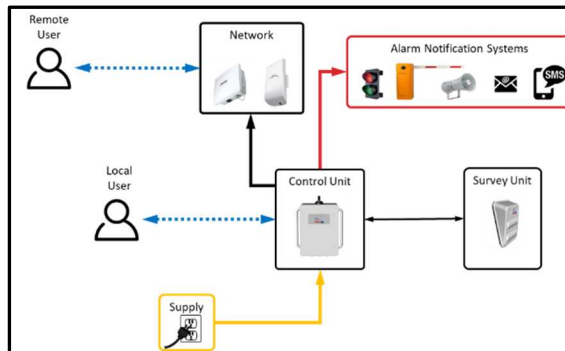


Fig. A- RockSpot system architecture

The RockSpot system is composed by the following units (Fig. B):

- Control Unit, for system control and management
- Survey Unit, for data collection and real time data processing



*Fig. B – RockSpot system overview*

## 4.2 How the system is delivered

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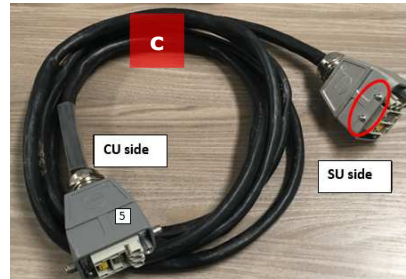
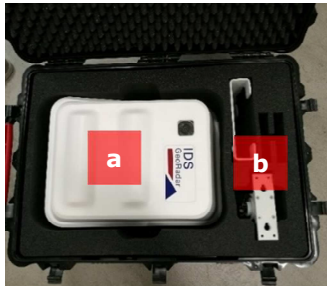
The system is delivered with two main boxes (Control Unit Box; Survey Unit iCase).



## 4.2.1 Survey Unit Case

The Survey Unit case contains:

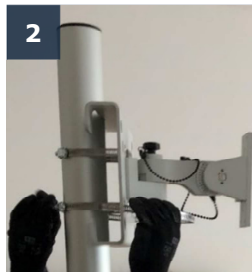
- Survey Unit (compact module enclosing the radar sensor, the camera and the GNSS)
- Mounting Brackets and metallic ties
- Control Unit-Survey Unit connection cable of 5m (located under the Survey Unit body).



## 4.3 Survey Unit installation and setup

In case the installation is on a pole, ensure that the pole is properly weighted on the base or coupled with a concrete base 50x50x20cm.

1. Mount the plate on the articulated bracket using T-30 Torx® key.
2. Mount the bracket with the plate on the pole, fixing with the metallic ties, using 7 mm socket wrench, with the tie screw facing the outward side of the pole and placed on the pole as much as close to the bracket.
3. Take the Survey Unit and put it gently on the bracket, screwing it to the metallic bracket; eventually direct the SU to the desired azimuth and tilt angles using the graduated knobs.



## 4.4 Control Unit installation and setup

1. Install the horizontal bracket on the pole base tightening with metallic ties.
2. Lift the CU by the handles and fix it to the designated brackets supports, tightening with metallic ties using 7 mm socket wrench, tangent and far from the pole as much as possible.

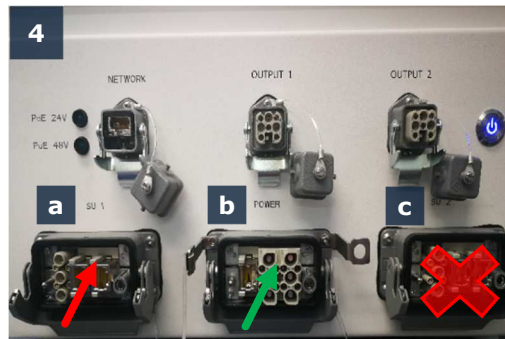


Apply isolating or Dutch tape on the sharp-cutting edge of the metallic ties that fix the CU and SU, after HW installation. Make sure of the proper fixing-fastening of the SU and CU brackets

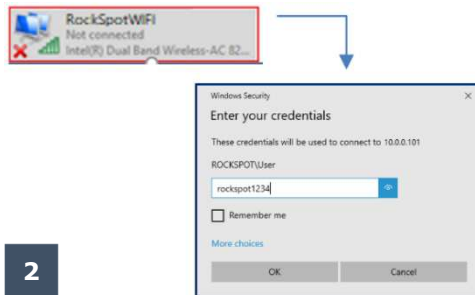




3. Connect the SU to the CU by the designated cable (**Error! Reference source not found.**)
4. Connect the CU to the SU by inserting the dedicated cable (**Error! Reference source not found.**) in the connector **a** (SU1 red arrow); *do not connect the survey unit to the connector* **c** (SU2).

In order to supply the CU, connect the designated cable (**Error! Reference source not found.**, **Error! Reference source not found.**) to the Power Connector **b** (green arrow) and then to an external stabilized power source AC: 110VAC, 4.6A÷240 VAC, 2.3A or 12÷24 VDC, 20A (480W at least) input.



## 5 Switching the system ON/OFF



1. Switch **ON** the CU by pressing  Power button located on the right edge of bottom side of the CU for 2-3 seconds, until it is possible to observe CONTROL UNIT LED blinking (1s). Turn **OFF** the CU by pressing the  power button (for 6-7 seconds) until the CONTROL UNIT LED turns OFF.
2. The user can access to RockSpot Controller SW running in the embedded PC through the tablet (optional). The connection between the tablet and the embedded PC is through Wi-Fi: connect the tablet to "**RockSpotWiFi network**" (password: *rockspot1234*). Connect to the industrial PC (10.0.0.101) using the tablet via Remote Desktop:  
**User** = ROCKSPOT\user; **Password** = rockspot1234

## 6 Care and Transport

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In the present section general information about ROCKSPOT system maintenance are provided. 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. Particular attention must be taken in verifying the following (but not limited to):

- Check that SU bracket's bearing and tilt nodes are well tightened.
- Check the metallic ties that hold both SU and CU are well fastened to the pole.
- Visually check that all the connectors, both on SU and CU are well fastened and intact.
- Visually check the integrity of all the cables and cable pins.
- Visually check the integrity of LockOut-TagOut device (metal bar) on POWER connector of the SU.
- Check that the Pointing camera protective glass on SU is clean and free from dust, ice and water drops.
- If optional pole is present, check that the lobe knob that joins upper and lower pole sections and the pole to the base are well tightened.
- If optional Wi-Fi antenna is present, check the correct alignment and free Line of Sight.

# 7 Disclaimer

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## 1 Generals

- 1.1 The present Disclaimer applies to all products (the “Products”) designed, produced and distributed by IDS GeoRadar s.r.l., its Subsidiaries, Affiliated and authorized Distributors (IDS GeoRadar). IDS GeoRadar. reserves full ownership and intellectual property rights of any “Information” contained in this Disclaimer including Trademarks and Graphics. No part of this Disclaimer may be used or reproduced in any forms without the prior written agreement of IDS GeoRadar.
- 1.2 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.
- 1.3 This Disclaimer shall be interpreted, governed, construed and enforced in accordance with the laws of Italy. Buyer hereby consents to the exclusive jurisdiction of Pisa.

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

- 2.1 The Buyer, for setting-up and using the purchased Products, shall consult the official documentation provided by IDS GeoRadar. for the Products (“Reference Documentation”) and carefully ascertain the compliance with national laws and requirements, which may limit or even forbid their use.
- 2.2 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 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.
- 2.3 For RockSpot System, Buyer/User warrants:
  - 2.3.1 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 harmless against any liability (including attorney’s fees) for non-compliance with the terms of this article.

- 2.3.2 that no operation or use of the ROCKSPOT System shall be started before its designated Operator/s has got the ROCKSPOT User Certificate, as defined by IDS GeoRadar. specific procedure which the Buyer confirms to know and accept.
- 2.3.3 For Products which include specific “Operational” software with automatic data processing and analysis “Tools”, i.e. the ROCKSPOT system, 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.
- 2.4 In no event IDS GeoRadar. 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.

- 3.1 The User shall follow the instructions provided by IDS GeoRadar. 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.
- 3.2 In no event IDS GeoRadar. 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, in particular for the following main aspects:
- 3.3 Use of IDS GeoRadar. Products outside its limitation of use, without proper and adequate scientific/technical knowledge or without specific training.
  - 3.3.1 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.
  - 3.3.2 Opening of the Equipment (for HW Products) without express written authorization of IDS GeoRadar;
  - 3.3.3 Unauthorized changes and additions to the Products.
  - 3.3.4 Use of the Products connected to suspected non-working equipment or with equipment (mainly PC) having characteristics non in compliance with the required specifications of IDS GeoRadar not expressly authorized by IDS GeoRadar;

- 3.3.5 Poor or faulty operation of the electrical and telecommunication networks not directly managed by IDS GeoRadar or its delegates.
- 3.3.6 Poor or faulty operation Software/Hardware of the third parties connected with IDS GeoRadar . Equipment.
- 3.3.7 Poor or faulty operation of the Products due to Software Virus which infected the Products after their delivery.
- 3.3.8 Use of the Products which have encountered suspected manumissions, accidents, electrostatic shocks, flashes, fire, earthquake, flooding or other natural disasters or unexpected events.
- 3.3.9 Use or storage of the Products outside the limits of the “Operational Temperature Range” specified by IDS GeoRadar.

## 4 Disclaimer for the “RockSpot System

### 4.1 Introduction

- 4.1.1 As any other physical device, some RockSpot functionalities and performances may be limited by several external factors with respect to the specifications listed in §3. Therefore, RockSpot’s functionality and performance is dependent on several external factors (as described below) even if operated within the given Specifications as defined there.
- 4.1.2 Possible limitations of a RockSpot are described below; in no way they must be intended as exhaustive

### 4.2 General Limitations

#### 4.2.1 Power supply

- 4.2.1.1 RockSpot operation require an external power supply. In case of power failure the system will not be operational; power supply availability is solely under user responsibility.

#### 4.2.2 Hardware failure

- 4.2.2.1 RockSpot system is designed to operate continuously 24/7, but it may become temporarily unavailable due to hardware failures. In case of unavailability, the system is designed to provide the user with a warning message by e-mail and SMS. In these cases, monitoring data and automatic alarm activation are not available until the instrument is repaired. It’s the user’s responsibility to check such warning messages regularly and to take appropriate actions accordingly. This notification mechanism may fail as a consequence of hardware or network failure. IDS GeoRadar is

not liable for damages or claims of any kind, which are based on the disregard of such warning messages and / or missing or incorrect actions on behalf of the user.

#### **4.2.3** Software failure

**4.2.3.1** RockSpot system is designed to operate continuously 24/7, but it may become temporarily unavailable due to software failures. In case of unavailability, the system is designed to provide the user with a warning message by e-mail and text-messages SMS. In these cases the monitoring data and automatic alarm activation are not available until the software is properly restored. It's the user's responsibility to check such warning messages regularly and to take appropriate actions. It's the user's responsibility to check such warning messages regularly and to take appropriate actions accordingly. This notification mechanism may fail as a consequence of hardware or network failure. IDS GeoRadar is not liable for damages or claims of any kind, which are based on the disregard of such warning messages and / or missing or incorrect actions on behalf of the user.

#### **4.2.4** Alarm rules setup

**4.2.4.1** Automatic alarm activation by RockSpot system, requires an appropriate setting of the alarm rules, with the definition of the areas concerned, alarm levels and type of alarm devices to activate. Incorrect alarm rules setup may lead to missing or incomplete alarm activation. Appropriate alarm rules setup is solely under user responsibility, based on his knowledge of the specific application features.

#### **4.2.5** Data Quality

**4.2.5.1** In case of extreme weather conditions radar data quality may be below the required minimum threshold. In this case the user is notified by an alarm, and the monitoring and event detection will not be available. Consequently, GeoAlarms will not be triggered. This notification mechanism may fail as a consequence of hardware or network failure.

#### **4.2.6** DTM Availability

**4.2.6.1** To properly locate and track the rockfall events, RockSpot requires an accurate DTM of the monitored scenario, which needs to be provided by the user. In order not to worsen the system tracking performances, DTM required accuracy must be at least equal to the radar tracking specifications reported in §3. In case DTM accuracy is below the minimum required accuracy, location and precise tracking of rockfall events will be affected. DTM is also necessary to distinguish the areas with moving machineries from those affected by rockfalls. The unavailability of an accurate DTM

can worsen tracking performances and in some circumstances may lead to missing or improper detection. User is responsible to provide and upload a suitable DTM.

#### **4.2.7** GNSS coverage

**4.2.7.1** To properly locate and track the rockfall events, RockSpot requires an accurate GNSS measure of the Survey Unit position and orientation. In the absence of adequate satellite coverage, the measure provided by the integrated GNSS compass may not be sufficiently accurate and might lead to inaccurate or less accurate tracking performances than reported in the data sheet. IDS GeoRadar does not assume any liability whatsoever for such inaccurate or less accurate tracking performances based on missing or inadequate GNSS measures.

#### **4.2.8** Alarm devices operation

**4.2.8.1** Alarm activation by RockSpot system, requires that appropriate alarm devices (such as sirens, traffic lights, barriers etc.) are correctly connected and working. In case of alarm devices not correctly connected or not working, the alarm activation will therefore not be possible. Hence, it's the user's responsibility to connect appropriate alarm devices only as well as to assure that they are correctly connected, properly working and maintained.

#### **4.2.9** Network connection

**4.2.9.1** Alarm messages dispatch by RockSpot system, requires an appropriate LAN or WAN connection. In the absence of adequate connection, messages dispatch cannot be guaranteed. The user is responsible to provide for the operation and the maintenance of such appropriate LAN or WAN connection.

#### **4.2.10** Mobile phone coverage

**4.2.10.1** Alarm messages dispatch by RockSpot system, requires an appropriate mobile phone communication network coverage. In the absence of adequate coverage, messages dispatch cannot be guaranteed. Hence, it's the user's responsibility to provide for an appropriate mobile phone communication network coverage.

#### **4.2.11** Early warning

**4.2.11.1** RockSpot is an instrument devoted to the detection and notification of rockfalls during the event course itself. RockSpot is not effective in the early warning notification and it is not be possible to set up proper alerts prior to the rock detachment.

#### **4.3** Performance limitations



#### 4.3.1 Operating range

**4.3.1.1** RockSpot system is designed to operate in a wide range, however system detection performances worsen with increasing distance. Rockfall occurring beyond the RockSpot maximum operating range cannot be detected by the system.

#### 4.3.2 Field of View

**4.3.2.1** RockSpot system is designed to operate in a wide Field of View (FoV), however system detection performances shown in the data sheet are valid at the FoV center and worsen approaching the FoV limits. Rockfall occurring outside the RockSpot FoV cannot be detected by the system.

#### 4.3.3 Rock sizes

**4.3.3.1** RockSpot system provides state-of-the-art performance in terms of rock size sensitivity detection. Detection probability increases with the boulder size. Falling of rocks with small dimensions may not be detected by the Rockspot.

#### 4.3.4 Alarm activation time

**4.3.4.1** RockSpot system is designed to trigger an output signal as soon as possible after the rock detachment. However, the activation time depends on the quality of the signal reflected by the falling rock, and in some circumstances, it is not possible to guarantee the output signal activation in due time. It is solely in the user responsibility to assess if the scenario conditions and event characteristics allow for a sufficient alert time; for example, if fall time of a rock is too short the alert cannot be triggered early enough.

#### 4.3.5 Alarm activation sensitivity

**4.3.5.1** RockSpot system provides state-of-the-art performance in terms of rockfall alarm activation sensitivity. RockSpot sensitivity depends on the quality of the signal reflected by the falling rock, which is influenced by many factors including but not limited to the distance, the angle of view, the boulder size, the boulder shape, the boulder material, the boulder surface roughness and the falling dynamics. Therefore, the RockSpot detection performance cannot be constant throughout the entire monitored scenario and on all the possible events. This may lead to insufficient or improper detection of rockfall events, which IDS GeoRadar is not liable for.

#### 4.3.6 Line of Sight

- 4.3.6.1** Doppler Radar technology detect the movement only along the Line of Sight (LoS). Rocks falling perpendicularly or close to the perpendicular to the radar LoS could be underestimated or even undetected. The number of radar to be installed and their locations must be carefully evaluated in order to minimize this effect, although, due to installation constrains, there could be residual areas on the slope with unfavourable LoS. The user is responsible for the evaluation of the number of radars to be installed as well as for the decision of their location. It's the user's responsibility to decide on a proper installation plan accordingly.
- 4.3.7** Rock speed
- 4.3.7.1** RockSpot system is designed to detect moving object over a minimum speed threshold. Rocks falling with a line of sight velocity under the minimum detectable speed (see data sheet) cannot be detected and hence, it's out of the responsibility/liability of IDS GeoRadar if such rock falls are not detected.
- 4.3.8** Simultaneous events
- 4.3.8.1** RockSpot has been designed to detect and track a single event per distance. However, the system can correctly handle multiple events simultaneously, as long as their instantaneous distances from the sensor differ by at least 8 m from each other. Multiple events occurring simultaneously at the same distance, might reduce system detection and tracking performances and hence, there's no liability/responsibility whatsoever of IDS GeoRadar in case of multiple events which occur simultaneously.
- 4.4** Environmental limitations
- 4.4.1** Operating temperatures
- 4.4.1.1** RockSpot system is designed to operate in a wide temperature range, however operation close the operating temperature border could decrease the intrinsic radar sensitivity. Operation outside the system specifications (see data sheet) is not guaranteed.
- 4.4.2** Atmospheric events
- 4.4.2.1** RockSpot system incorporates state-of-the-art algorithms for the correction of atmospheric-induced false alarms. However, it must be noted that modelling of real phenomena like atmospheric events leads to an approximation of real-world physics, which may not be always effective, and could introduce false alarms, especially under particularly strong or sudden atmospheric variations.

#### **4.4.3** Vegetation movements

- 4.4.3.1** RockSpot system incorporates state-of-the-art algorithms for the correction of vegetation-induced false alarms. However, it must be noted that modelling of real phenomena like vegetation movements leads to an approximation of real-world physics, which may not be always effective, and could introduce false alarms, especially in densely vegetated areas.

#### **4.4.4** Hydrological elements

- 4.4.4.1** RockSpot system provides measurement in very wide area, however the presence of natural moving hydrological elements (such as rivers, waterfalls, etc.) inside the system FoV may introduce false alarms, especially in areas where these elements are present.

#### **4.4.5** Machinery

- 4.4.5.1** RockSpot system provides measurement in very wide area, however the presence of machineries such as trucks, shovels, etc. must be taken into account. These moving objects inside the system FoV may introduce false alarms, especially in areas where these machineries are present.

#### **4.4.6** Multiple reflection

- 4.4.6.1** Due to the complex physics of electromagnetic wave propagation some slope scenarios could generate multiple reflections of radar waves which cannot be totally be a-priori predicted or detected. The presence of such reflections may introduce spurious data, which could limit the detection performance of the radar. In these circumstances a proper evaluation by radar expert may be necessary to assess the origin of the interference.

#### **4.4.7** Multiple Survey Unit interference

- 4.4.7.1** RockSpot system is designed to operate with various simultaneously active sensors. However, the close presence of multiple Survey Units, may introduce interference signals which, in some circumstances, could affect the detection performance. To avoid this, one should not point directly one sensor in front of another, especially if the distance between them is less than 2 km.

#### **4.4.8** External devices interference

**4.4.8.1** RockSpot system is designed to operate together with any other electronic device. However the close presence of instruments that emit electromagnetic waves in the same RF operating band stated in the specifications sheet, may introduce interference signals which, in some circumstances, could limit the radar detection performances.

#### **4.5** Training requirements

**4.5.1.1** For the safe and proper use of the Rockspot system, it is absolutely essential that it is operated exclusively by skilled users. A skilled users is someone who has successfully completed appropriate training. It is therefore strongly recommended that all users complete such training from IDS GeoRadar. IDS GeoRadar is not liable for any damages caused by unskilled and/or untrained users.

## 8 CUSTOMER SUPPORT

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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](mailto:support.geo@idsgeoradar.com)

MIN BU Customer Care: [support.mining@idsgeoradar.com](mailto:support.mining@idsgeoradar.com)



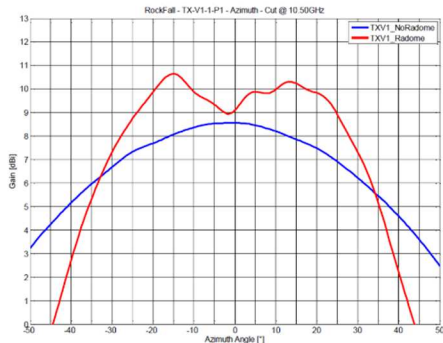
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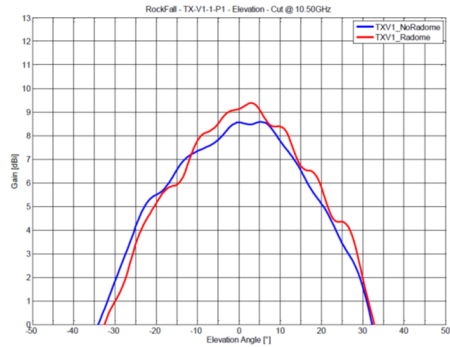


## A. Appendix A

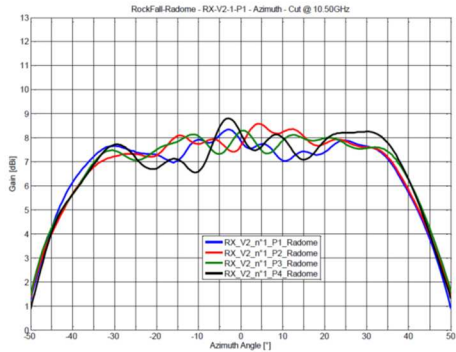
In this appendix the datasheet of TX and RX antennas are reported. In particular, the Elevation and Azimuth patterns are shown. It is clearly visible the typical 9 dBi gain at 0° azimuth, 0° elevation direction, both for TX and RX antennas.



**Figure A – TX Antenna: azimuth beam pattern**

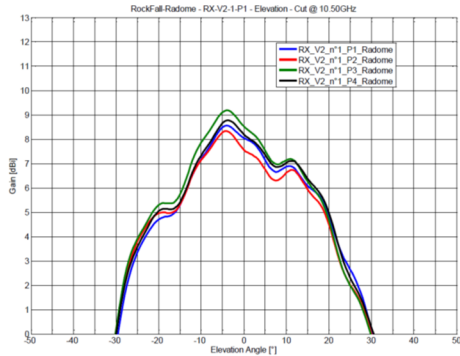


**Figure B – TX Antenna: elevation beam pattern**



**Figure C – RX Antenna: azimuth beam pattern**





**Figure D – RX Antenna: elevation beam pattern**