

RockSpot

User Guide



October 2021



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

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.

**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.

**Conformity to
Canada
regulations.**

Information can be obtained at 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.

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

. 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 installé 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

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.

1.1.7



WARNING

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

1.1.8



DANGER

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

1.1.9



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: 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.

1.1.10**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...

1.1.11**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.

1.1.12

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.

1.1.13



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.

1.1.14



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.

1.1.15



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.

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

Precautions:

1.1.16



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.

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: 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.

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



Precautions:

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

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.

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.

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.



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.

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

3 SYSTEM SPECIFICATIONS

IDS GeoRadar RockSpot is a remote sensing monitoring system, capable of detecting in real-time the occurrence of sudden falling of rocks, mudflows, avalanches or any similar falling event related to geological/environmental hazards hereinafter called Sudden Falling Event (in short SFE) and to provide corresponding real-time tracking. IDS GeoRadar stress out that RockSpot has not been designed as an automatic decision-making system; in fact, it has been designed for providing information and notification to the Decision Maker. Critical decisions about reactive measures to be taken with reference to sudden falling event related to geologic hazard must be taken by the Decision Maker under his exclusive responsibility.

Examples of SFEs include rock avalanches, snow avalanches, debris flows, mud flows, rapid collapse of earth-made structures.

Even if RockSpot helps in reducing the risks of damages caused by the above mentioned hazards, it cannot guarantee the complete removal of these risks.

RockSpot is an instrument devoted to the detection and notification of SFEs during the event course itself. RockSpot is not effective in early warning notifications and it is not possible to set up proper alerts prior to SFE.

Like any other radar device, RockSpot may be subjected to false positives (detections triggered in the absence of a real SFE or unwanted detections), and false negatives (missing detections). Moreover, in some specific conditions (weather, radar line of sight, geometry, kinematics, interferences), missing detection (false negative) of a moving object can also happen. The probability of missing detections depends on the power of backscattered signal from moving object, which in turn depends on various factors (weather, radar line of sight, geometry, kinematics) and changes from scenario to scenario. In the implementation of a safety-critical system for SFE real time alert, it is required to use Rockspot in conjunction with other measurements sensors or measures to validate the notifications triggered by RockSpot.

To set up an effective SFE alerting system, RockSpot must be used in conjunction with other sensors, such as

seismometers, trigger lines, geophones etc. to maximize detection probability, minimize false alert rates and to increase redundancy. In some conditions the sensors could be ineffective to provide the desired protection (e.g. a high rate of rock falls, short falling time etc.) and construction/barriers measures must be applied. It is end user responsibility to assess the proper system setup for effective protection against SFEs. RockSpot must not be intended as an equipment to be used alone or as a replacement of other effective protection measures.

The suitability of using the RockSpot system for SFEs alerts to the Decision Maker must be carefully evaluated by the user against the specific scenario to be monitored. For instance, depending on the height and fall angle of the SFEs, the travel time of SFE could be too short to provide effective protection. In case SFE events are too frequent, the adoption of other construction protective measures should be considered.

It is also recommended to perform a trial period with the system in the scenario to be monitored prior to put it into operation, in order to tune the optimal setup for the system parameters and verify the suitability of the system for the specific application/scenario.

Although RockSpot has been designed to allow 24/7 continuous monitoring, the product is not a Safety Instrumented System (SIS) and does not include the self-checking redundant circuitry/software functions that are necessary to control critical processes and to avoid adverse Safety, Health and Environmental (SH&E) consequences.

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
Operating range	50 m - 2000 m
Azimuth FoV	80°
Elevation FoV	40°
Rockfall speed detection	> 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 indicative 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
Tracking range resolution	4 m
Tracking azimuth accuracy	Up to 1°
Track update frequency	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 Alert Activation

Parameter	Value
Physical alert alert activation	Can trigger up to 4 independent external alert devices addressed to the Decision Makeralert
Remote alert alert notifications	e-mail and text-messages

Table 3 - RockSpot alert activation specifications

3.1.4 Environmental Specifications

Parameter	Value
Operating Temperature	-40 °C ÷ +55 °C
Protection	IP65
Operating conditions	Designed to operate in any weather conditions. Detection, Tracking and Alert activation performance functions may be affected by strong wind, presence of vegetation, heavy rain or snow falls.
Dimension Control Unit	62 cm x 47 cm x 22 cm
Dimensions Survey Unit	50 cm x 37 cm x 20 cm
Weight Control Unit	27 kg
Weight Survey Unit	12 kg

Supply	110/230 V AC – 24 V DC
Supply autonomy	Continuous AC or DC power input required. Integrated backup batteries prevent sudden system shut down in case of temporary lack of external power.
Power Consumption CU	70 W
Power Consumption SU	45 W (single unit)

Table 4 – Environmental specifications.

3.1.5 Radio-Equipment Specifications

Parameter	Value
RF operating band	EU: 10.50 – 10.60 GHz USA: 10.40 – 10.50 GHz Canada: 10.50 – 10.55 GHz
Emission bandwidth	EU/USA 100 MHz Canada 50 MHz
Maximum power at the antenna connector	EU: 17 dBm USA: 31 dBm Canada: 23.7 dBm
Antenna Gain	9 dB
Equivalent Isotropic	EU: 26 dBm

Radiated Power (EIRP)	USA: 40 dBm Canada: 32.7 dBm
Signal modulation	FMCW
Certifications	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.

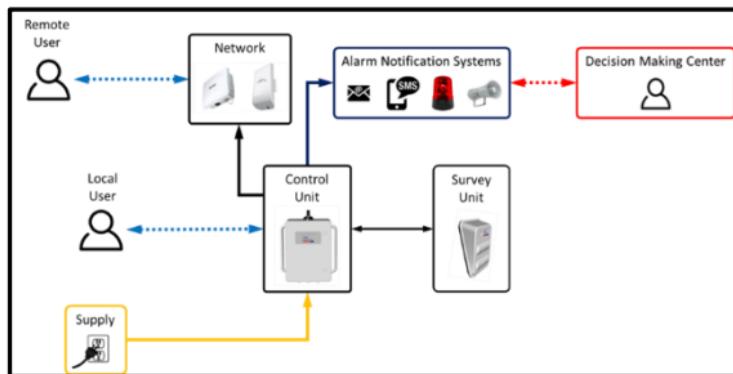


Fig. A- RockSpot system architecture

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

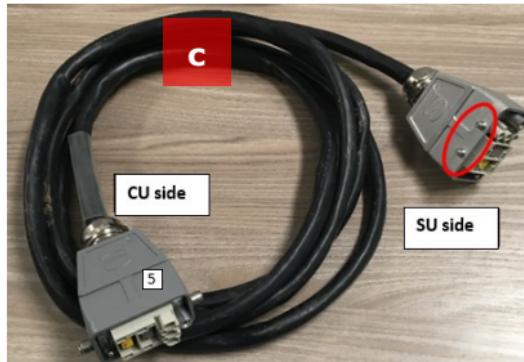
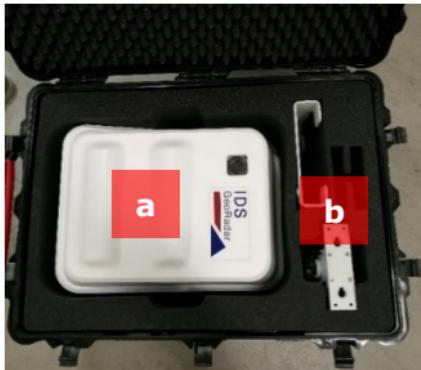
The system is delivered with two main boxes (Control Unit Box; Survey Unit iCase).



4.2.1 Survey Unit Case

The Survey Unit case contains:

- a) Survey Unit (compact module enclosing the radar sensor, the camera and the GNSS)
- b) Mounting Brackets and metallic ties
- c) 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.



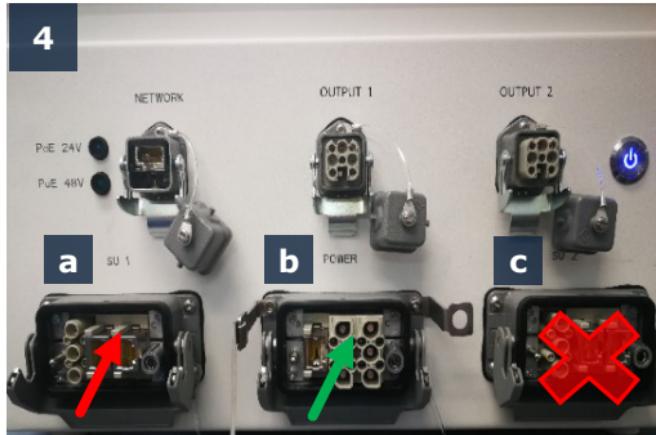
Apply. isolating or Dutch tape on the sharp- cutting edge of the metallic ties that fix the CU and SU, after HW installation. Make sure of the proper fixing-fastening of the SU and CU brackets

3. Connect the SU to the CU by the designated cable (Errore. L'origine riferimento non è stata trovata.)

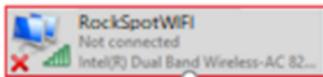
4. Connect the CU to the SU by inserting the dedicated cable (Errore. L'origine riferimento non è stata trovata.) in the connector **a** (SU1 red arrow); do not connect the survey unit to the connector **c** (SU2).

In order to supply the CU, connect the designated cable (Errore. L'origine riferimento non è stata trovata.,

Errore. L'origine riferimento non è stata trovata.) to the Power Connector **b** (green arrow) an 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

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

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 functionality and performance are dependent on several external factors (as described below) even if operated within the given Specifications as defined in the User Manual.

Possible limitations of a RockSpot are described below; in no way they must be intended as exhaustive.

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

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.

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.

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.

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.

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.

For RockSpot System, Buyer/User warrants:

- 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.
- 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.

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.

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".

7.1 **Generals Limitations**

7.1.1 **Power supply**

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.

7.1.2 Hardware/Software

RockSpot system is designed to operate continuously 24/7, but it may become temporarily unavailable due to hardware/software 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 alert activation addressed to Decision Maker are not available until the instrument is repaired. It is user responsibility to check such warning messages regularly and to take appropriate actions accordingly. This notification mechanism may fail because of hardware or network failure.

7.1.3 Alert rules setup

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

7.1.4 Data Quality

In case of extreme weather conditions radar data quality may drop below the required minimum threshold. In this case the user is notified by an alert, and the monitoring and event detection will not be available. Consequently, SFE alerts will not be triggered. This notification mechanism may fail because of hardware or network failure.

7.1.5 False alarms & Missing detections

Like any other radar device, RockSpot may be subjected to false positives (detections triggered in the absence of a real SFE or unwanted detections), and false negatives (missing detections). IDS GeoRadar shall not be liable in the event of such false positives and missing detection. In radar-based systems false positive probability depends on noise characteristics at the receiver and the chosen threshold, and may vary on the specific scenario. The probability of false negatives depends on the power of backscattered signal from moving object, which in turn depends on various factors

(weather, radar line of sight, geometry, kinematics) and changes from scenario to scenario.

7.1.6 DTM Availability

To properly locate and track the SFE events, RockSpot requires an accurate DTM of the monitored scenario, which needs to be provided by the user. DTM required accuracy must be at least equal to the radar tracking specifications reported in Tab. 3.2. In case DTM accuracy is below the minimum required accuracy, location and precise tracking of SFE events will be affected. DTM is also necessary to distinguish the areas with moving machineries from those affected by SFE. 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.

7.1.7 GNSS coverage

To properly locate and track SFE 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.

7.1.8 Output ports operation

Output ports activation by RockSpot system, requires that appropriate alert devices (such as sirens, etc.) are correctly connected and working. In case of alert devices not correctly connected or not working, the alert activation will therefore not be possible. It is user responsibility to connect appropriate alert devices and ensure that they are correctly connected, working and maintained.

RockSpot output ports must not be used to connect devices featuring an automatic decision for alert generation (e.g. barriers, traffic lights, evacuation triggers, etc.); as stated in paragraph 3, this represents a misuse of the system. IDS GeoRadar stress out that RockSpot has not been designed as an automatic decision-making system; in fact, it has been

designed for providing information and notification to Decision Maker. Critical decisions about reactive measures to be taken with reference to sudden falling event related to geologic hazard must be taken by the Decision Maker under his exclusive responsibility. IDS GeoRadar does not assume any liability whatsoever for any consequences related to such a misuse of the output ports and hereby disclaims any and all liability related to the use of RockSpot as automatic decision-making device.

7.1.9 Network operation

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.

7.1.10 Mobile phone coverage

Alert messages dispatch by RockSpot system, requires an appropriate mobile phone communication network coverage. In the absence of adequate coverage, messages dispatch cannot be guaranteed. It is user responsibility to provide for an appropriate mobile phone communication network coverage.

7.1.11 Early warning

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

7.2 Performance limitations

7.2.1 Opearating Range

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

7.2.2 Field of View

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. SFEs occurring outside the RockSpot FoV cannot be detected by the system

7.2.3 SFEs size/extent

RockSpot system provides state-of-the-art performance in terms of SFEs size/extent sensitivity detection. Detection probability increases with the SFEs surface extension. SFEs with small dimensions may not be detected by the RockSpot.

7.2.4 Alert activation time

RockSpot system is designed to trigger an output signal as soon as possible after the SFEs. However, the activation time depends on the quality of the signal reflected by the SFE, and in some circumstances, it is not possible to guarantee the output signal activation in due time. It is 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.

7.2.5 Alert activation sensitivity

RockSpot system provides state-of-the-art performance in terms of SFE alert activation sensitivity. RockSpot sensitivity depends on the quality of the signal reflected by the SFE, which is influenced by many factors including but not limited to the distance, the angle of view, size/extent, shape, material, 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 SFEs, which IDS GeoRadar is not liable for.

7.2.6 Line of Sight

Doppler Radar technology detect the movement only along the Line of Sight (LoS). SFEs taking place perpendicularly or close to the perpendicular to the radar LoS could be underestimated or even undetected. The number of radars to be installed and their locations must be carefully evaluated in order to minimize this effect, although, due to installation constraints, there could be residual areas on the slope with unfavourable LoS. The user handles the evaluation of the number of radars to be installed as well as for the decision of their location. It is user responsibility to decide on a proper installation plan accordingly.

7.2.7 SFE speed

RockSpot system is designed to detect moving object over a minimum speed threshold. SFEs having a line of sight velocity under the minimum detectable speed (see data sheet) cannot be detected. IDS GeoRadar declines any liability for such missed detections.

7.2.8 Simultaneous events

RockSpot has been designed to detect and track a single event per distance. However, the system can correctly handle multiple events simultaneously, if their instantaneous distances from the sensor differ by at least 20 m from each other. Multiple events occurring simultaneously at the same distance, might reduce system detection and tracking performances and hence, there is no liability/responsibility whatsoever of IDS GeoRadar in case of multiple events which occur simultaneously.

7.2.9 Ordinary Maintenance and expected service life

RockSpot performances set forth in the datasheet imply that the following actions, as detailed in the user manual and explained during the training as per section **Errore. L'origine riferimento non è stata trovata.** (Training) (i.e. the ordinary maintenance activities) must be performed by the user. Whether such ordinary maintenance activities, such as bracket's bearing and tilt nodes monthly tightening, metallic ties monthly checking and fastening, cables and connectors annual inspections, camera glass polishing are not carried out by the user, RockSpot performance may decrease (FoV and LoS not optimal, possible receiver electronics damage due to Survey Unit and Control Unit movement/detachment with consequent loss of signal quality, possible interference with other systems due to Survey Unit movement). As a result of such performance limitation rate of false positives and false negatives may increase, SFEs may be wrongly geocoded on the DTM, and videos from camera could be blurred.

It is exclusive responsibility of the user to carry out proper ordinary maintenance on the RockSpot unit/s, IDS GeoRadar annual support packages do not replace ordinary maintenance. IDS GeoRadar shall not be liable for any RockSpot performance not matching the datasheet specification in the event of ordinary maintenance deemed wrong or missing by IDS GeoRadar in its sole discretion. Provided that ordinary maintenance is properly and timely performed on the equipment, RockSpot expected service life is 7 years after system commissioning. RockSpot performance may be degraded after the end of Expected Service Life. IDS GeoRadar shall not be liable for any RockSpot performance not matching the datasheet specification after the end of Expected Service Life.

7.3 Environmental limitations

7.3.1 Operating Temperatures

RockSpot system is designed to operate in a wide temperature range, however operation close the operating temperature limits could decrease the intrinsic radar sensitivity. Operation outside the system specifications (see data sheet) is not guaranteed.

7.3.2 Atmospheric events

RockSpot system incorporates state-of-the-art algorithms for the correction of atmospheric-induced false positives. 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 alerts, especially under particularly strong or sudden atmospheric variations.

7.3.3 Vegetation movements

RockSpot system incorporates state-of-the-art algorithms for the correction of vegetation-induced false positives. 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 alerts, especially in densely vegetated areas.

7.3.4 Hydrological elements

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

7.3.5 Machinery

RockSpot system provides measurement of very wide area, the presence of machineries such as cars, trucks, shovels, etc. must be considered. These moving objects inside the system FoV may introduce false alerts, especially in areas where these machineries are present.

7.3.6 Multiple reflection

Due to the complex physics of electromagnetic wave propagation some slope scenarios could generate multiple reflections of radar waves which cannot 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.

7.3.7 Multiple Survey Unit interference

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.

7.3.8 External devices interference

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, limit the radar detection performances.

8 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@idsgeordar.com



©2020 IDS GeoRadar – Part of Hexagon

www.idsgeoradar.com



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.

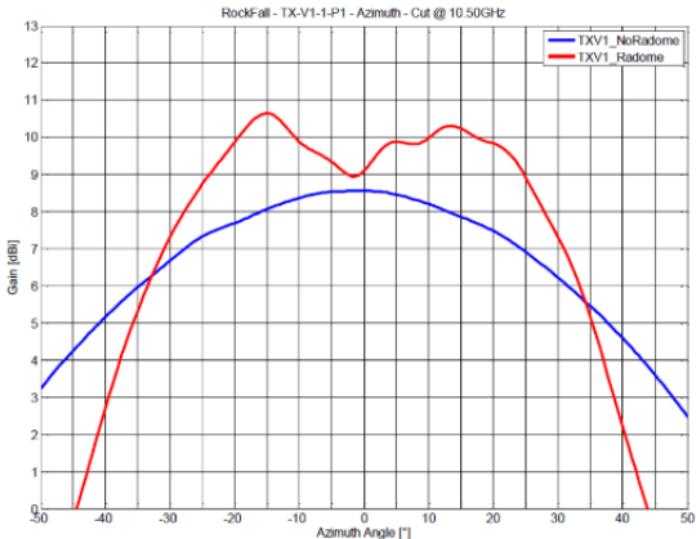


Figure A – TX Antenna: azimuth beam pattern

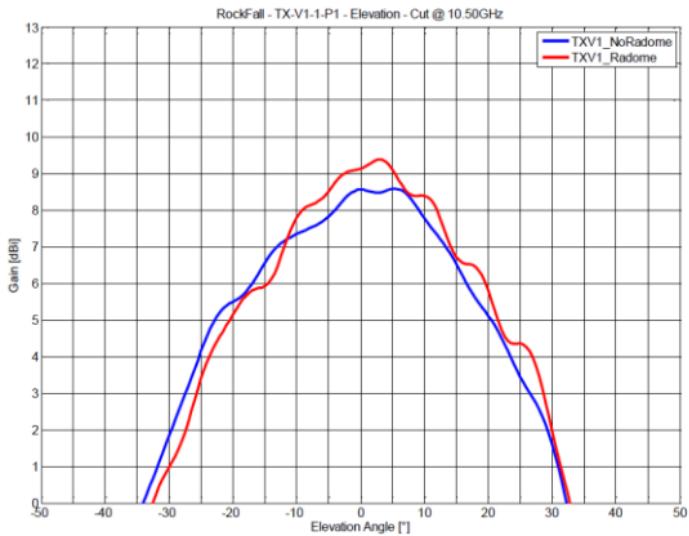


Figure B – TX Antenna: elevation beam pattern

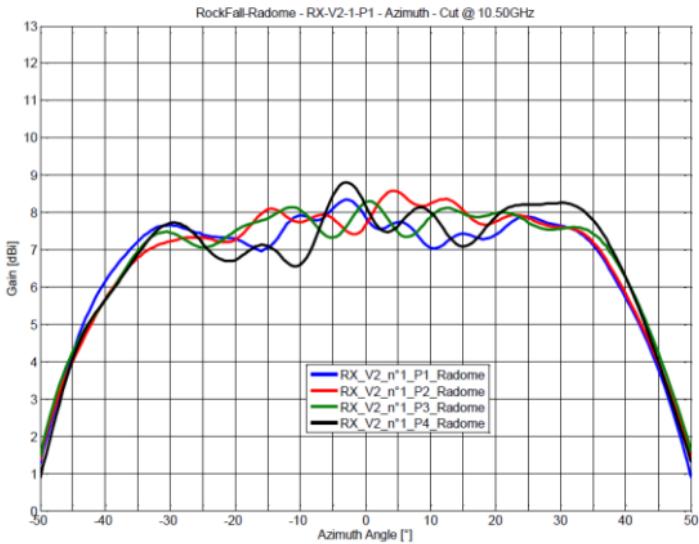


Figure C – RX Antenna: azimuth beam pattern

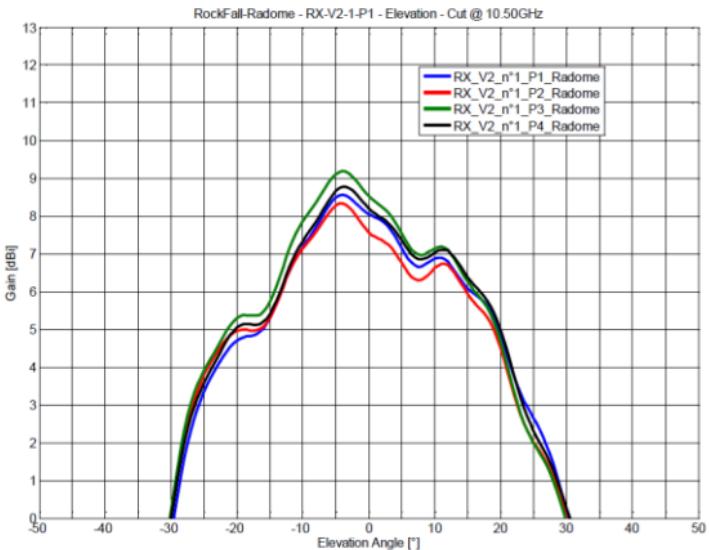


Figure D – RX Antenna: elevation beam pattern