HEXAGON MINING

MINING SAFETY

HxGN Mine Operator Alertness System – Light Vehicles

User Reference Manual

Version No. 3.0
Issued February 2020
English

HxGN Mine Operator Alertness System – Light Vehicles User Reference Manual

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This document is optimized for printing on Letter paper.

Revision History

Date	Document Version	Software Version	Author	Revision
20 Feb 2020	1.0		Marco Carvalho	Manual Initial Version
06 Mar 2020	2.0		Gustavo Severino	Adding the MPE Calculations, Label Variants, adding all units
13 Apr 2020	3.0		Gustavo Severino	Updating the Labels, statements to ANATEL and NOM/IFT compliance and the item 3.2 with the RF Exposure Caution.

Table Of Contents

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1 Document Introduction

The HxGN Mine Operator Alertness System – Light Vehicles User Reference Manual is part of Hexagon Mining's Documentation Suite.

This manual is intended to serve as a guide to the Mine Operator Alertness System – Light Vehicles (OAS-LV) module. This manual provides all instructions required to operate the OAS-LV product to a basic level. This manual provides an overview of the system together with the care and transport, technical data, and safety directions.

It is assumed a person using this manual is familiar with:

- Site-specific safety procedures, Safe Work Procedures (SWPs) and Standard Operating Procedures (SOPs).
- Electrical installation processes and procedures.
- Hardware installation processes.
- Hexagon Mining equipment installation.

Note

The document uses generic images to show general layout and generic information for various procedures. The site-specific screen layout, menu, and procedure information may vary from what is displayed in the manual.

1.1 Contacting Support

For all Hexagon Mining product support:

Contact Method	Details
Web portal	https://hexagonmining.com/customer/portallogin

1.2 Document Conventions

This document uses basic conventions to indicate actions:

Convention Example	Description
Select **FILE** > **PRINT**	Menu selections, buttons, and icons appear in bold text. In this case, select the **FILE** menu and the **PRINT** option. Location and capitalization of menu items may vary by mine site.
Ctrl+P	Keyboard shortcut keys. The example indicates to select and hold down the Ctrl key and select the P key.
See xxx Refer to	"See" indicates a reference to another section of this document. "Refer to" indicates reference to another document.
WARNING	Warnings alert the user to dangerous procedures which could cause injury or death.
CAUTION	Cautions alert the user to dangerous procedures which could cause damage to equipment.
Note	Notes supply important information about a procedure which is not covered in the procedure text.

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2 Overview

The HxGN Mine Protect OAS-LV embedded module computer serves as an on-machine integrated Fatigue Monitor application module. It detects and monitor Fatigue patterns using a camera in real-time position through GNSS. It can store fatigue events information and communicates back to a central server using integrated vehicle Wi-Fi or cellular networks. The camera can detect and track fatigue patterns even in harsh conditions like in the dark due to IR illuminators installed in the module.

Note

The images used in this manual are for reference purposes only; individual screens and icons may differ from the actual items.
This product is intended for Professional Use only.

HxGN Mine Protect OAS-LV is industrial solution targeting to light vehicles.

2.1 System Information

2.1.1 HxGN Mine Protect OAS-LV models 202, 204, 211 and 280

The OAS-LV module consists of an 2GHz Quad-core, ARM Cortex-A53™ plus 400MHz Cortex-M4™ real-time processor, an internal GNSS receiver, USB port, USB OTG (Ethernet driver), enabling it to serve as monitor fatigue device for data transfer to a central server via Wi-Fi and/or a Cellular network.

The OAS-LV unit is identified by its black base

2.1.2 OAS-LV Features

All OAS-LV modules share these features:

- One GNSS module (L1 GPS/GLONASS/BeiDou). (1 x SMA connector for external antenna)
- One WI-FI/BT Integrated module
- One 4G LTE Module configured to operate according to some specific bands
- One Power Input port w/ignition sense (9V-32 VDC, 5W)
- Two USB 2.0, 480 Mbit port, available in Micro USB (OTG) and Mini-USB connectors
- One Micro SD memory card interface supporting 64 GB of data
- Two integrated speakers
- Four IR Illuminators
- Digital Camera with optical size of 1/4" and 5 Megapixel.
- Multicolor LED
- SIM card holder to support 4G LTE cellular communication.
- One internal 3-axis accelerometer.
- Multi-Function Push Button switch

2.1.3 Cellular Modem Specs

CAUTION
The 4G SIM card must be a data SIM, and data must be activated on the carrier's network. Voice-only networks won't carry the data.

Note
Data charges may apply. Due to the activity on the networks, unlimited data contracts are suggested to avoid extra data charges.

2.1.3.1 Model 202 – Cellular modem specs

One Cellular Modem (4G LTE, 3G UTMS)

- LTE – Band 2, 4, 5,12 and UTMS Band 5 and Band 2

2.1.3.2 Model 204 – Cellular modem specs

One Cellular Modem (4G LTE)

- LTE – Band 4, 13

2.1.3.3 Model 211 – Cellular modem specs

One Cellular Modem (4G LTE, 2G GSM/GPRS)

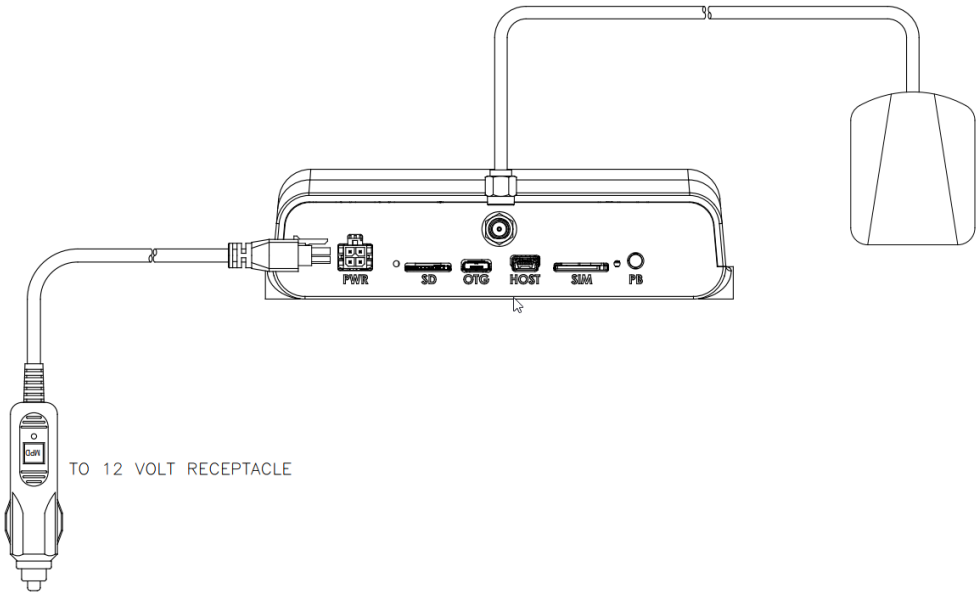
- LTE – Band 3, 7, 20 and E-GSM 900MHz and DCS 1800MHz

2.1.3.4 Model 280 – Cellular modem specs

One Cellular Modem (4G LTE, 3G UTMS)

- LTE – Band 3, 8, 28 and UTMS Band 1

2.1.4 OAS-LV System Diagram



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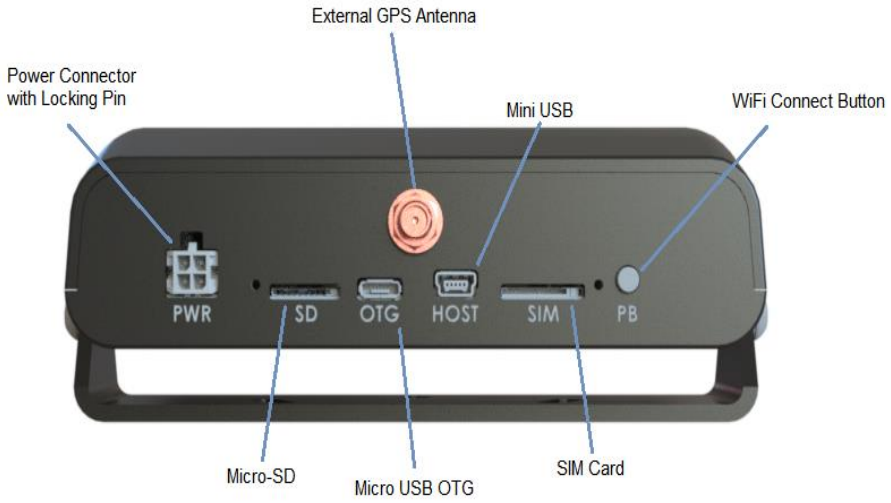
2.2 Connector Description

2.2.1 Connector Identification

The OAS-LV has a connector identification according to the picture below.



2.2.2 Connector Interface Description

A description of the interfaces is listed in the following table:

Connector/Device name	Connector/Device specification	Label Name	Interface
Power Connector with Locking Pin	Micro-Fit, 4POS, 3MM, Dual Row	PWR	9-32V DC power in, ignition sense input
Micro-SD	Micro-SD Memory card connector, Push-Push	SD	
USB OTG	Micro USB, Receptacle, 5POS, Type B	OTG	USB OTG connection to interface to external devices (examples)
USB Host	Mini USB, Receptacle, 5POS, Type B	HOST	USB Host connection to interface to external devices (examples??)
Sim Card	Micro SIMM Card connector, Push-Push	SIM	Cellular carrier SIM card interface
Push Button	Push Button Switch	PB	Push Button Switch to control Wi-Fi operation mode
External GPS Antenna	SMA, Female	-	External GPS Antenna

2.3 Multifunction LED

The LED on the front of the OAS-LV indicate the status of the module for different working and error conditions

2.3.1 LED Indicator Light Location

The LED indicator light is located on the front of the module in right side. Picture below indicate the LED turned on in green.

2.3.1.1 LED Identification

There is one external LED indicator light on the OAS-LV module. It is a multicolor led that can show different status or Error coders for the unit. See 2.3.1.2 LED Status and Error Codes below for more information on the displayed light patterns.

LED	Function
Multicolor LED	The LED can show different status and codes with will indicate how it is working.

2.3.1.2 LED Status and Error Codes

The Multicolor LED indicates different status for Power, GPS signal, Wi-Fi power and status of the unit during boot up and regular operation. Details of the LED status codes are shown below:

State	LED Color/Status	Notes
Power off	Turned off	System running, or powered off
Booting process	BLINK	Initial on-boot
Flashing Yellow	BLINK	Starting up or loading software from microSD
System Failure	BLINK	System failure, typically GPS not available

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State	LED Color/Status	Notes
Wi-Fi Hotspot	BLINK	Wi-Fi hotspot enabled

2.4 Speaker

The system is composed by two speakers which provides audio messages to the operator.

Currently the following messages are provided in English.

Message Description	Audio Message
"blocked_camera"	"camera has been obstructed"
"bluetooth_connected"	"bluetooth connected"
"bluetooth_disconnected"	"bluetooth disconnected"
"braking_event"	"hard braking detected"
"burn_in"	"system burn in mode"
"caution"	"proximity alert"
"caution_front"	"caution, front"
"caution_front_left"	"caution, front left"
"caution_front_right"	"caution, front right"
"caution_rear"	"caution, rear"
"caution_rear_left"	"caution, rear left"
"caution_rear_right"	"caution, rear right"
"collision"	"collision alert"
"collision_stop"	"collision alert, stop"
"collision_slow_down"	"collision alert, slow down"
"cornering_event"	"hard cornering detected"
"dispatch_1"	"please contact dispatch"
"distraction_1"	"distraction noticed, please keep your eyes on the road"
"distraction_2"	"distraction alert"

Message Description	Audio Message
"distraction_3"	"caution, concentrate on the road"
"fatigue_1"	"fatigue alert"
"fatigue_2"	"if you are fatigued, please contact your supervisor"
"fatigue_3"	"if you are fatigued, please contact dispatch"
"fatigue_4"	"stay alert, call dispatch if you are tired"
"fatigue_5"	"if you feel sleepy, call dispatch or your supervisor"
"fatigue_6"	"caution, if you feel tired call your supervisor"
"fatigue_look_down"	"fatigue alert, looking down"
"focused_1"	"stay focused, if you are tired get dispatched to change room"
"focused_2"	"stay focused, concentrate on the road"
"following_dist"	"following distance breached"
"front"	"front"
"goodbye"	"goodbye"
"gps_error"	"GPS offline"
"heavy_machinery"	"heavy machinery"
"hello"	"hello"
"id_not_found"	"operator ID not found"
"id_not_found_2"	"your operator ID cannot be found"
"illuminator_ok"	"IR illuminator OK"
"light_vehicle"	"light vehicle"
"left"	, "left"
"logged_in"	"logged in"
"logged_off"	"logged off"
"mesh_network_ok"	"mesh network, OK"

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Message Description	Audio Message
"oas_init"	"operator alertness system initialized"
"no_face"	"the fatigue sensor cannot see your face, please call DISPATCH now"
"no_face_2"	"the fatigue sensor cannot see your face"
"no_operator"	"no operator is currently logged in"
"no_sound"	"I can't say that"
"on_boot"	“welcome aboard, your fatigue management system is operational"
", "on_boot_2"	"your fatigue management system is ready"
"on_login"	"you are logged in"
"on_login_failed"	"operator ID not found"
"on_logoff"	"you are logged off"
"overspeed"	"overspeeding alert, slow down"
"pedestrian_1"	"pedestrian alert, slow down"
"pedestrian_2"	"pedestrian alert, stop"
"pedestrian_3"	"pedestrian alert"
"phone_detected"	"cellular phone detected"
"please_login"	please login"
"proximity"	"proximity alert"
"radar_1"	"radar alert, slow down"
"radar_2"	"radar alert, stop"
"radar_3"	"radar alert”
"rear"	"rear"
"right"	"right"
"speed_1"	"speeding alert, please slow down"
"speed_2"	"speeding alert"
"speed_3"	"caution, your speed is too high"

Message Description	Audio Message
"supervisor_1"	"please contact your supervisor"
"system_failed"	"your fatigue system is not yet operational"
"system_ok"	"your fatigue system is fully operational"
"system_shutdown"	"your fatigue system is shutting down"
"warning"	"collision alert"
"warning_front"	"warning, front"
"warning_front_left"	warning, front left"
"warning_front_right"	"warning, front right"
"warning_rear"	"warning, rear"
"warning_rear_left"	"warning, rear left"
"warning_rear_right"	"warning, rear right"
"welcome"	"welcome"
"wifi_ok"	"wireless network is online"
"wifi_start"	"Wi-Fi hotspot enabled"
"wifi_stop"	"Wi-Fi hotspot disabled"
"seatbelt"	"please fasten your seatbelt"
"format_sdcard"	"formatting backup video storage"

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2.5 Label

2.5.1 Label Location

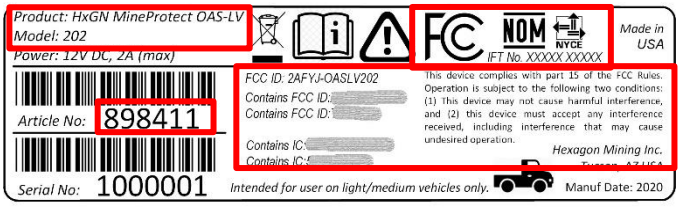
The product has just one label were all information related to the product can be found. The label is located at the back of the unit like shown in the picture attached.

The Product label on the base of the module lists: Description, Power Requirement, Article Number, Serial Number, Company name and where Manufactured.

2.5.2 Label Content and Layout

The label layout is the same for all variants available. The information will change according to the article number and its certifications.

- Product: HxGN MineProtect OAS-LV
- Model: 202, 204, 211, 280
- Article Number: 898411, 905058, 905059, 905060
- Compliance requirements: FCC, IC, CE, ANATEL, NOM, IFT, ICASA, RMC

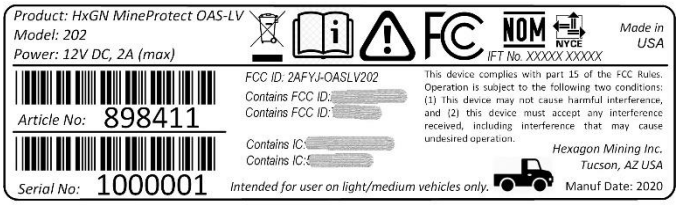


2.5.3 Label Examples

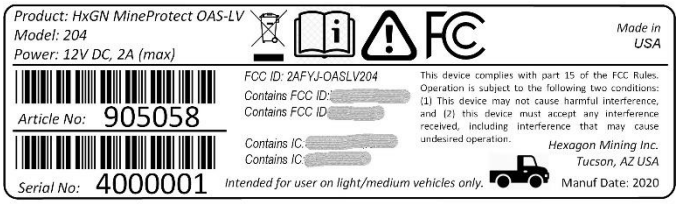
2.5.3.1 FCC Certification Labels

Model: 202

Note
This model includes the NOM Certification.



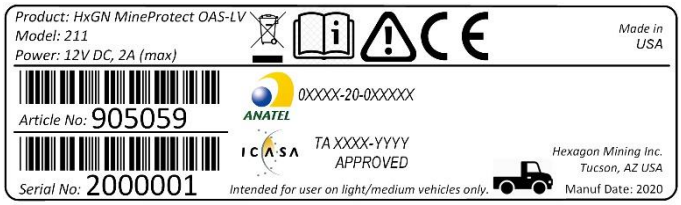
Model: 204



2.5.3.2 CE Certification Labels

Model: 211

Note
This model includes ANATEL Certification and ICASA Certification.



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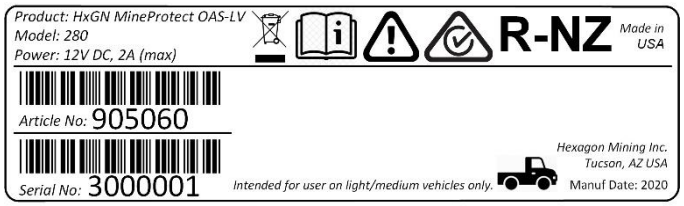
2.5.3.3 RCM Certification Labels

Model: 280
Note This model includes R-NZ Certification. 

3 Hardware Installation

3.1 Before Installation

Installation requires specialized knowledge and must be installed by a Hexagon Mining Authorized Installer. Hexagon Mining recommends that installation of the OAS-LV equipment be performed by a qualified technician.

The average installation time varies, and the time of installation will be dependent on vehicle type and options purchased.

For OAS-LV module safety and installation instructions refer to the HxGN Mine Discover OAS-LV Installation Manual.

WARNING
All Hexagon Mining Equipment must be installed by qualified installation personnel.

CAUTION:
During any welding on the machine, the OAS-LV module must be completely isolated from the machine by disconnecting all its cables including power, I/O, and RF cables. Welding can cause large ground currents, which may damage internal electronic components of the OAS-LV module or its GPS antenna. The OAS-LV module is not warranted for damage when connected during welding activities.

- Install the system in a clean and dry workshop environment. Failure to do so may cause the system to short or promote product malfunction.
- Route and secure all cables and wiring to ensure that they do not rub, causing premature failure.

3.2 OAS-LV Module Installation

CAUTION

RF Exposure: OAS-LV has internal antennas and must be mounted more than 20 cm away from the human body.

WARNING
Do not mount the OAS-LV where it may obscure the driver's view of the road or field.
Do not mount the OAS-LV where it may be struck by a deploying airbag.

For OAS-LV module safety and installation instructions refer to the HxGN Mine Discover OAS-LV Installation Manual.

3.2.1 Power Cable Installation

For OAS-LV module safety and installation instructions refer to the HxGN Mine Discover OAS-LV Installation Manual.

WARNING
Always ensure the power supply cable is connected at the 9-32V DC power supply source on the vehicle through a fuse rated no higher than 3A. Failure to do so may result in damage to the equipment and/or fire.

CAUTION
The OAS-LV unit is a 9-32-volt DC (negative-to-earth) system only. Connecting to a positive-to-earth system will cause damage, which is not covered by warranty.

There are two ways to connect the power cable to the vehicle:

- Cigarette plug
- Regular Installation

3.2.1.1 Installation using Cigarette Plug

1. Make sure the vehicle cigarette socket supplies a voltage in the range from 9 to 32V DC.

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2. Connect the cigarette plug connector side in the supplied power cable to the vehicle cigarette socket
3. Route and secure all cables and wiring to meet Hexagon Mining requirements and ensure that there is no rubbing, which can cause premature failure.
4. Connect the other side of the power cable in the OAS-LV unit. Make sure the cable connector will lock in the OAS-LV Power connector.

3.2.1.2 Regular installation

1. Connect the supplied power cable to a reliable power source, for example, the vehicle's main power system.
2. Connect the red wire to a 9-32-volt positive, 3A fused power source, capable of delivering a constant 5A.
3. Connect the black wire to the vehicle's earth.
4. Connect the blue wire to a 9-32-volt positive, 5A fused source that is active (positive voltage) when the vehicle's ignition key is turned to the "ON" position.
5. Route and secure all cables and wiring to meet Hexagon Mining requirements and ensure that there is no rubbing, which can cause premature failure.
6. Connect the other side of the power cable in the OAS-LV unit. Make sure the cable connector will lock in the OAS-LV Power connector.

3.3 Antenna Installation

3.3.1 GNSS Antenna Application

To ensure correct antenna application, refer to the Antenna Application table.

WARNING
Only antenna listed in the Antenna Application table are permitted to be used. If higher powered antennas are used, injury to personnel may occur.

WARNING
The Wi-Fi antennas must be mounted more than 30cm away from the operator.

CAUTION
Only antenna cables provided with the OAS-LV module equipment for installation, and as identified in the specific OAS-LV module installation diagrams are to be used in OAS-LV module antenna installations to ensure optimal performance and meet regulatory requirements.

GNSS Antenna Application

Module	Required Antenna: Hexagon Mining Part Number
OAS-LV	GNSS: 913422

3.3.2 GNSS Antenna Installation

CAUTION
Antennas must be mounted more than 20 cm away from any other antenna.

CAUTION
The OAS-LV GNSS Antenna must be mounted with a clear view of the sky and free from any obstruction from machine components.

Note
Read all instructions prior to assembly and installation.

The OAS-LV GNSS Antenna must be mounted with a clear view of the sky and free from any obstruction from machine components and must meet the following criteria.

1. The OAS-LV GNSS Antenna must be on the flat level part of the machine or mast.
2. Route the cables through the existing grommets if possible; if not, modification may be required to route the cables to the required location. If creating a new entry point, use a grommet to protect the cables.
3. The cables must not be cut, kinked, or bent tightly, as it degrades performance and a system failure may result.
4. Cables must be routed neatly back to the OAS-LV.

3.4 Connection to Additional Sensors or devices

For connection to all additional sensors and interfaces refer to machine specific installation manuals.

3.5 Upgrade Software

New versions of software may be installed on the OAS-LV module from either a USB Flash Drive or by using Hexagon's web-based software configuration tool. Please consult the Hexagon Mine Protect OAS-LV Configuration manual for detailed instructions regarding how to update software on the OAS-LV module.

4 Care and Transport

4.1 Transport

When transporting the product by rail, air, or sea, always use the complete original Hexagon Mining packaging, cardboard box, or an equivalent, to protect the product against shock and vibration.

4.2 Storage

Ensure the temperature limits are followed when storing the equipment, particularly in summer if the equipment is inside a vehicle. Please reference the Technical Data section for information about temperature limits.

4.3 Cleaning and Drying

4.3.1 Product and Accessories

Use only clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

4.3.2 Connectors and Plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

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5 Safety Directions

5.1 General Introduction

- The following directions should enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.
- The person responsible for the product must ensure that all users understand these directions and adhere to them.

5.2 Intended Use

5.2.1 Permitted Uses

- Module is intended for Mining use only.
- Module is intended to be fitted to Mining assets only.
- Data communication with external appliances as part of a Hexagon Jigsaw Mining Solution.

5.2.2 Adverse Use

Adverse use can lead to injury, malfunction, and damage. It is the task of the person responsible for the equipment to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed on how to work with it.

WARNINGS:
Unauthorized modification of Mining machinery by mounting or installing the product may alter the function and safety of that mining machinery.
WARNING:
Follow the instructions of the machinery manufacturer. If no appropriate instruction is available, ask the machinery manufacturer for instructions prior to mounting or installing the product.

The following items result in adverse use.

- Use of the product without instruction.
- Use outside of the intended limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools (e.g. a screwdriver) unless this is specifically permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obviously recognizable damage or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Hexagon Mining.
- Inadequate safeguards at the working site (e.g. when using on the intended site).

5.3 Limits of Use

5.3.1 Environment

WARNING
Not to be used on planes or any aircraft.

WARNING
Local safety authorities and safety experts must be contacted before working in hazardous areas, or in close proximity to electrical installations or similar situations by the person in charge of the product.

This product is suitable for use in an atmosphere appropriate for permanent human habitation.

5.4 Responsibilities

5.4.1 Manufacturer of the Product

Hexagon Mining is responsible for supplying the product, including the User Manual and original accessories, in a completely safe condition.

5.4.2 Manufacturers of Non-Hexagon Mining Accessories

The manufacturers of non-Hexagon Mining accessories for the product are responsible for developing, implementing, and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Hexagon Mining product.

5.4.3 Persons in Charge of the Product

WARNING:
The person responsible for the product must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the product and for the safety of the equipment in use.

The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instruction in the User Manual.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Hexagon Mining immediately if the product and the application becomes unsafe.

5.5 Hazards of Use

5.5.1 General Hazards

- The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial, and environmental consequences.
- All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.
- Only Hexagon Mining authorized service workshops are entitled to repair these products.
- Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.
- Always ensure that the working site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.
- The operator assures that the machine is operated, guided and monitored by a qualified user (e.g., a licensed driver). The user has been able to take emergency measures, for example an emergency stop.
- While providing information to the operator of the machine, accidents may occur due to:
  - The operator not paying attention to the surroundings (people, ditches, traffic, etc.).
  - Malfunctions (of a system component interface, etc.).

5.5.2 Mechanical Hazards

- Incorrect fastening of the equipment to vehicles or transporters poses the risk of the equipment being broken by mechanical influence, vibration, or airstream. This may result in accident and injury.
- Periodically carry out test measurements and perform the field adjustments, particularly after the product has been subjected to abnormal use and before and after important measurements.
- When setting up the product, ensure that the accessories are correctly adapted, fitted, secured, and locked in position. Avoid subjecting the product to mechanical stress.
- Attach the external antennae professionally. The external antennae must be secured additionally, for example by use of a safety cord. Ensure that the mounting device is correctly attached and able to carry the weight of the external antenna safely.
- Deflect the mechanically moving machine components as far as possible and define a safe installation zone.

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- If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example, by blows or falling objects, the product may be damaged, or people may sustain injury.

5.5.3 Lightning Hazards

WARNING:
If the product is used with accessories, for example, masts, staffs, or poles, you may increase the risk of being struck by lightning. Danger from high voltages also exists near power lines. Lighting, voltage peaks, or the touching of power lines can cause damage, injury and death.

- Be sure to remain at a safe distance from electrical installations. Do not use the product directly under or in close proximity to power lines. If it is essential to work in such an environment, contact the safety authorities responsible for electrical installations and follow their instructions.
- To prevent damages due to indirect lightning strikes (voltage spikes) cables, for example for antenna, power source or modem must be protected with appropriate protection elements, like a lightning arrester. These instructions must be carried out by an authorized specialist.
- If there is a risk of a thunderstorm, or if the equipment is to remain unused and unattended for a long period, protect your product additionally by unplugging all systems components and disconnecting all connecting cable and supply cables.
- If the product must be permanently mounted in an exposed location, it is advisable to provide a lightning conductor for the product as described below. Always follow the regulations in force by your country regarding grounding antennas and mast. These installations must be carried out by an authorized specialist.

5.5.3.1 Lightning Conductors

Suggestions for design of a lightning conductor for a GNSS system follow:

5.5.3.1.1 On Non-Metallic Structures:

On Non-Metallic Structures, protection by air terminals is recommended.

1. An air terminal is a pointed solid or tubular rod of conducting material with mounting and connection to a conductor.
2. The position of four air terminals must be uniformly distributed around the antenna at a distance equal to the height of the air terminal. The air terminal diameter must be 12mm for copper or 15mm for aluminum. The height of the air terminals must be 25cm to 50cm.
3. All air terminals must be connected to the down conductors. The diameter of the air terminal must be kept to a minimum to reduce GNSS signal shading.

5.5.3.1.2 On Metallic Structures:

Protection is as described for non-metallic structures, but the air terminals can be connected directly to the conducting structure without the need for down conductors.

5.5.4 Disposal

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced, which may impair health.
- By disposing of the product irresponsibly, unauthorized persons may use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

CAUTION

The product must not be disposed of with household waste. Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorized personnel. Product Specific treatment and waste management information can be obtained from your Hexagon Mining dealer.

5.6 Electromagnetic Compatibility (EMC)

The term Electromagnetic Compatibility is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

- Electromagnetic radiation can cause disturbances in other equipment. Although the product meets the strict regulations and standards that are enforced in this respect, Hexagon Mining cannot completely exclude the possibility that other equipment may be disturbed.
- There is risk that disturbances may be caused in other equipment if the product is used in conjunction with accessories from other manufacturers, for example field computers, personal computers, two-way radios, non-standard cables, or external batteries.
- Use only the equipment and accessories recommended by Hexagon Mining. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers and two-way radios, pay attention to the information about electromagnetic compatibility provided by the manufacturer.
- Disturbances caused by electromagnetic radiation can result in erroneous measurements. Although the product meets the strict regulations and standards which are enforced in this respect, Hexagon Mining cannot completely exclude the possibility that the product may be disturbed by very intense electromagnetic radiation produced by, for example, nearby transmitters, two-way radios, or diesel generators.
- Check the plausibility of results obtained under these conditions.
- If the product is operated with connecting cables attached at only one of their two ends, the permitted level of electromagnetic radiation may be exceeded, and the correct functioning of other products may be impaired.
- While the product is in use, connecting cables must be connected at both ends.

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6 Technical Data

6.1 Design

Aluminum base plate with Powder Coat finish for protection against corrosion and sunlight (UV).

Plastic ABS top enclosure

6.1.1 User Interface

- One Multicolor LEDs (refer to item 2.3 for more information).
- Two speakers (82db)

6.1.2 Dimensions

Length (cm)	Width (cm)	Height (cm)
15	12	5

6.1.3 Weight

Module	Weight (kg)
OAS-LV module	0.425

6.1.4 Power Supply

Power Consumption	External Supply Voltage
W max	Normal Voltage 24 V DC Voltage Range 9 V – 32 V DC

6.2 Interfaces

Interface	Description
SD Card	1 x SD card able to handle 64 GB card
USB Host	1 x USB 2.0 (480 MB/s)
USB OTG	1 x USB 2.0 (480 MB/s)
GNSS external antenna	GPS L1C/A; GLONASS L1OF; BeiDou B1I
SIM card	1 x SIM card
Push Button	1 x Push Button
Accelerometer	1 x Internal sensor, 3-axis accelerometer

6.3 Environmental Specifications

6.3.1 Temperature

Operating Temperature (°C)	Storage Temperature (°C)
-40 to +60	-40 to +85

6.3.2 Vibration

Parameter	Specification
Vibration	IEC 600068-2-64 5 Hz to 500 Hz, 15 mmpp 5 g, 1 Octave/min, 20 cycles each in X, Y, and Z Sweep to hold for 10 min at resonant frequencies 5Hz to 500Hz, 1 mmpp 5 g, 1 Octave/min, 20 cycles each in X, Y, and Z Sweep to hold for 10 min at resonant frequencies

6.4 FCC Statement (Applicable for U.S.)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense.

This equipment generates, uses and can radiate frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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

6.5 ANATEL Statement (Applicable for Brazil)

This equipment operates in a secondary manner, that is, does not have the right of protection against prejudicial interference, even from stations of the same type, and nor can they cause interference to systems operating in a primary manner.

6.6 IFT Statement (Applicable for Mexico)

The operation of this equipment is subject to the following two conditions: (1) it is possible that this equipment or device may not cause harmful interference and (2) the equipment or device must accept any interference, including interference that may cause undesired operation.

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7 Appendix A – Connector Pinout

	Micro-Fit, 4POS, 3MM, Dual Row	Micro-SD Memory Card connector, Push-Push	Micro USB, Receptacle, 5POS, Type B	Mini USB, Receptacle, 5POS, Type B	Micro SIMM Card connector, Push-Push
pin#	PWR	SD	OTG	HOST	SIM CARD
1	IGNITION (*1)	standard pinout	standard pinout	standard pinout	standard pinout
2	PWR IN (*2)				
3	GND				
4	GND				
5					
6					

*1 Ignition voltage range 9-36V

*2 Input voltage range 9-36V

8 Appendix B: FCC Maximum Permissible Exposure Calculations

Reference: FCC document 'Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. From herein this document is referred to as the 'FCC Guideline to MPE' document.

8.1 OAS-LV Intentional Radiators

The OAS-LV units comprise the following RF intentional radiators

8.1.1 Wi-Fi

Radio: Max Power 16 dBm (39.81 mW)

Antenna: 2.5 dBi, 2400 GHz to 2500 MHz – 3.0 dBi, 4900 MHz to 5900 MHz

Reference documents:

Refer Supplied Wi-Fi radio and Wi-Fi antenna data sheets.

8.1.2 GSM (LTE, 4G)

Radio: LTE and UMTS module, Max Power 23 dBm (200 mW)

Antenna: Gain 2.9 dBi, 698-960MHz, 4.3dBi 1710-2690MHz

Refer supplied Product Technical Specification and Antenna Specification for further information.

8.2 MPE Calculations

8.2.1 MPE Formula

The FCC Guide to MPE document section 3 'Methods of Predicting Human Exposure' page 17, advises to use the following formula

$S = P \bullet G / 4 \bullet \pi \bullet R^2$

⇨ $R = (P \bullet G / 4 \bullet \pi \bullet S)^{0.5}$

Where

S = Power Density (MPE) mW/cm^2

P = Power input to antenna (power output from radio) (mW)

G = Power gain of antenna relative to isotropic radiator (converted from dBi)

R = Distance from antenna (cm)

8.2.2 Wi-Fi MPE and LTE (LTE, 4G) Calculations

8.2.2.1 LTE 300 to 1500 MHz

Referring to The FCC Guide to MPE document, Appendix A, Table 1 (B) Limits for General Population/Uncontrolled exposure (300 MHz to 1500 MHz).

For 300-1500 MHz single transmitters (General use)

Freq. MHz	EUT Power dBm	EUT Power mW*	Cable Loss Loss dB	Ant Gain dBi	Power at Ant dBm	EIRP mW	Power Density (S) at 20 cm mW/cm^2	MPE Limit at 20 cm mW/cm^2
707.5	24.5	281.8	0	2.9	24.5	549.5	0.109	0.472
782.0	24.5	281.8	0	2.9	24.5	549.5	0.109	0.521
836.5	24.5	281.8	0	2.9	24.5	549.5	0.109	0.558

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8.2.2.2 Wi-Fi and LTE 1.5 GHz to 15 GHz

Referring to The FCC Guide to MPE document, Appendix A, Table 1 (B) Limits for General Population/Uncontrolled exposure (1.5 GHz to 15 GHz).

For 1.5-15 GHz single transmitters (General use)

Freq.	EUT Power		Cable Loss	Ant Gain	Power at Ant	EIRP	Power Density (S) at 20 cm	MPE Limit at 20 cm
MHz	dBm	mW*	dB	dBi	dBm	mW	mW/cm^2	mW/cm^2
1732.5	24.5	281.8	0	4.3	24.5	758.6	0.151	1.000
1732.5*	24.5	281.8	0	4.3	24.5	758.6	0.151	1.000
1880.0	24.5	281.8	0	4.3	24.5	758.6	0.151	1.000
2412.0	23.5	221.9	0	2.5	23.5	394.6	0.078	1.000
2462.0	23.5	221.9	0	2.5	23.5	394.6	0.078	1.000
5180.0	17.8	60.2	0	3.0	17.8	120.2	0.024	1.000
5230.0	17.8	60.2	0	3.0	17.8	120.2	0.024	1.000
5260.0	15.8	38.0	0	3.0	15.8	75.9	0.015	1.000
5320.0	15.8	38.0	0	3.0	15.8	75.9	0.015	1.000
5500.0	21.1	130.0	0	3.0	21.1	259.3	0.052	1.000
5720.0	21.1	130.0	0	3.0	21.1	259.3	0.052	1.000
5745.0	17.8	60.2	0	3.0	17.8	120.2	0.024	1.000
5825.0	17.8	60.2	0	3.0	17.8	120.2	0.024	1.000

* Verizon

Note 1:	Cell modem RF power information was derived from the test Report: MDE_UBLOX_1712_MPEb provided by 7 Layers (UMTS as worst case, including tune-up tolerances)
Note 2:	Tune up tolerance of +2 dB applied to Wi-Fi RF power per the test Report: TR 315356 E (RFx) provided by Laird

8.2.3 Simultaneous Transmission (WLAN and GSM) MPE Calculations

MPE, S_{TOT} <= 1.0mW/cm^2 at R = 20cm

Where $S_{TOT} = S_{WLAN} + S_{GSM}$

Using formula $S = P.G / 4.\pi.R^2$

FCC MPE Calculation

Combined exposure from all 2 radios (highest contribution from each radio) as a percentage of the corresponding limit

Freq. MHz	Power Density (S) at 20 cm mW/cm^2	MPE Limit at 20 cm mW/cm^2	% of the limit	Total
707.5	0.109	0.472	**23**	**23**
782.0	0.109	0.521	21	-
836.5	0.109	0.558	20	-
1732.5	0.151	1.000	15	-
1732.5*	0.151	1.000	15	-
1880.0	0.151	1.000	15	-
2412.0	0.078	1.000	**8**	**8**
2462.0	0.078	1.000	8	-
5180.0	0.024	1.000	2	-
5230.0	0.024	1.000	2	-
5260.0	0.015	1.000	2	-
5320.0	0.015	1.000	2	-
5500.0	0.052	1.000	5	-
5720.0	0.052	1.000	5	-
5745.0	0.024	1.000	2	-
5825.0	0.024	1.000	2	-
				31%

Result: **Pass**

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9 Glossary

Term	Definition
EMC	Electromagnetic Compatibility
GNSS	Global Navigation Satellite Systems
GPS	GPS is the shortened term for NAVSTAR GPS, which stands for Navigation System with Time and Ranging Global Positioning System.
g_{rms}	Unit of measure of force or acceleration due to gravity, where g is a unit of force (g = gravity) and rms is root mean square.
LED	Light-Emitting Diode
MPE	Maximum Permissible Exposure

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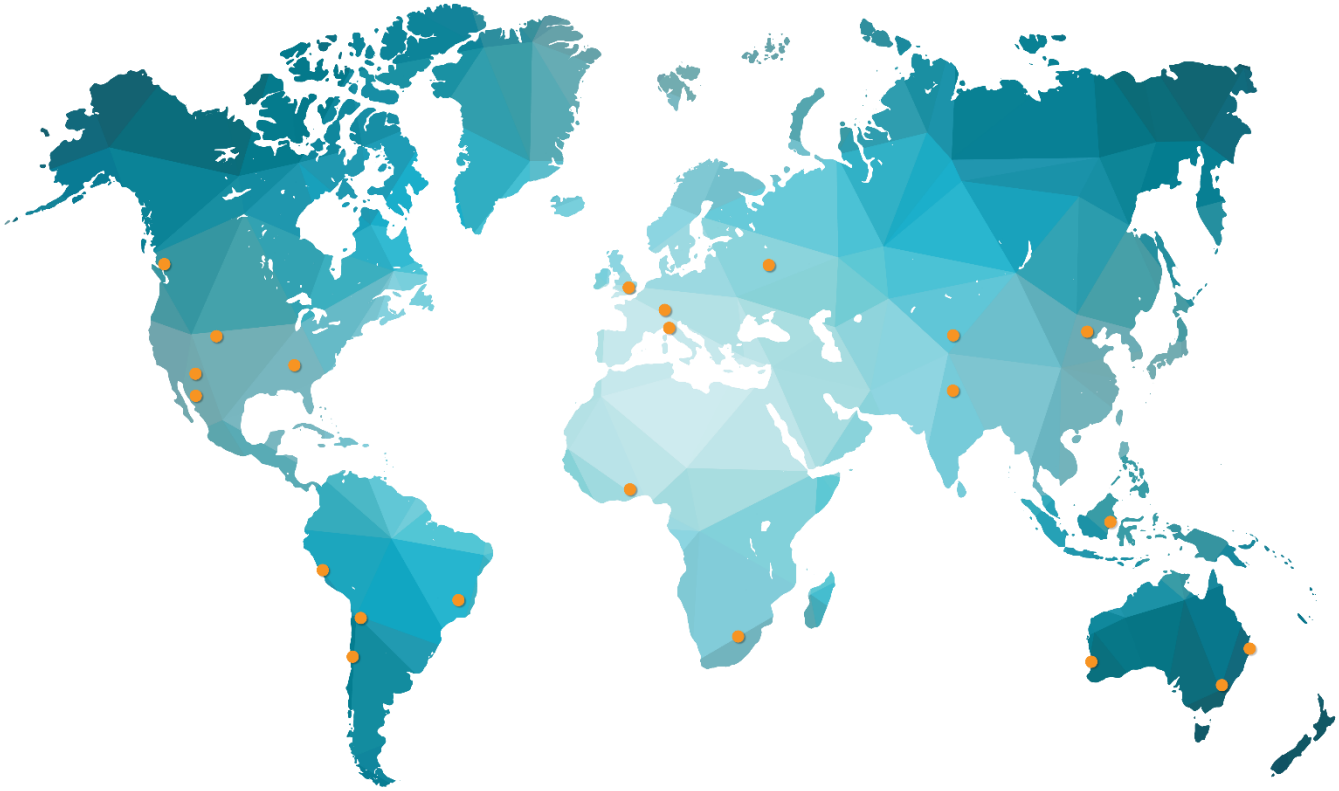

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Mining depends on precision, accuracy, and safety. Mines must find ways to integrate, automate, and optimize critical workflows for a competitive edge. Now more than ever, the industry must cut costs while improving safety.

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