

# HxGN MINEPROTECT PERSONAL ALERT

## PRODUCT MANUAL

### Version Control

Date	Version	Author	Description
2017-04-12	0.5	MBY	Initial draft version
2017-05-05	0.6	MBY	CAS LEDs Description
2017-10-15	0.7	MBY	Hardware
2018-05-18	0.8	MBY	Small Improvements
2018-05-18	1.0	MBY	Grammatic Improvements
2018-06-04	2.0	MBY	FCC Compliance
2018-07-13	2.1	MBY	Monitoring Update
2018-08-16	2.2	SIGB	FCC/IC Compliance

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## 1. Introduction

This document is aimed for customers and sales and represents the basic functionalities for the HxGN MineProtect Personal Alert. It describes the technology used, the recommended applications and limitations of the system.

The Personal Alert System (PA) is a pedestrian tagged personnel tracking system that utilizes the latest Time of Flight technology in the Ultra-Wideband (UWB) to determine with high precision personnel position relative to heavy machinery and provides reliable protection even under conditions of poor or no GPS reception.

## 2. Product Description



HxGN Mine Personal Alert is the first accident-avoidance device worn by field personnel that ensures visibility around heavy equipment. Using the reliability and precision of Time of Flight technology in the Ultra-Wide Band frequency, Personal Alert is integrated with Hexagon Mining's Collision Avoidance System (CAS) for a comprehensive warning solution.

It enhances the visibility of personnel and vehicles in dangerous situations, reducing accidents by alerting about the presence of anyone working around heavy machinery in the CAS display.

Position, heading, and path are calculated using the CAS in the vehicle, which together with PA accurately determine one or multiple surrounding pedestrian tags distances against the heavy machinery. This distance is then compared against the configured detection zones to alert vehicle operators and pedestrians in case of imminent risk.

The Personal Alert System (PA) provides the following main functions:

- **Personnel Position Awareness:** which shows the heavy machinery operators where personnel within the detection range are located.
- **Personnel Protection Alarms:** based on the movement of the personnel and the heavy machinery, it measures continuously the distance between machinery and pedestrian predict potential close interactions generating visual within protection distances and in case of critical danger audible and vibratory alarms to both heavy machinery operators and pedestrians to avoid possible accidents.

- Close Interaction Reporting/Notifications: Every close interaction alarm will generate an alarm that is transmitted to the monitoring/reporting server for immediate notifications or historical reporting for trend analysis.
- Personnel Tracking: All data is wireless transmitted to the server, which allows the personnel within range distance to a vehicle with CAS to be tracked on the Live monitoring web services.
- Incident Analysis: Pedestrian close interactions are logged in the on-board hardware, which can be recreated for incident analysis.

#### **FEATURES AND BENEFITS:**

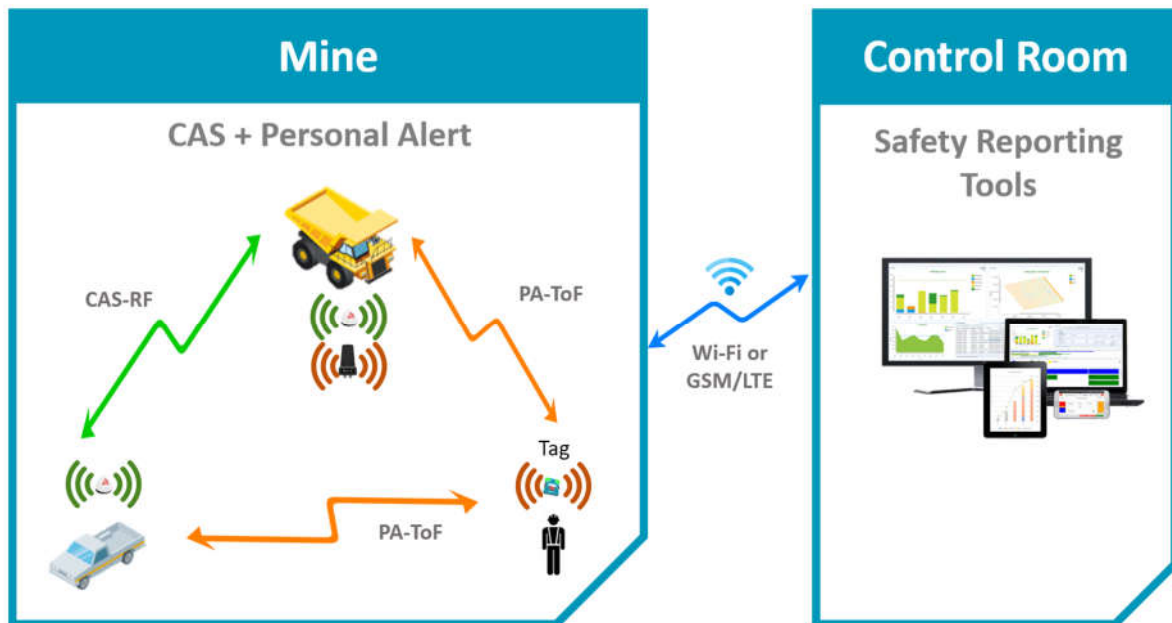
- Alert - Uses high-performance algorithms within the same proven approach of safety zones from CAS, employing highly intuitive ascending visual, audible, and vibration alarms to help drivers and pedestrians avert imminent accidents
- Minimize accidents - Reduce the risk of accidents involving personnel and vehicles in all areas
- Reduce Blind Spots - Time of Flight technology tracks all personnel around vehicles at all times, and alerts operators and pedestrians with 360 degrees of protection at any speed
- Adaptable to site specific requirements: Tremendously configurable detection and alarming zones, based on vehicle location and situation reduces many nuisance alarms in un-risk situations
- In-Cabin Driver Detection - Strategically mounted anchor devices identify pedestrian entering the cabin, reducing nuisance alarms
- Integration and scalability - Fully integrated with CAS and able to upgrade with FatigueMonitor, and HxGN Mine VIS
- Using web-based reporting and analytics, supervisors can detect and correct unsafe operator practices by analyzing information wireless transmitted (WiFi/GSM/LTE)
- Improve safety culture - With the enhanced reporting capabilities, unsafe behaviors can be identified and strategically reduced by knowing the root cause
- Investigate – Black box recording and data transfer records, specifically detailed data such as location, tag ID and traffic for incident investigation
- Increase usability and learnability - Fully integrated with CAS, operators interact with a single user interface for all safety purposes, reducing training time
- Monitor remotely - WiFi or GSM connectivity allows wireless data transfer, status monitoring, and remote support functions
- Reliable and precise technology - Time of Flight technology increases the detection reliability under poor GNSS conditions or under roof scenarios with a 50 meters range and a 5cm precision not degraded by the distance.

### 3. System Architecture

#### 3.1. Overview

The Personal Alert (PA) is composed by the following components:

- HxGN Collision Avoidance System (CAS)
- PA Vehicle Anchors
- PA Pedestrian Tags



The Personal Alert, combined with the HxGN Collision Avoidance System (CAS) technology, makes use of risk-based algorithms to differentiate between pedestrians which can lead to dangerous situation and others which do not represent threats based on pre-configured parameters. This real-time analysis and sophisticated algorithms will determine a possible risk level and indicate it to the operator of the vehicle via the CAS LED display and the personnel in danger via various alerting mechanisms on the Pedestrian tags.

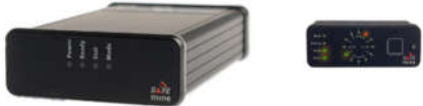


**All the alerts from the PA can be transmitted to the Control Room for reporting capabilities.**



The Personal Alert System (PA) consists of Vehicle Anchors and Pedestrian tags. The Vehicle Anchors contain a UWB ranging radio, a powerful microcontroller for distance computations and a CAN interface to transmit ranging information to the CAS. Pedestrian tags are wearable devices with high-capacity Li-Ion batteries and integrated charging system, which also contain a UWB ranging radio and microcontroller, as well as two RGB LEDs with dynamically adaptive brightness, powerful vibration motor and buzzer for alerting. The devices communicate with each other using Time of Flight Technology at UWB frequencies, and the Vehicle Anchors are connected to the Collision Avoidance System (CAS) using a proprietary CAN protocol.

The distance and detection zone between each Pedestrian tag and each Vehicle Anchor on heavy machinery is calculated by the Vehicle Anchors and transmitted to the CAS main unit. The information is also transmitted back to each Pedestrian tags as a low power signal at frequent intervals (adaptive, up to 4 times per second). The PA will provide visual awareness to both the heavy machinery operators and the surrounding field personnel inside the configured detection zones.

When the PA determines a dangerous proximity to personnel, the CAS LED display gives the heavy machinery operator a warning of the greatest danger at that moment, this is given by a visual awareness with direction of the closest detected personnel and a buzzing sound, at the same time the pedestrian tag also provides a visual alert, buzzing sound and a vibration alarm to the personnel depending on the configuration.

### 3.2. Hardware components

Components	Product Number	Description	Picture
CAS Set	QN55X	Collision Avoidance System unit, acts also as processing unit for PA and to provide information via the LEDs display to the operator.	
Reverse Gear « input »		CAS unit does have to be connected to the reverse gear sensor, as the information of vehicle direction is needed.	
Vehicle Anchors	QT370	The Vehicle Anchors contains the UWB ranging radio that communicate and performs the distance measurements. It has an LED to display status and two CAN connectors.	
M12-4 Terminators	QT375	This terminator provides a 120 Ohm load on both ends of the CAN bus for proper and reliable communications between the vehicle AnchorVehicle Anchors and the CAS unit.	

XXm CAN Extension Cables	QT37X	This harness provides the connection extension from the CAS unit to the Vehicle Anchors.	
CAN 6-Branches Harness	QD216	This harness is used to connect the Vehicle Anchors to the CANBus.	
Pedestrian Tags	QT360	This component is used by the personnel on the field and communicates with the Vehicle Anchors to measure the distance, and provides all the visual, audible and vibratory signals to the personnel on the field.	

**NOTE:**

*This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s).*

*Operation is subject to the following two conditions:*

- (1) this device may not cause harmful interference, and*
- (2) this device must accept any interference received, including interference that may cause undesired operation.*

*Le présent appareil est conforme aux CNR d'Industrie 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, et*
- (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

**NOTE:**

*Changes or modifications made to this equipment not expressly approved by (manufacturer name) may void the FCC authorization to operate this equipment.*

*Les changements ou modifications apportés à cet équipement non expressément approuvés par (nom du fabricant) peuvent annuler l'autorisation FCC pour l'utilisation de cet équipement*

**NOTE:**

*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 his own expense.*

*Cet équipement a été testé et déclaré conforme aux limites imposées aux appareils numériques de classe A, conformément à la section 15 des règles FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre des ondes radio et, s'il n'est pas installé et utilisé conformément au manuel d'instruction, et peut provoquer des interférences nuisibles aux communications radio. L'utilisation de cet équipement dans une zone résidentielle est susceptible de provoquer des interférences nuisibles, auquel cas l'utilisateur devra corriger ces interférences à ses propres frais.*

### 3.3. Software components

Component	Description
CAN Protocol	Proprietary protocol used to communicate between the CAS unit and the Vehicle Anchors.
CAS Personal Alert Firmware	Specific firmware which integrates CAS and PA functionalities.
Pedestrian Tag Firmware	Firmware provided to update the functionalities of the Pedestrian Tag.
Vehicle Anchor Firmware	Firmware provided to update the functionalities of the Vehicle Anchor.
PPS Tool	Tool used for uploading firmware and configuration to Vehicle Anchor and Pedestrian Tags, as well for troubleshooting

### 3.4. System boundaries

Hexagon Mining Personal Alert system is responsible for the detection of personnel wearing a properly functioning Pedestrian Tag representing a threat and provides the correct visual signs to the vehicle operator via the CAS User Interface and the personnel wearing the Pedestrian Tag based on the preconfigured danger areas on the configuration.

The Personal Alert system requires line of sight between the Vehicle Anchor and the Pedestrian Tags to perform according specifications, if the Pedestrian Tag is in a part of the body that blocks the Time-of-Flight signal from the vehicle Anchor it might not be detected if there are no reflecting areas on the surrounding of the personnel. Hexagon Mining recommends locations that allow the Pedestrian Tag to be seen from 360 degrees from the Vehicle Anchors like the shoulders, helmets or belts (On the side).



## 4. Main Features

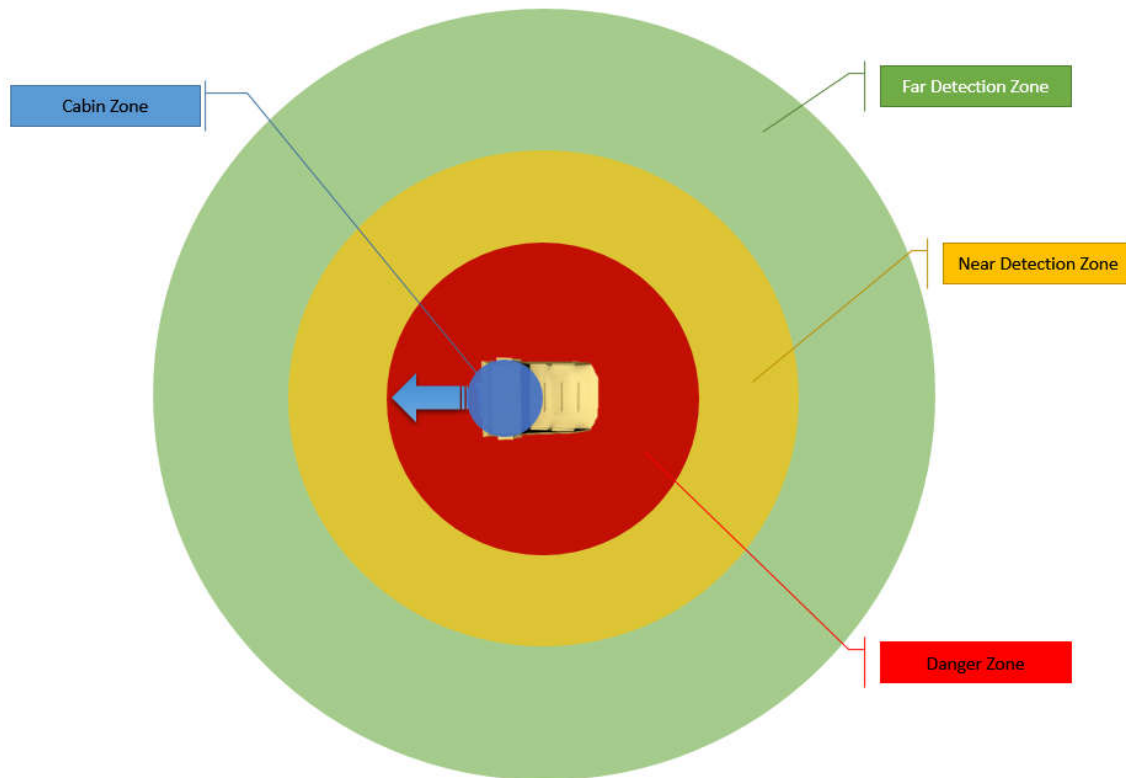
### 4.1. Enabling Personal Alert and Geo-Fencing Functionalities

In the default configuration Hexagon Mining Personal Alert is active mine wide. However, it is possible to mute the visual and audible alarms, as well as to adapt the detection zones depending on area or speed settings.

To achieve this, the Personnel Alert must be activated or deactivated only on the desired geo-fences and up to the desired speed using the Areas configuration in the CAS vehicle Register.



## 4.2. Personal Alert Detection Zones



The detection zones are configurable distances around the Vehicle Anchors. When a Pedestrian tag is detected by a vehicle Anchor in the immediate proximity around the vehicle it processes the location of the Pedestrian Tag and its distance relative to the Vehicle Anchor. Within three different zones, the PA system will react differently providing visual, audible and vibratory alerts to the vehicle operators and personnel.










There are four possible danger zones that are configurable, and each one of them will represent a different notification to users:

- **Cabin Detection Zone:** This zone represents the distance on where the vehicle operators are usually sitting, all alarms within this distance are suppressed on both Pedestrian Tag and CAS, as well as on other PA-equipped vehicles.
- **Far Detection Zone:** This zone represents the distance on where vehicle operators and personnel would be visually warned about each other, showing the direction of detection on the vehicle LED display.
- **Near Detection Zone:** This zone represents the distance on where both vehicle operators and personnel are still warned visually, but with higher intensity.
- **Close Detection Zone (Danger Zone):** This zone represents the distance on where vehicle operators and personnel are in danger of suffering from an accident, and all possible alert mechanisms are used to invoke an action of the operator and personnel. An audible alarm on the CAS LEDs will only be triggered if the personnel is within the danger zone and the vehicle is moving below the PA speed threshold in the direction of the personnel.

The following table describes the notification outputs from the PA user interfaces:

Detection Zone	Description	Display Awareness/Alerting	PEDESTRIAN TAG Awareness/Alerting
Cabin Zone	This zone determinates if a person with a Pedestrian tag is within the cabin of the vehicle. This matters to prevent unwanted alarms within drivers and other vehicles.	None	None
Far Zone	This zone determinates if a person is in the proximity of the vehicle, but it does not represent an immediate threat.	Visual Awareness	Visual Awareness
Near Zone	This zones determinates if a person is in a medium danger distance within a vehicle.	Visual Awareness	Visual Awareness
Close Zone (Danger Zone)	This zone determinates if a person is within the danger zone, and will escalate to the highest priority awareness and alarms.	Visual Awareness + Audible Alarm* *If vehicle is moving	Visual Awareness + Audible Alarm + Vibration

In the following representations, the indications of the CAS User Interface and the Pedestrian Tag will be shown in the below manner:

Indication	Description
	A non-lit LED
	A LED illuminated in green
	A LED illuminated in red
	A LED blinking in red
	A LED blinking in amber
	A LED blinking in blue
	A LED illuminated in blue
	An audible beeping sound
	A vibration alarm



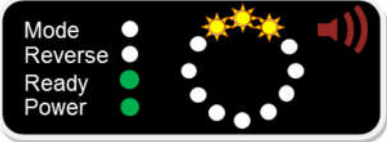
Since the notifications will provide different combinations signs in the vehicle cabin and the pedestrian tag, the preconditions and outputs for each situation will be separated for the CAS LED display and the Pedestrian tag in the upcoming chapters:

#### 4.2.1. Notifications in Vehicle Operator (CAS LED Display):

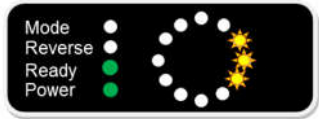
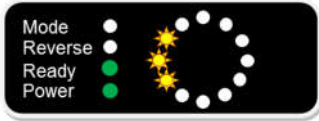

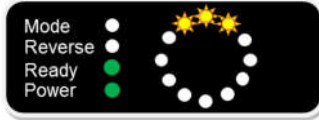
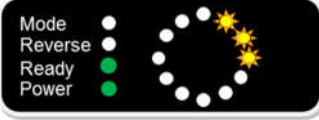
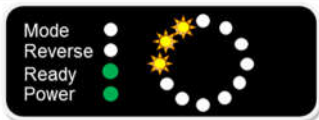
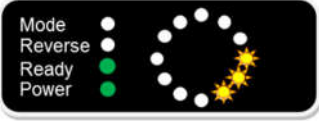
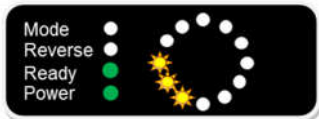
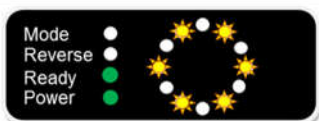


Several LEDs colors and sounds indicate different threat levels of a person to the vehicle operator. Depending on the distance to pedestrian tagged personnel and on the configuration parameters a visual and an audible alarm might be generated.

The center compass displays direction and distance of personnel within the detection zones as explained below:

Detection Zone (Priority)	Awareness/Alerting in the traffic awareness LEDs	User Interface
Cabin Zone	None	
Far Zone	Three solid amber LEDs in the vehicle Anchor location.	
Near Zone	Three amber LEDs in the vehicle Anchor location blinking at 2 Hz.	
Close Zone (Danger Zone)	<p>Three amber LEDs in the vehicle Anchor location blinking at 4 Hz. If the vehicle movement is not Standstill or parked an audible alarm is also generated.</p> <p>*The audible alarm will also be dependent on the direction of movement of the vehicle. E.g. If there is a person detected by the rear Vehicle Anchor and the vehicle is moving forward, no audible alarm is raised.</p>	

Depending on the location configuration of the vehicle Anchor detecting the Pedestrian tag, the LEDs could be shown in different locations as shown below:



Vehicle Anchor Location Detecting Pedestrian tag	User Interface
Right	
Left	
Rear	
Front	
Font-Right	
Front-Left	
Rear-Right	
Rear-Left	
Center	


Use PA Center position only with one single vehicle Anchor on a vehicle.

#### 4.2.2. Notifications for Personnel (Pedestrian Tag):



The LEDs on the front side of the PEDESTRIAN TAG show the status of the device and depending on the configuration, the LEDs will change colors if there is a possible threat by a vehicle equipped with CAS, also an audible or vibration alarm could be generated if the threat reaches a high-risk level. There is a button on the front of the Pedestrian tag that can trigger different functions depending on the configuration.

Detection Zone (Priority)	Awareness/Alerting in the traffic awareness LEDs	User Interface
Cabin Zone Far Zone	None Green (alternating left/right) LED Blinking Period (0.5s)	
Near Zone	Amber (alternating left/right) LED Blinking Period (0.15s)	

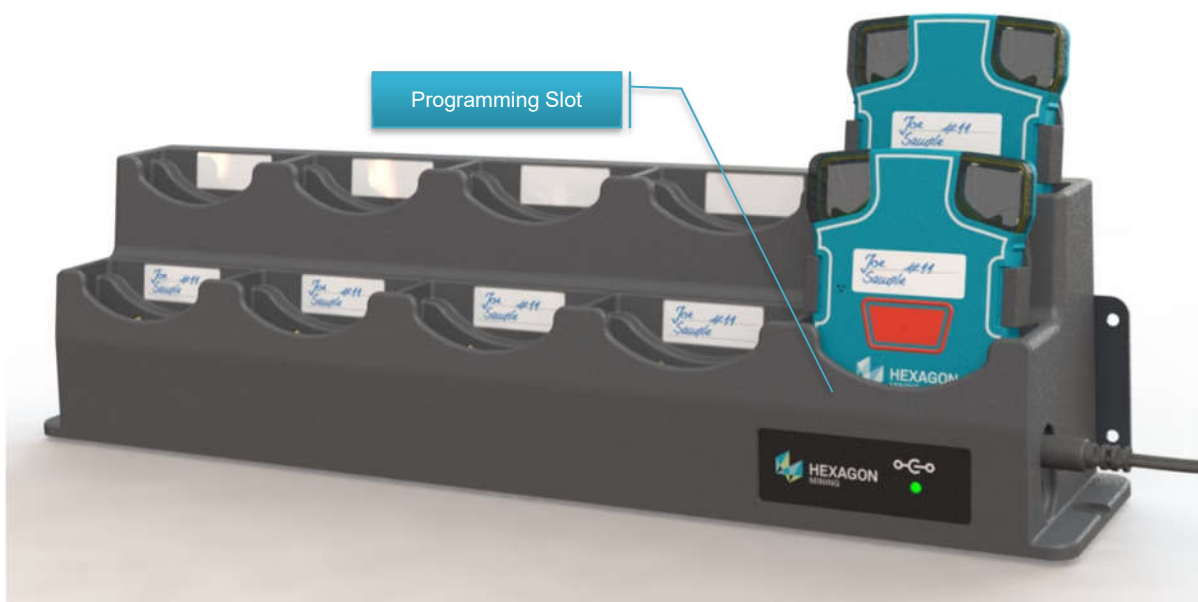
Close Zone (Danger Zone)	Red (alternating left/right) LED Blinking Period (0.25s) Buzzer at High Frequency Vibration at High Frequency	
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## 4.3. Power, Battery Charging and Configuration

### 4.3.1. Heartbeat Indication

Every 30s, the pedestrian tag LEDs shows a heartbeat signal. This is a short simultaneous blink on both LEDs, and only shows up when no other threat is around. In case of a battery with sufficient state of charge, this is in green color. If the battery state of charge is medium (roughly 3h battery life left), this is in amber color. If the battery state of charge is getting low (roughly 1h battery life left), this is in red color.

### 4.3.2. Gang Charger



The Pedestrian Tags Gang Charger QT365 device provides battery charging capabilities for up to ten Pedestrian tags simultaneously and provides one special slot for updating the Pedestrian Tag Firmware.

There is one LED showing that the charger is successfully connected to the power adapter.


### 4.3.3. Charging Procedure

Before charging the Pedestrian tags, please make sure the voltage of the power supply corresponds to the data given on the gang charger instructions, usually Gang Charger can work from 110 to 240V and make sure that the correct power adapter is used (5VDC supply voltage).

The charging procedure starts as soon as the Pedestrian Tag is inserted into any of the sockets of the Gang Charger QT365 given that the battery temperature is within a safe range (10-45C). The Pedestrian tag immediately starts charging the battery, which is displayed with different LEDs indications explained below:

#### Meaning of Indication Elements:

All the indications are displayed on the inserted PEDESTRIAN TAG LEDs, and the different colors and position of the turning LEDs represent the status of the charging progress of the PEDESTRIAN TAG as explained in the table below:

Status	Indication	User Interface
Battery not Charging	The right LED will be blinking every 2 second in <b>RED</b> color.	
Battery Charging	The right LED will be blinking in a period of 2 second in <b>BLUE</b> color.	
Fast Charging in Progress	The right LED will be blinking in a period of 0.5 second in <b>BLUE</b> color.	
Battery Fully Charged	The right LED will be constantly on in <b>GREEN</b> color.	



Battery status Indications		
Battery OK	The left LED will be constantly on in <b>GREEN</b> colour.	
Battery End-of-Life	The left LED will be constantly on in <b>RED</b> colour.	

When pressing the acknowledge button for 5 seconds while charging, the Pedestrian Tag proceeds to perform a hard reset.

#### 4.4. Acknowledge Button and Alarm Exceptions



Personnel wearing Pedestrian Tags can silence the Pedestrian tag from threats alerting, this does not acknowledge all other vehicle alarms, but only the sound and vibratory alarms from the current situation once the button is pressed. The personnel will get another alarm if a second vehicle approaches, even if alerts with the first vehicle have already been silenced.

To acknowledge alarms on a pedestrian tag, the personnel should press the center button only once, all current vehicles, at their current ranges, will be acknowledge and the sound and vibrating alarms will be silenced.

If a vehicle moves to a closer zone and a highest risk range, the pedestrian tag will rearm the sound and vibrating alarms again, for the vehicle at its close range, only increasing the risk (e.g. going from near to close) will rearm the alarms. Vehicles moving further away (e.g. going from close to near) should not cause the sound and vibratory alarm to be rearmed.

If a vehicle moves out of range of the detection zones, it is forgotten by the pedestrian tag acknowledge function, so that if it reappears, it will cause a new alert.

**Alarm priorities:**

When the vehicle is in standstill, and up to a speed of max\_pps\_speed (default 8 km/h), PA alarms have priority over other CAS alarms. At speeds, faster than this parameter (If configured), Personal Alert alarms will be disabled.

**4.4.1. Battery Power Indication**


By double clicking the Acknowledge Button, the Pedestrian Tag LEDs shows battery power status. This is shown as a short simultaneous blink on both LEDs. In case of a battery with sufficient state of charge, this is shown in green color, if medium battery life an amber color will be displayed on the LEDs, and this indicates a life span of approximately 2-3 hours. If the battery is at a low level a red color will be displayed, and this indicates a life span of less 1 hour left.

Once the battery has reached a critically low state of charge, it will display a permanent indication to the user that it needs to be recharged. This indication is shown by displaying both LEDs in a constant red color:



This sign indicates that the Tag is no longer operational and it indicated until the battery is flat.

**Limitation:** In rare cases, the Pedestrian Tag will stop emitting the correct alerts on the LEDs due to low power but it will not show the Low Battery Indication.

Status	Indication	User Interface
Battery fully charged	The right and left LEDs will glow in GREEN colour for 2 seconds.	

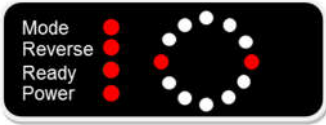
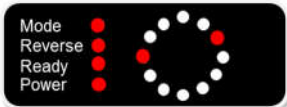
Battery medium	The right and left LEDs will glow in <b>AMBER</b> colour for 2 seconds.	
Battery low	The right and left LEDs will glow in <b>RED</b> colour for 2 seconds	

## 5. System Status

### 5.1. CAS+PA

#### 5.1.1. Errors

If the CAS Main Unit encounters an error of the Personal Alert System (PA) a combination of LEDs will indicate its findings on the display. If an Error is displayed check the cabling, the connections and the sensor units for proper operation.

Error Type	Possible Causes	User Interface
PA Error	<ul style="list-style-type: none"> <li>▪ Vehicle Anchor Malfunction</li> <li>▪ PA Wiring fault</li> <li>▪ Vehicle Vehicle Anchors disconnected</li> <li>▪ Wrong Vehicle Anchor configuration</li> </ul>	
CAN-Bus Error	<ul style="list-style-type: none"> <li>▪ Communications Error System (renders PA inoperable)</li> <li>▪ PA Faults as above</li> </ul>	

If a PA installation presents connectivity issues check the cabling for the following best practices being applied:



- The CAN-bus cabling resembles a simple daisy chain.
- The M12-4 terminator pieces are installed at both ends of the CAN-bus.
- The CAN-bus cabling has no branches other than individual vehicle Anchor units and one CAS unit attached to it. The entire system must describe a bus.
- The CAN-bus should not close on itself, nor should it create any other type of loop.
- Each Vehicle Anchor on the vehicle has its own unique ID (0-6)
- Check the configuration parameters of the PA on the CAS.
- Check that the system has not been damaged by excessive supply voltage or that the fuses of the power supply were blown.


If the error persists after having checked the installation for the application of best practices and assessing the system for faulty equipment, please contact your Hexagon Mining support responsible.

## 5.2. PEDESTRIAN TAG

### 5.2.1. Errors

If the PEDESTRIAN TAG is on an error state a combination of LEDs will indicate the possible causes as shown in the table below:

Error Type	Possible Causes	User Interface
PEDESTRIAN TAG not communicating	Battery is flat.	
No Firmware	Firmware is not correct or have not been uploaded.	

<p>Battery End-of-Life (This error occurs only on the Charging Bay)</p>	<p>Battery capacity is not sufficient anymore. Replace battery.</p>	
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If a PEDESTRIAN TAG presents connectivity issues check the batterie status for the following best practices being applied:

- The battery needs to be charged
- The firmware needs to be upgraded.
- The battery needs to be replaced.

## 5.3. Vehicle Anchor

### 5.3.1. Errors

If the Vehicle Anchor is on an error state a combination of LEDs will indicate the status as shown in the table below:

Indication Type	LED Indication	User Interface
No power	no indication	
System fault	Red LED steady	
Powered and a Pedestrian Tag in range. NO CAS Communication.	Amber LED Blinking	
Powered. NO CAS Communication.	Amber LED steady	
Powered, CAS Communicating and a Pedestrian Tag in range	Green LED slow flash	
Powered CAS Communicating	Green LED steady	

## 6. Use Cases

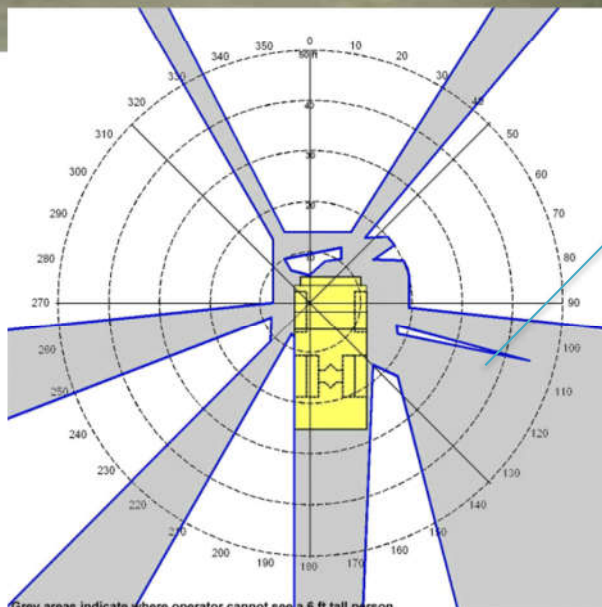
### 6.1. Tire Handler

Situations on where the operation requires close interaction between heavy machinery and personnel are the perfect application for the PA, providing audible notification to the operators in case of the interaction with the personnel gets to the high-risk level due to the low visibility of the environment and the high focus of the operators to the task process and not the environment.



## 6.2. Workshop/Field Maintenance, Regular Mining Operation

After maintenance is performed, personnel is still around the heavy machinery but operators have a very limited field of view of the environment due to the dimensions of the heavy machinery (see graph 1). The PA improves the awareness of the operators by presenting the position and relative distance to the personnel surrounding the vehicle avoiding accidents that could lead to a fatality.






Grey Areas indicates where operator cannot see a 6 feet tall person

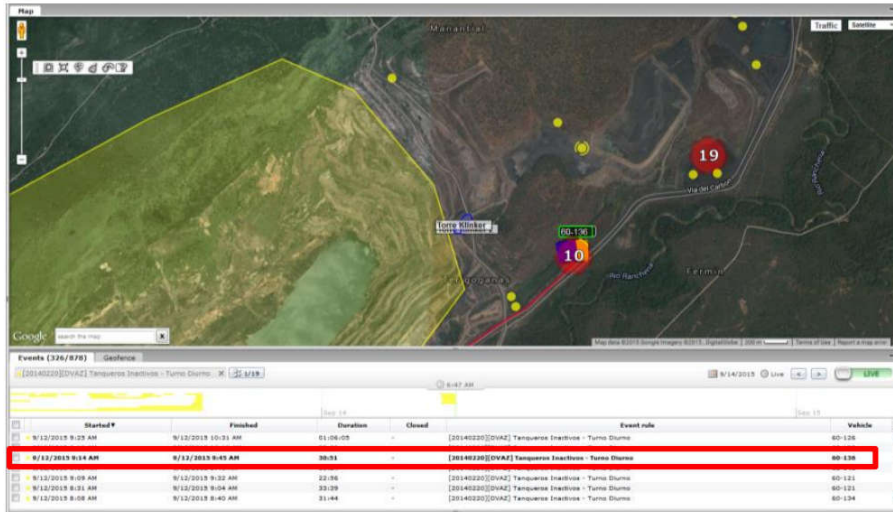
Grey areas indicate where operator cannot see a 6 ft tall person.



### 6.3. Installation in Vehicle Types

Vehicle Type	Characteristics	Image
Light Vehicle	<ul style="list-style-type: none"> <li>• One Vehicle Anchor</li> <li>• 3 zones of Protection</li> <li>• Adaptive protection zones to Avoid Nuisances Alarms</li> </ul>	
Haul Truck ADT Loaders Dozers	<ul style="list-style-type: none"> <li>• Two or Three Vehicle Anchor</li> <li>• 3 zones of Protection</li> <li>• Adaptive Protection Zones               <ul style="list-style-type: none"> <li>• 5m</li> <li>• 15m</li> <li>• 25m</li> </ul> </li> </ul>	
Shovel	<ul style="list-style-type: none"> <li>• Four Vehicle Anchor</li> <li>• 3 zones of Protection</li> <li>• Adaptive Protection Zones               <ul style="list-style-type: none"> <li>• 10m</li> <li>• 20m</li> <li>• 25m</li> </ul> </li> </ul>	

## 7. Monitoring and Reporting



The screenshot displays a satellite map of a mining site with several yellow and red markers representing vehicle locations. Below the map is a table titled 'Events (324/878)' with columns for Started, Finished, Duration, Closed, Event rule, and Vehicle. The table contains several rows of data, with one row highlighted in red.

Started	Finished	Duration	Closed	Event rule	Vehicle
8/13/2018 9:08 AM	8/13/2018 10:31 AM	01:06:05	-	[00140E20][DVAZ] Tanqueque Inadmisión - Turno Diurno	80-126
8/13/2018 9:14 AM	8/13/2018 9:45 AM	00:01	-	[00140E20][DVAZ] Tanqueque Inadmisión - Turno Diurno	80-139
8/13/2018 9:09 AM	8/13/2018 9:32 AM	00:06	-	[00140E20][DVAZ] Tanqueque Inadmisión - Turno Diurno	80-121
8/13/2018 9:31 AM	8/13/2018 9:04 AM	00:09	-	[00140E20][DVAZ] Tanqueque Inadmisión - Turno Diurno	80-121
8/13/2018 9:08 AM	8/13/2018 9:40 AM	01:04	-	[00140E20][DVAZ] Tanqueque Inadmisión - Turno Diurno	80-134

The HxGN TRACK is a browser-based software application where vehicles can be tracked in real-time anywhere in the world using any PC connected to the internet or local server.

The SMTRACK allows the user to display vehicles on a satellite image or on a mine custom map, along with information about their current position, speed, and status.

Each CAS unit includes an integrated GSM or WIFI modem to transmit vehicle information that integrates with the PA, this allows the customer to view in near real-time if dangerous interactions between heavy machinery and personnel are occurring.

Several notifications could be generated simultaneously and configured to alert the right personnel regarding a high-risk interaction or simply provide the report for the PA alarms.

System will require server connectivity using Wi-Fi or GSM/LTE networks.

**Tracking example:**

Every tag could be assigned to a specific person and it could be tracked at any time as long as it is close to a vehicle or an infrastructure anchor.

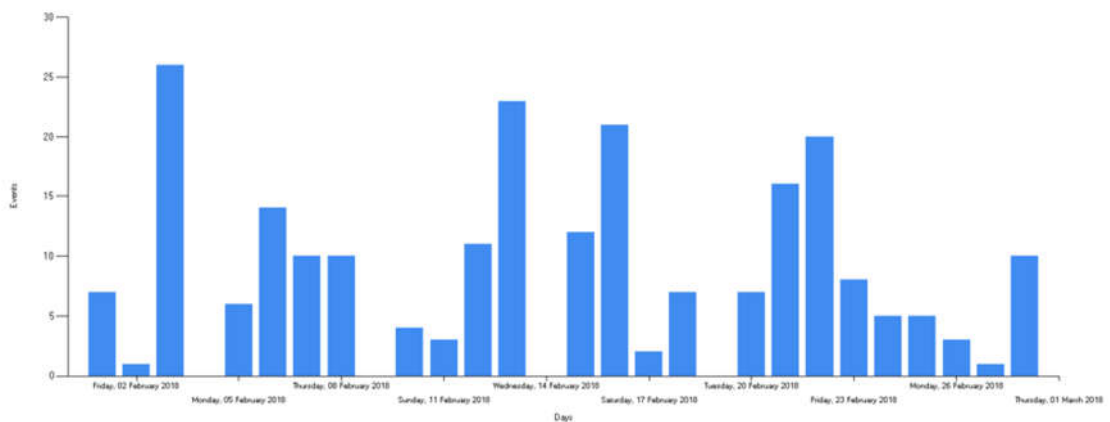
In the example below the location of a person as well as the time of visualization on the location is seen on the server, this could be configuring to remain active at all times to verify the last known location of any personnel or it could disappear as soon as the pedestrian tag is not identified by any close PA system.



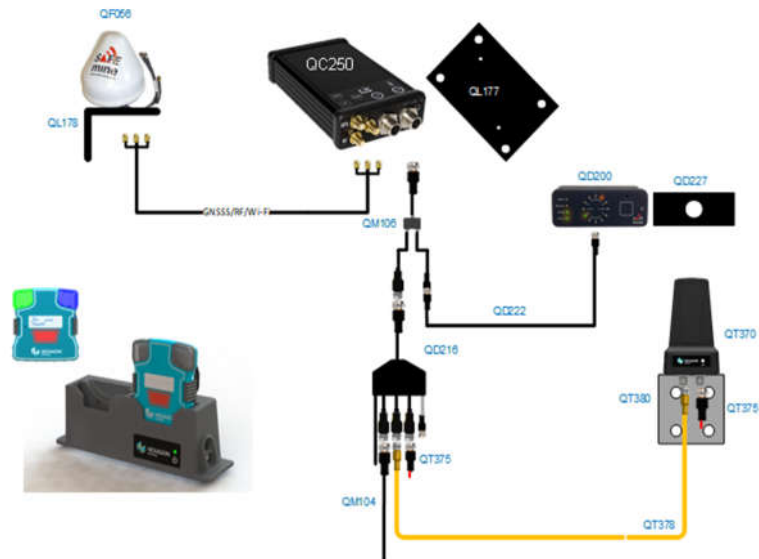
**Reporting example:**

In the below report it is possible to analyse the trends of dangerous events between vehicles and personnel, as well as visited locations.

Period From: 02/01/2018 to 03/01/2018  
Total Events: 232  
Total Vehicles: 11



## 8. Wiring Diagrams



## 9. Disclaimer

TBC