Proximity Detection & Collision Avoidance

Strata’s solutions for surface, underground, and surface-to-underground
Strata Worldwide has years of R&D and real-life experience with proximity detection and collision avoidance technologies. Working closely with mine managers and personnel around the world, the company continues to expand and enhance its safety technologies.

**HazardAVERT®** - Near-field electromagnetic detection, alarm and interlocking system for surface and underground

**HazardAVERT 360™** - Multi-range detection and alarm system for surface only
HazardAVERT® is a well-established, near-field electromagnetic proximity detection and collision avoidance system that has been active in mines around the world for nearly 10 years. It is proven effective in all types of mining and construction environments and works to detect close proximity and imminent danger while working around mobile machinery.

HazardAVERT® electromagnetic zones are fully functional both on the surface and underground, ensuring that vehicles traveling between surface and underground locations are continuously armed and detectable.

### HazardAVERT® System Components

<table>
<thead>
<tr>
<th>ON-DASH LED DISPLAY SCREEN</th>
<th>PERSONAL ALARM DEVICE (PAD)</th>
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</thead>
<tbody>
<tr>
<td>• 5 inch J1939-Based LCD Display</td>
<td>• Personnel-worn devices detect and measure electromagnetic zones to determine proximity and visually and audibly warn against potential vehicle-to-person accidents</td>
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<tr>
<td>• IP67 Rating</td>
<td>1. HA PAD with Warning Module – Small, lightweight unit attaches to hard hat and Warning Module with flashing LED light and audible sounder attaches to hard hat brim</td>
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<td>• Displays zone operating status and active alarms</td>
<td>2. PAD - Lightweight and ergonomically designed to be worn on the belt or arm. Flashing LED light and in-built audible sounder</td>
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<td>• 2-camera inputs and live camera views</td>
<td>3. TPL-Eco - LED cap lamp powered by a small rechargeable battery pack worn on the belt. Proximity detection technology and sounder alarm located in the head piece</td>
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### Interface Module

- Control unit for the system
- Power supply to Proximity Modules
- Controls equipment interlocking
- Silent Zone generator
- Power supply to On-Dash Display and/or sounder
- Memory storage to monitor and log events
- Contains Wi-Fi board for data transmission
ELECTROMAGNETIC DETECTION

Key Features
- Can be interlocked into equipment controls to automatically slow, stop and/or disable hydraulics
- High resolution coverage extending up to 100 ft (30 m) at the front and rear of equipment
- Functions both on the surface and underground
- Detects pedestrians and vehicles of all sizes, even when stationary
- Stable, reliable and repeatable zones
- Does not affect production and enables workers to operate safely and effectively
- Capacity to function with hundreds of vehicles and pedestrians in close proximity without latency or delay

HAZARDAVERT® MARKER ZONES
- HazardAVERT® Proximity Modules installed on equipment create two levels of marker zones that completely surround the equipment, covering blind spots and turning radius.
  - Warning Zone – Outer-most zone
  - Hazard Zone – Inner-most zone
- Silent Zone – Located in the operators cab or compartment and silences the PAD while operating the machinery

Warning Alerts
- Breach of the Warning and Hazard Zones by vehicles or pedestrians trigger audible and visual warning alarms to equipment operator(s) and pedestrian(s)
- On-Dash Display screen highlights front and/or rear location markers to indicate breach location
  - Warning zone – Orange
  - Hazard Zone – Red
- Pedestrian PAD or TPL-Eco LED flashes and audible sounder alarms
- In the case of multiple breaches, all parties are alerted

System Interlock & Equipment Override
- If HazardAVERT® has been interlocked into the controls of the equipment, configuration options include:
  - Warning Zone breach: All vehicles involved will be slowed
  - Hazard Zone breach: All vehicles involved will be slowed, stopped or hydraulics fully or partially disabled
- Machine functions that may be controlled by the proximity system relays are determined by the customer and the equipment OEM.
SURFACE APPLICATIONS

Inherent dangers of this working environment for which HazardAVERT® is intended:

- The large scale and volume of machinery
- The diverse scale of vehicles and machinery
- Significant blind-spots on large machinery
- Requirement for people to work in close proximity to machinery
- Large equipment starting up and/or moving in reverse
- Restricted vision due to time of day and weather conditions

Studies show that a large majority of accidents and injuries occur when machinery and vehicles are traveling at lower rates of speed and in reverse due to close proximity. HazardAVERT® can be programmed to stop or disable equipment at specified speeds determined by the OEM and customer.

HAZARDAVERT® SAFETY FEATURES & USER EXPERIENCE

- Increase safety awareness and reinforce training
- No operator interaction required
- No line-of-sight required
- Fallen pedestrian detected
- Stationary equipment and/or pedestrians detected
- Direction of travel is irrelevant
- Unaffected by visibility
- Unaffected by daylight/darkness, weather conditions, particles in the air
- Penetrates rock, gravel, sand, mud, coal, water
- Penetrates earth substrates to detect around corners
- Penetrates ventilation curtains and barriers
- 100% perimeter coverage including blind spots and turning radius
- Monitoring and reporting

UNDERGROUND APPLICATIONS

Inherent dangers of this working environment for which HazardAVERT® is intended:

- Restricted visibility
- Confined work spaces
- Out of site pedestrians or vehicles around corners
- Mobile equipment and pedestrians working in close proximity
- Pedestrians interacting with numerous pieces of equipment at the same time
- Difficulty determining travel speeds
- Visual obstructions such as equipment, ventilation curtains and/or barriers
ON-DASH DISPLAY SCREEN

Five inch LCD display screen designed for use in harsh working environments. Installed in vehicle cabs, the screen displays HazardAVERT® zone status and activity, warning alarms and live camera feeds.

- HazardAVERT® Zones
  - ON/OFF Icon displays system status
  - Compass icon displays direction of travel
  - Orange – Warning Zone breached
    - Indication of front or rear of vehicle
  - Red – Hazard Zone breached
    - Indication of front or rear of vehicle
- Camera views
  - Live feed from front and rear facing cameras
  - Operable depending on direction of travel

CAMERAS

Strata has integrated two wide-angle-lens cameras for front and rear viewing

- Operators see the front and rear areas of equipment
- Live-feed displayed on On-Dash Display Screen
- Front versus back camera activity based on direction of travel
- Front view when stationary
- IP67 rating
- NTSC format

HAZARDAVERT® MONITORING AND REPORTING

All vehicle-to-vehicle and pedestrian-to-vehicle interactions that trigger alarms and equipment overrides, are logged and stored in the Interface Module. This data can be downloaded for analysis and reporting via Wi-Fi or cable connection. In underground applications, data can also be wirelessly transmitted to dispatch over Strata’s communication networks.

REPORTING

- Safety Reports
  - Worker and machinery operator safety practices
  - Zone breaches – frequency and duration
- Productivity reports
  - Machinery tracking
  - Travel time
  - Stop time
  - Interactivity time

MONITOR

- Working & safety practices of personnel
- Worker and machinery interaction
- Warning and/or Hazard zone breaches and duration of breach
- Emergency, Hazard Zone breaches and/or stops
- Duration of inactivity
- Damage to components
Strata HazardAvert 360™ is a surface proximity detection and collision avoidance system that seamlessly combines multi-range detection technologies, to provide close range, extended range and full-view awareness while working in and around heavy and/or highly mobile equipment. It is designed to detect equipment and pedestrians in its vicinity and emit warning alarms if there is any potential danger of collision.

### 360°™ System Components

- **ON-DASH LED DISPLAY SCREEN**
  - Processing unit of the system with a 7” LED screen
  - User interface includes full circumference distance markers for 360° visual display of other vehicles and pedestrians
  - Built-in sounder alarms if potential collision is detected
  - Input button to enable temporarily disarm of alarms – operator command

- **CONCENTRATOR**
  - System bus - connects system antennas and feeds data to the On-Dash Display

- **OMNI DIRECTIONAL ANTENNAS**
  - Precise triangulation location for short range detection

- **GPS ANTENNA**
  - Precise relative location for far range detection

- **PERSONAL ALARM DEVICE (PAD)**
  - Personnel-worn devices that are detected by the system and visually and audibly warn pedestrians of potential vehicle-to-person accidents
  - Lightweight and ergonomically designed to be worn on the belt or arm
  - Includes flashing LED light and in-built audible sounder
**360°™ Features & Capabilities**

- Multiple detection technologies for expanded coverage and safety overlay
- Vehicle-to-vehicle detection
- Vehicle-to-personnel detection
- Vehicle-to-fixed asset detection
- Equipment and personnel function together without conflict
- Individual recognition and identification
- Audio and visual warnings to all parties involved
- Real-time monitor displays in vehicle cab
Vehicle-to-Vehicle Detection

HazardAVERT 360°™ system components can be installed on any type of mobile equipment and individual workers wear a Personal Alarm Device (PAD). The system begins identifying other vehicles and displaying their locations on the On-Dash Display when they are within 1000 ft (300 m). If the system detects a potential collision, it will audibly and visually alarm and simultaneously alert all vehicle operators involved.

Vehicle-to-Person Detection

Pedestrians wearing a PAD and positioned within 165 ft (50 m) of the equipment, will appear on the On-Dash Display and be identified as a pedestrian. The system detects the PAD location and determines if there is potential danger. If danger is imminent, both the pedestrian and equipment operator will be immediately alerted.

Warning Alerts

The On-Dash Display in the vehicle cab(s) act as a warning device as well as a location display screen. When in warning-mode, the screen will flash red and an audible sounder will alarm to alert the driver(s) of potential collision.

Pedestrian PADs include a flashing LED warning light and audible sounder. PADs are lightweight and ergonomically designed to be worn on the belt or arm. A flashing LED light on the front of the device and an built-in audible alarm alert the pedestrian.

Equipment operators may manually override warning alarms once they have been activated in order to enable other vehicles and/or pedestrians to approach the equipment as needed. Operators acknowledge their presence using the On-Dash Display screen and temporarily disabling the alarm.
INTEGRATING THE CAPABILITIES OF HAZARDAVERT 360°™ & HAZARDAVERT® ELECTROMAGNETIC

HazardAVERT 360°™ and HazardAVERT® electromagnetic can be integrated to operate in conjunction and display information on a single user interface. Together the systems provide comprehensive detection and alarm capabilities, including the ability to automatically slow, stop or disable the equipment in an emergency situation.

The system integration is seamless, requiring no interaction or input from equipment operators during operations.
HAZARDAVERT® SEES WHAT PEOPLE CAN’T, AND REACTS WHEN PEOPLE DON’T.