



The MST Proximity Solution

The MST Proximity Solution helps maintain the safety of personnel working around mobile machinery. It uses electromagnetic near field technology to monitor personnel entering and exiting zones, which are designated as Safe, Warning and Danger. It alerts machine operators and tag-carriers when these zones are breached. The MST Proximity Solution allows for up to 7 vehicle mounted systems to operate with 50 proximity tags in a single coverage area.

How does it work?

The MST Proximity Solution consists of four parts:

- A cabin-mounted display panel; with its own in-cabin transmitter
- Proximity tags. Personally carried, ICCL cap lamp integrated or vehicle mounted
- A machine-mounted system control unit
- One or more machine-mounted transmitters



System Controller



Transmitter



Operator Display



Personnel Tag



ICCL Integrated Tag



Vehicle Tag

Zones

MST's proximity tags detect and measure the strength of the electromagnetic signals from the machine-mounted transmitters. The closer the tag gets to the transmitter, the stronger the signal gets. The relationship between signal strength and distance is direct and highly repeatable, making the boundaries of the Safe, Warning and Danger zones precise and reliable.



Alerts

The display panel uses coloured LEDs and an audible alarm to notify the machine operator of personnel moving into the Warning and Danger zones. The proximity tag notifies the tag-holder of its movement into and out of hazardous areas using vibration, an audible alarm, and coloured flashing LEDs according to the zone being entered.

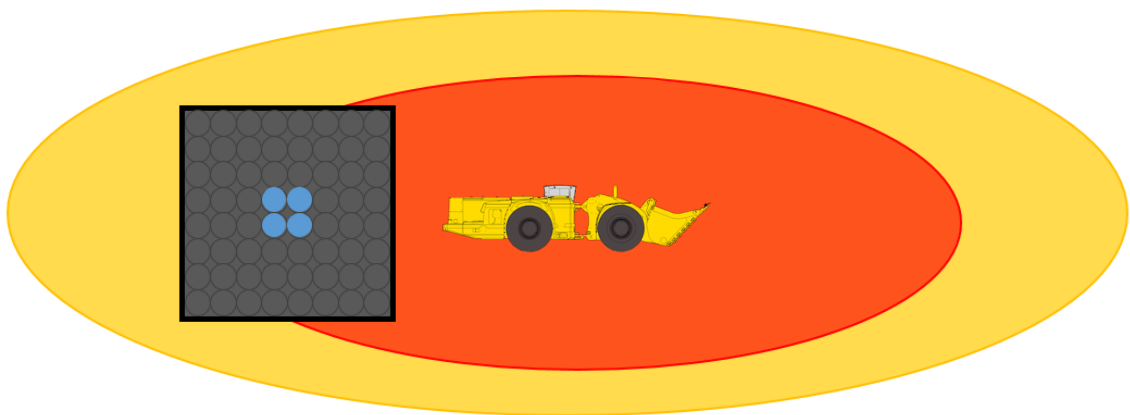
The cabin-mounted display panel generates the Safe zone signal, and the machine-mounted transmitter(s) generate the Danger and Warning zone signals. The system determines in which zone the proximity tags are. The display panel's signal covers the size of the cabin and the system recognises when the tag carried by the machine operator is within the Safe zone of the cabin.

System and tag behaviour

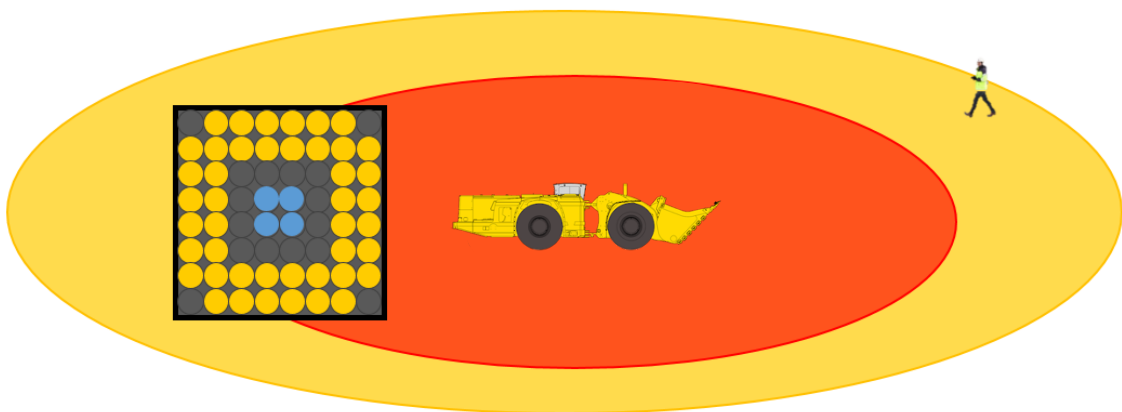
The scenarios below outline the response of tags and the display panel as personnel carrying tags enter the various hazard zones.

Alerts cannot be cancelled, but in each scenario below they can be acknowledged, which momentarily suppresses the alarm actions. Details of this operation is explained on page 9.

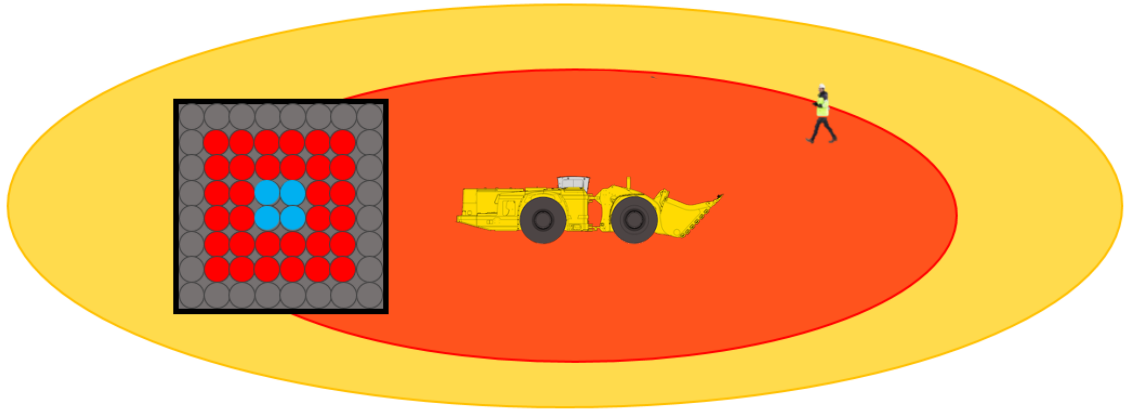
1. The machine operator is in the cabin indicated by blue LEDs on the display panel. Other proximity tags may be in radio communication range, but will be outside the hazard zones.



2. Personnel carrying a tag enters the Warning zone and yellow LEDs flash on the display panel and the audible alarm sounds, which continues while the tag remains in the Warning zone. The blue LEDs remain since the operator is in the cabin.

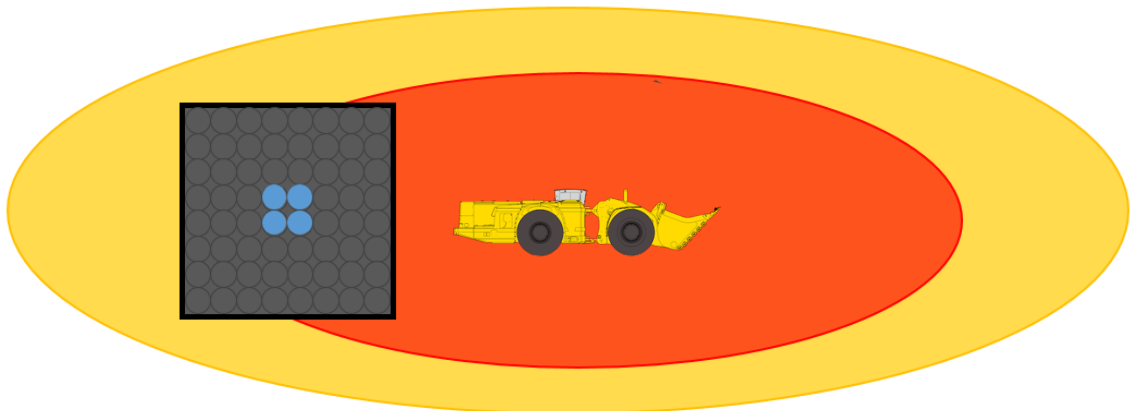


3. The personnel carrying the tag now enters the Danger zone and red LEDs flash on the display panel and the audible alarm sounds, which continues while the tag remains in the Danger zone. Since there is now no tag in the Warning zone, the yellow LEDs do not display. The blue LEDs remain since the operator is in the cabin.

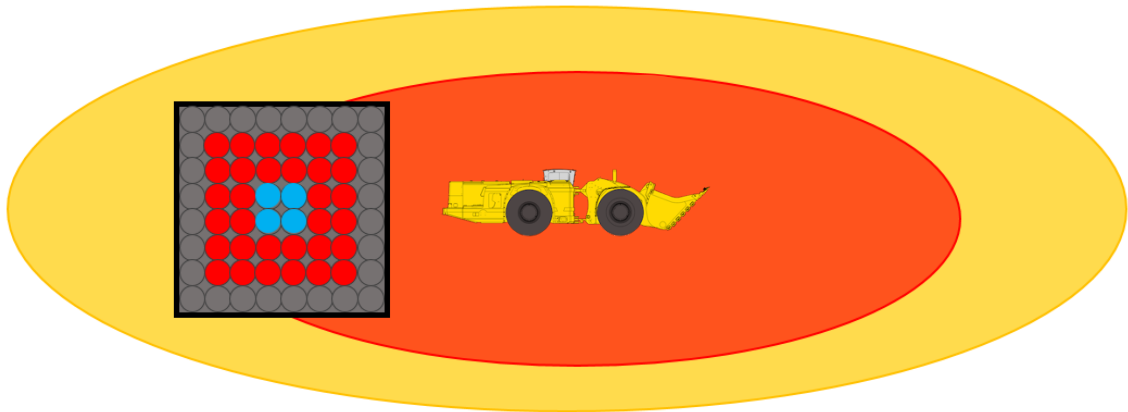


The approaching personnel tag vibrates, emits an audible alarm, and its LED flashes red, which continues while the tag remains in the Danger zone.

4. If the personnel carrying the tag now enters the machine's cabin, the tag is detected in the Safe zone. The display panel will stop flashing the red LEDs, and will flash the blue LEDs instead, while issuing a short audible alarm.

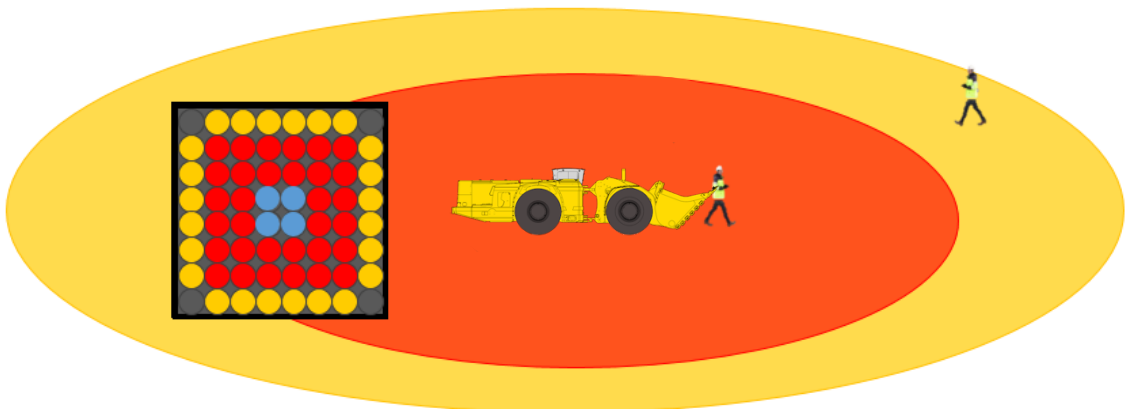


5. When the personnel carrying the tag now exits the cabin and enters the Danger zone, the red LEDs flash on the display panel and the audible alarm sounds, which continues while the tag remains in the Danger zone. The blue LEDs remain since the operator is in the cabin.



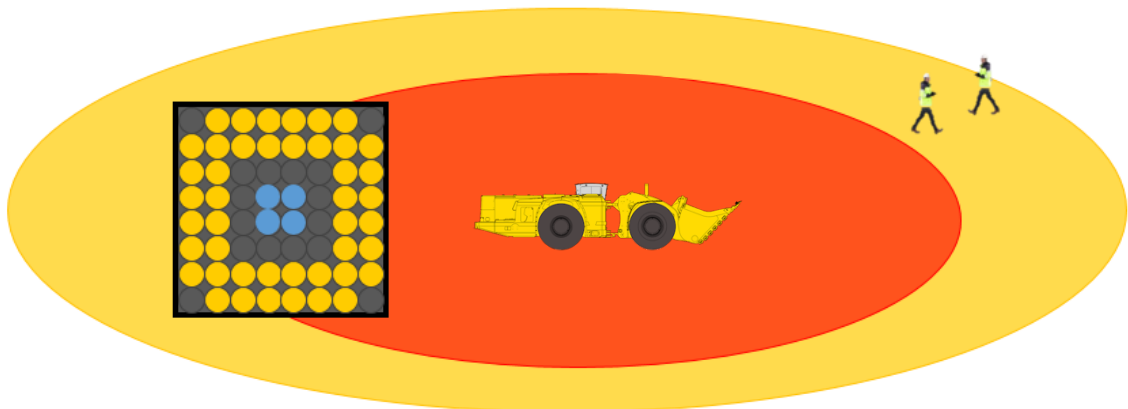
The exiting personnel's tag vibrates, emits an audible alarm, and its LED flashes red, which continues while the tag remains in the Danger zone.

6. A second person carrying a tag now enters into the Warning zone, while the first person is in the Danger zone. The display panel will flash with both the red (Danger) and yellow (Warning) LEDs, and the audible alarm will sound.



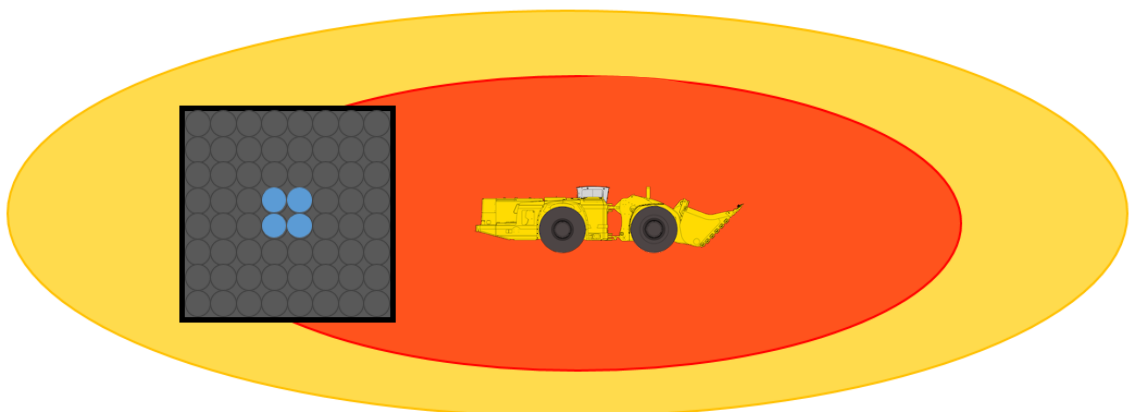
The second person's tag vibrates, emit an audible alarm, and its LED will flash yellow, which continues while the tag remains in the Warning zone.

7. The first person now joins the second person in the the Warning zone. The yellow LEDs flash on the display panel and the audible alarm sounds, which continues while both tags remain in the Warning zone. The blue LEDs remain since the operator is in the cabin.



The first person's tag vibrates, emits an audible alarm, and its LED flashes yellow, which continues while the tag remains in the Warning zone.

8. When these two personnel leave the Warning zone the display panel stops issuing audible alarms and only the blue LEDs illuminate.

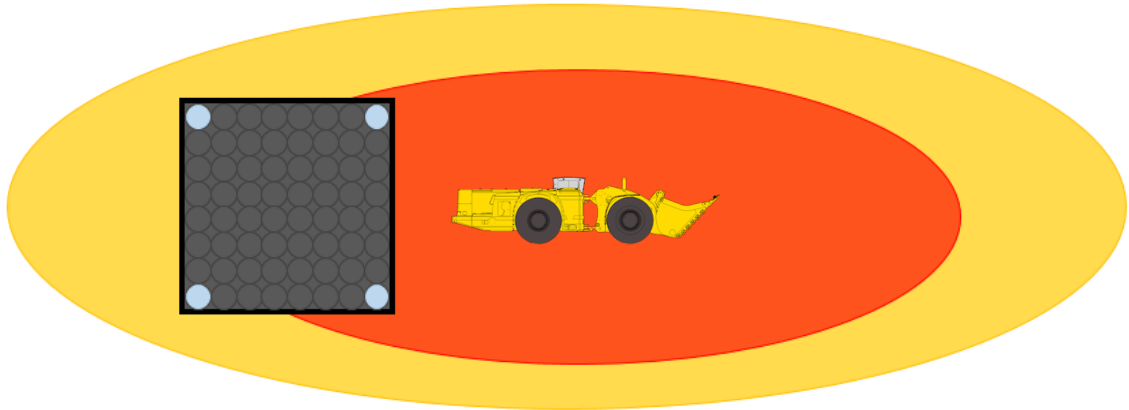


The personnel tags will cease vibrating, emitting an audible alarm, and the LED will now flash blue.

The display panel does not show how many tags are within each zone; only that at least one tag is within the band currently issuing an alarm.

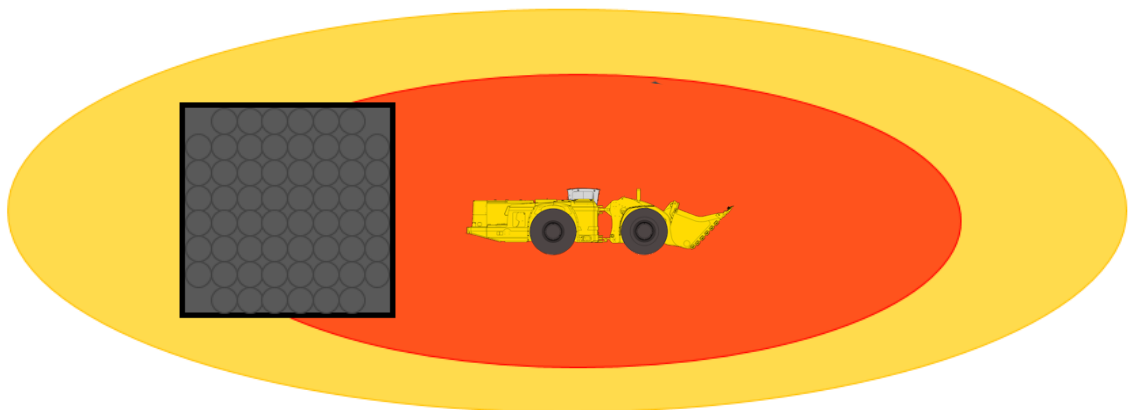
Other important scenarios

1. When the display panel has the corner LEDs illuminated, it means there are no tags in radio or electromagnetic range.



If the operator is in the cabin and sees this, it means that his/her tag is defective, and a replacement tag must be obtained immediately.

2. If no LEDs are illuminated it means that radio communication with tags has been established, but the tags are not in a Warning, Danger or Safe zone. This means the system is not picking up the tag inside the cabin.



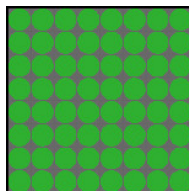
If the operator is in the cabin and sees this, it means that his/her tag is defective, and a replacement tag must be obtained immediately.

Acknowledging the alarm



Pressing the suppression button on a personnel tag or ICCL embedded tag will suppress the vibration and the audible alarm; the LED will also stop flashing and illuminate permanently. Suppression of the alarms allows personnel to concentrate on taking corrective action. This suppression is only temporary and all the alarm behaviours will resume after a user configurable time span.

When pressing the suppression button on the display panel, all green LEDs will briefly flash.



It will suppress the audible alarm and the alarm status LEDs will stop flashing and illuminate permanently. This suppression is only temporary and all the alarm behaviours will resume after a user configurable time span.

Pushing the display panel's suppression button, simultaneously acknowledges ALL TAGS in ALL the hazard zones.

Reactivation of the alarms

If a tag enters a different hazard zone, the tag and the display panel will issue a new alarm condition, irrespective of prior acknowledgements/suppressions.

The various alarms and notifications on the display panel and the tag automatically resume after the configurable timeouts.

The default timeout settings are:

- Danger zone: 30 seconds
- Warning zone: 60 seconds
- Safety zone: 12 hours

Changing the volume or brightness on the display panel

Buttons on the sides of the display panel control the screen brightness and volume.



Changing brightness

The up/down buttons on the **left-hand side** of the display panel (pictured above) change the screen brightness.

Changing volume

The up/down buttons on **the right-hand side** of the panel change the volume.

Tag batteries

Proximity tags have an operating battery life of approximately 12 hours, depending on tag activity and age. The tags should be fully charged at the end of every shift.

When a tag is down to 20% capacity, the LED will flash red once every 5 seconds, and will sound a single chirp sound every 5 minutes. This indicates that the tag should be recharged.

To charge the tag, insert it into the charger, as shown below:



When the tag is charging, the tag charger LED will show red. When the tag is fully charged and ready to be used the LED will show green.

When the tag is removed from the charger, it chirps the audible alarm once and flashes the LED to confirm the tag is working.

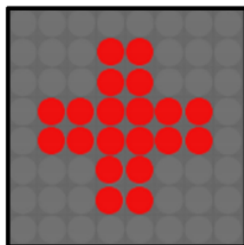
System faults

If the panel is displaying an error, the proximity system is not functioning. It means that the system is either temporarily or permanently unavailable.

System errors

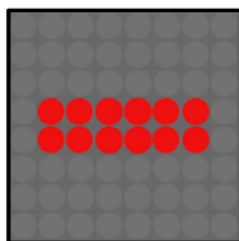
If the Proximity Controller detects a system error, the audible alarm will buzz every 3 seconds, and the display screen will show either of the screens below. In both conditions, the machine operator needs to proceed with extreme caution, as the system will not issue alerts of personnel present in the hazard zones.

Fatal error:



Fatal error

A fatal or unrecoverable error means the system has stopped running. The system will require a reboot to continue. Depending on the cause of the error, the system may reboot itself. An example of this kind of error is if a transmitter is unplugged while the system is operating.



Recoverable error

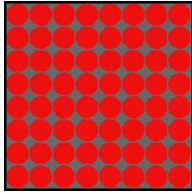
Recoverable error:

This error occurs when the system detects a fault that it is temporary or one it can resolve itself. The system will keep running, but will display the red LED pattern above.

An example of this kind of error is if a tag in the area is detecting an unknown transmitter.

Acknowledging the error

Errors are acknowledged in the same way as a breach of a proximity zone. If the fault alarm is acknowledged, the screen will flash briefly with all-red LEDs:



The audible alarm is silenced, and the LEDs will return to the pattern associated with the error condition, illuminated permanently rather than flashing.

The iButton

The iButton sensor on the front of the display panel is shown in the image below:



The iButton sensor is activated by inserting iButton fob supplied with the controller. When activated the system WiFi is enabled, which provides the user with access the system's configuration using standard web browsers.

A power cycle is required in order to restore the system to the operational state.

Even though all plug connections are designed to avoid electrical short-circuit, it is recommended to disconnect power when connecting and disconnecting transmitters to the controller or to each other.

**WARNING**

The proximity detection system has been designed to enhance operational safety. However it is not a replacement for normal safety practices and procedures. Personnel must remain vigilant at all times.

**WARNING**

High levels of electric or magnetic interference may degrade system performance or prevent timely operation.

**WARNING**

It is the responsibility of site safety management to ensure that detection ranges are correctly configured for the intended application. System configuration should be confirmed through operational tests conducted during commissioning and repeated on a regular basis consistent with site policies.

**WARNING**

When establishing safe zones, confirm that the range does not extend beyond the safe working area.

**WARNING**

Vehicle speeds and stopping distances must be properly considered when establishing Warning and Danger zones.

**WARNING**

Zone configurations must not be altered except by personnel authorised by site safety management.

**WARNING**

The Proximity Tag contains a rechargeable lithium battery. Recharge only using an approved MST charging dock.

**WARNING**

Personnel are responsible for ensuring their proximity tag is operational and fully charged before use. Tags with visible damage should not be used.

**WARNING**

Tags will alert the user a low battery condition. Site operating procedures must advise the user to take immediate action to leave the working area o obtain a replacement tag.

**WARNING**

The transmitter and panel emit a low frequency magnetic field. Persons with electronic medical devices (such as pacemakers, defibrillators, insulin pumps or others) must remain at a safe working distance. Safe working distances are 0.5m from a Transmitter, and 0.1m from a Panel.

**CAUTION**

The proximity detection system contains no user serviceable parts. Service must only be performed by a qualified technician. Unauthorised entry may void warranty.

**CAUTION**

Tags should be stored in the charging dock to ensure the Tag is ready for 12 hours of use.

**CAUTION**

Ensure appropriate disposal of electronic equipment and batteries.

**CAUTION**

Transmitter and Panel contain parts operating at high voltages.
Do not open!

Note:

The proximity detection system meets regulated safe levels for electromagnetic exposure per EN62311 and EN62209-2.

Compliance Statements

This device complies with Part 15 of the FCC Rules. 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.

Cet appareil est conforme à la section 15 de la réglementation de la FCC. Le fonctionnement de l'appareil est sujet aux deux conditions suivantes :

- (1) cet appareil ne doit pas provoquer d'interférences néfastes, et
- (2) cet appareil doit tolérer les interférences reçues, y compris celles qui risquent de provoquer un fonctionnement indésirable.

Note: This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this product 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 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.

Attention: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

With the exclusion of the Personnel Tag, this equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. The Personnel Tag can be worn directly against the body.

Avec l'exclusion du Personnel Tag, cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre l'émetteur et votre corps. Le Personnel Tag peut être porté directement contre le corps.

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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 d'interférences, et
- (2) l'utilisateur de l'appareil doit accepter toute interférence radioélectrique subi, même si les interférences sont susceptibles d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques d'interférences radioélectriques à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.