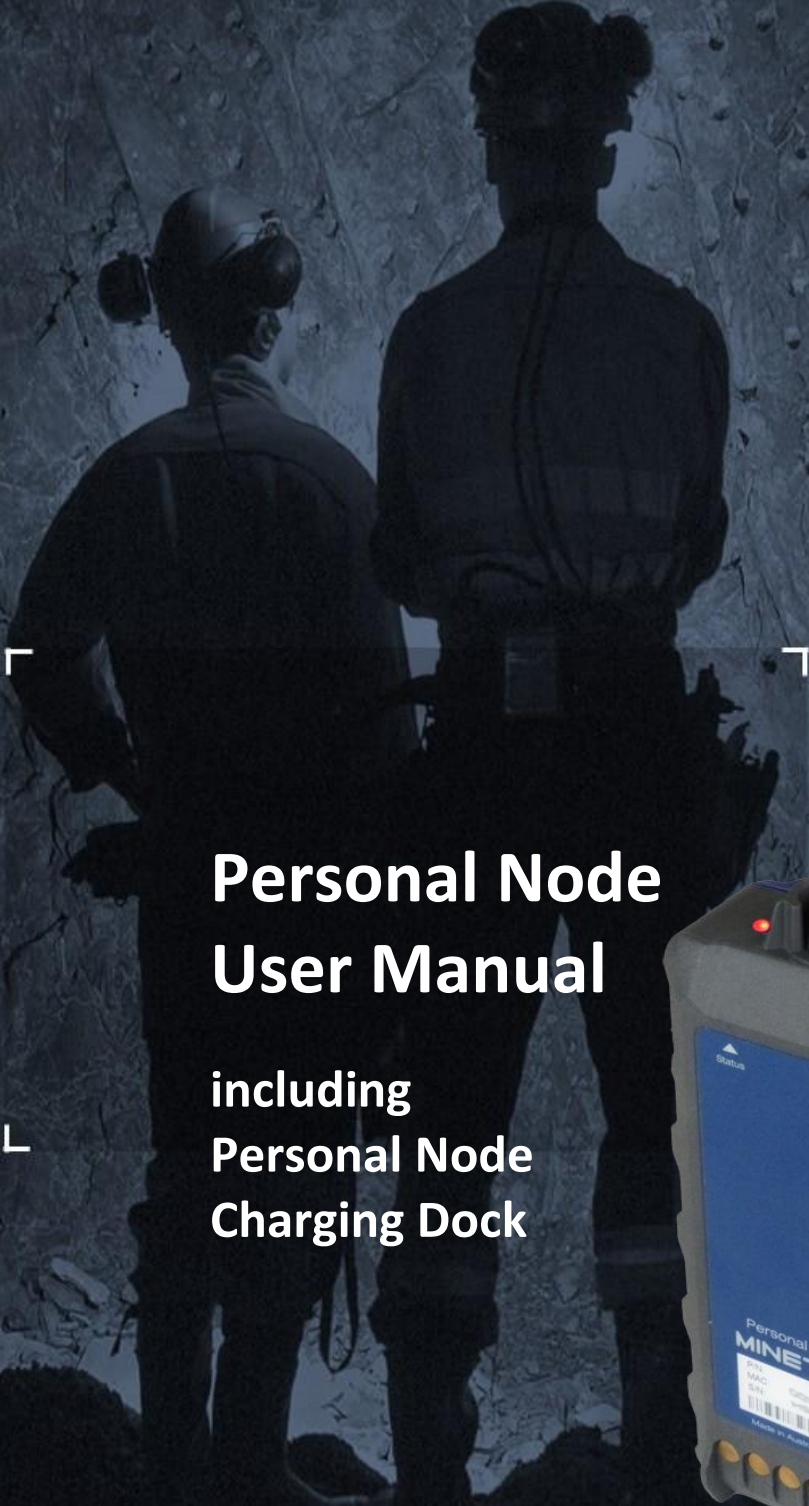




MINETEC™
STOP WORKING IN THE DARK



Personal Node User Manual

including
Personal Node
Charging Dock



**Pedestrians and
Vehicle Operators**

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It is important to install and operate the devices and systems according to the guidelines in this document to maintain conformity with regulations, standards and directives.

Responsible use

This document describes a Minetec system, including how to operate or troubleshoot hardware and/or software. The procedures and guidelines are not prescriptive and do not include operational and safety processes that may apply at your site. As such, responsible use of the procedures and/or

guidelines in this document is only achieved by aligning with and/or being incorporated within the Contractor's own operational and HSE policies, guidelines and procedures.

Safety

To ensure your own personal safety and prevent electrical damage and/or fire, please read these safety statements before installing any devices.



CAUTION

Do not attempt to service any device unless both qualified and authorised by Minetec in writing, and as indicated in this document.



Always use care when handling or operating Minetec devices.

Devices are only to be opened by experienced, qualified and authorised electrician/electronics service personnel. Use extreme care and caution when installing or removing devices. For all devices:

- Dropping a device or letting it fall could cause damage resulting in a potential electrical or fire hazard and/or voiding the warranty.
- Some devices may get hot in use and could pose a potential fire or burn hazard. Do not place anything on top of the device or drop objects on the device.
- Make sure the voltage of the power source is correct before connecting any device to the power source. The incorrect voltage may pose an electrical and or fire hazard.
- To prevent damage, fire and/or electrical shock, all cautions or warnings on a device should be noted.
- Never pour any liquid on to or into any device. Depending on the device this may cause damage resulting in fire and/or electrical shock.
- For product warranty, safety and performance reasons, only authorised and qualified service personnel should open any device.
- Although all Minetec wireless devices meet established standards for exposure to RF energy, additional common-sense precautions may also be taken to minimise potentially harmful RF radiation. For example, increasing the distance from an RF source reduces the exposure.
- Unless qualified and authorised, never attempt to disassemble, repair or make any modifications to the device. Disassembly, modification or any attempt at repair could cause damage to the device and even bodily injury or property damage and will void the warranty.
- As some Minetec devices can get hot and/or are a source of RF radiation, do not store or carry flammable liquids, gases or explosive materials in the same compartment as the device, its parts or accessories.
- If any of the following situations arises, immediately have the device checked by qualified and authorised personnel:
 - If applicable, the power cord or plug is damaged.
 - The device has obvious signs of breakage or tampering.
 - The device has been dropped and damaged.
 - The device has been submerged in water.
 - The device does not work as expected after using these guidelines.
 - It is suspected that liquid has penetrated the device.

Personal Node safety

To reduce exposure to RF energy, always wear or carry the device with the faceplate facing away from the body. This is best achieved when using the supplied belt loop or detachable swivel belt clip. If carrying in a jacket or vest pocket (not recommended) then:

- Ensure the faceplate faces away from the body.
- The device cannot rotate in a pocket.

Lithium ion batteries

Personal Nodes have lithium ion battery packs fitted.



Ensure the Personal Node battery is flat before airfreighting. This is achieved by waiting >24 hours after the last charge cycle and no LEDs are illuminated.

If you are authorised and advised to replace a battery pack:

- Replace ONLY with a Minetec supplied battery pack:
M1011000 Personal Node Spare Battery Assembly (with rear cover & gasket).
- Installing the incorrect battery pack can result in a serious safety hazard.
- Do not dispose of lithium ion batteries as waste. Dispose of the battery according to the local regulations dealing with the disposal of batteries or take them to collecting points for disposal of batteries.

Personal Node Charging Dock safety

To ensure your own personal safety and prevent electrical damage and/or fire, please read these safety statements before installing the Personal Node Charging Dock.



Do not open the Charging Dock unless you are qualified and an authorised electrician/electronics service personnel.
Unplug the dock from the power source before opening.

All care must be taken when locating and using the dock to:

- Prevent damage to the charging leaf contacts.
- Prevent liquids or dirt entering the dock vents or charging slots.
- Disconnect devices from all power sources before cleaning. Do not use liquid or spray detergents for cleaning. Use a damp cloth.
- Prevent metallic objects (eg screws, swarf, etc.) entering the dock vents and charging slots.
- Replace any worn, damaged or cracked power cables.

To prevent electrical shock and/or fire, consider the following:

- Route all cables so that people cannot step on them.
- Ensure cables are not under strain when connected.
- Ensure the cables have no kinks or sharp bends.
- Protect lead wires from abrasion and chafing by using wire loom or conduit, and route away from moving parts, hydrocarbons and high-temperatures areas.
- Protect all cabling using conduit and secure using P-clamps and/or cable ties at suitable distances to minimise vibrational flexing and maximise bend radii.
- Use cable glanding for structural penetrations (eg holes through sheet metal).

Compressed Air

Many sites do not provide or permit the use of compressed air. If your site permits compressed air to be used for cleaning of equipment then follow all site HSE procedures.



Never direct compressed air at a person as the air can penetrate the skin and cause significant health issues.

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1 ABOUT THIS DOCUMENT

This document is the user manual for the Minetec Personal Node used in deployments of SafeDetect™ and/or Trax™. Most of the features and functions of the Personal Node relate to the SafeDetect system. When used with a stand-alone Trax system, the user has no interaction with the Personal Node other than charging and checking the device. For information on the above systems, refer to [Reference material](#) on page 5. This document is also the user manual for the Minetec Personal Node Charging Dock.

This document is one of a set of documents outlined in the roadmap diagram below. The Install, Configure and Maintain stages relate to the solution(s) deployed that use the Personal Node.



All descriptions, screenshots, procedures and conventions in this document are based on an out-of-the-box installation. Variations in the configuration of the hardware may occur. As such, the narrative and screenshots shown in this document may not describe exactly the installation at a given site.

1.1 Document revision

Release Date	Document Version	Notes
19/02/2019	1.1	Updated for baseline GA1 release, additional instructions for wall mounting and preventative maintenance.
29/09/2018	1.02	Updated for battery fault LED patterns

1.2 Reference material

The following materials support and supplement the information in this document. Please use the version supplied by Minetec.

Document	Notes
Personal Node Data Sheet	Technical data
Personal Node Charging Dock Data Sheet	Technical data
Personal Node Quick Reference Guide	Single quick reference sheet for SafeDetect and Trax.
SafeDetect™ Vehicle Operator User Manual	Viewing Personal Nodes in proximity of a vehicle.
Trax™ MineView User Manual	Tracking Personal Nodes on a mine map.
Trax™ TagBoard User Manual	Tracking Personal Nodes by zones (Supervisor)
MineOffice™ User Manual	Configuring Personal Nodes (System Administrator)
EzyStrut E4000 41x21mm Channel Specification	Technical data for vertical mounting of the Charging Dock. See the Online version

1.3 Audience

All users of SafeDetect should be trained and deemed competent before using the system. The intended audience for this document is any person entering site operations and carrying a Personal Node. The audience includes, but is not limited to:

- Operator.
- Shift Supervisor.
- ICT technician / electrician.
- Control Room Operator.
- Fitter / Auto-electrician.
- Health and Safety Officer.
- Mine Administrator/System Administrator.
- Mining Engineer.

1.4 Responsible use

This document describes a Minetec system, including how to operate or troubleshoot hardware and/or software. The procedures and guidelines are not prescriptive and do not include operational and safety processes that may apply at your site. As such, responsible use of the procedures and/or guidelines in this document is only achieved by aligning with and/or being incorporated within the Contractor's own operational and HSE policies, guidelines and procedures.

1.5 Notes and icons

Throughout this document, the following icons and text formats have the meanings as indicated:



Notes in this style highlight important general information.



Caution notes in this style may have an impact on the safety or wellbeing of personnel and/or equipment.



Tips in this style provide helpful process tips.



Best practice notes in this style advise a recommended course or approach where several options may be available.

2 ABOUT MINETEC SYSTEMS

Minetec systems include:

- *Trax*[™] - provides tracking visualisation of vehicles and personnel in underground mines.
 - *Trax TagBoard* for a Supervisor's PC. ○ *Trax MineView* for a Vehicle Operator's In-Vehicle PC.
- *SafeDetect*[™] - provides fast and accurate proximity detection between vehicles and pedestrians.
- *SMARTS*[™] - provides integration of asset, task and KPI management for mines.
 - *SMARTS Manager* for a Supervisor's PC to plan and manage tasks, messages and documents. ○ *SMARTS Operator* for a Vehicle Operator's In-Vehicle PC.

This document covers Personal Nodes used in *Trax* and *SafeDetect* systems. If multiple Minetec systems are deployed at your site you should also refer to *Trax MineView User Manual* and *SafeDetect Vehicle Operator User Manual*.

The Minetec Suite allows for integration with various other systems via the Minetec REST API.



If your site has integration with Caterpillar MineStar, certain elements of system configuration are managed in MineStar. Look for notes throughout this document that indicate integration with MineStar.

All Minetec's systems use wireless communication as described in [About Minetec technology](#) on page 68.

3 ABOUT THE PERSONAL NODE



--- Personal vigilance is paramount ---

Although the Personal Node provides audible and visible warnings, responsibility for any intervention or action remains with the wearer.

The Minetec Personal Node is a battery-powered wireless device worn by personnel and designed for use in harsh mining environments. Personal Nodes are used in Minetec’s:

- SafeDetect™, a high-precision proximity detection solution for vehicles and pedestrians.
- Trax™, a tracking and positioning solution, enabling high-precision positioning and tracking.

If both solutions are deployed, Personal Nodes provide combined positioning, tracking and proximity detection for personnel.

[Table 6 Function overview \(defaults\)](#) on page 18 lists the Personal Node features as they apply to each of the solutions. See [Table 3 Personal Node specifications](#) on page 11 for further information.

All Minetec nodes use the CSIRO¹ Wireless Ad-hoc System for Positioning (WASP) technology including Time of Arrival (ToA) techniques for accurate ranging.

Personal Nodes operate in the following wireless bands:

- 5.8 GHz for WASP.
- 2.4 GHz wireless band creating wireless mesh networks.



Personal Nodes **do not** use standard 2.4Ghz Wi-Fi.

Table 1 Wireless technology

Solution →	SafeDetect	Trax	SMARTS [^]
<i>Purpose →</i>	<i>Proximity awareness</i>	<i>Tracking / Positioning</i>	<i>Productivity / Scheduling</i>
5.8 GHz WASP	Personal Node and Mobile Node	Infrastructure	-
2.4 GHz mesh		-	
2.4 GHz Wi-Fi	In-Vehicle PC		
	-	Infrastructure for comms and data backhaul	

[^]SMARTS is a productivity and scheduling solution and does not use Personal Nodes.

3.1 Design Philosophy

SafeDetect aligns with elements of the EMERST Design Philosophy (DP-5) for Machine Operation Controls and the Performance Requirement (PR-5A) for Vehicle Interaction Systems as described in the *SafeDetect Operator User Guide*. Refer [EMESRT alignment](#) on page 70 for details.

The Personal Node is used to mitigate potential unwanted vehicle interactions known as *PUE 1 Equipment to Person*. This is only possible if all vehicles use In-Vehicle PCs.

¹ Commonwealth Scientific and Industrial Research Organisation, the Australian federal government scientific research agency.



Do not assume that all vehicles can 'see' you on an In-Vehicle PC. For example, some vehicles may not have an In-Vehicle PC.



The Personal Node does not replace personal vigilance and full responsibility remains with the wearer to act upon all visible or audible warnings in line with prevailing site based HSE policies and procedures.

When used with SafeDetect™, Personal Nodes will:

- 1) Warn users if vehicles enter pre-configured warning zone(s) around the Personal Node.
- 2) Enable users to be detected by vehicles when the user enters the vehicle's pre-configured warning zone(s).
- 3) Enable users to broadcast an alert showing the Personal Node's unique ID in *Broadcast Me* mode.
- 4) [Table 2 SafeDetect features](#) below summarises the SafeDetect™ features that are in addition to the basic operations described above. The descriptions in this table are based on **default settings** and the experience may differ slightly depending on the configuration at your site. **Table 2**

SafeDetect features

Feature	Description
Detection of a proximity event	When a vehicle is detected nearby, the Personal Node provides a visible warning by flashing 4 x LEDs. An audible warning may also annunciate and, if required, is muted by pressing the button at the top of the device. All users should be vigilant and respond to the visible and audible alarms on the Personal Node as described during training. Do not depend on the Vehicle Operator to see you on their SafeDetect™ display and respond to your presence.
In-Vehicle Detection Mode	When a user approaches or enters a vehicle, the Personal Node is detected by the vehicle's SafeDetect system. To suppress the proximity event alarm for a Vehicle Operator or passenger, the Personal Node is manually switched to Use In-Vehicle Detection (IVD) mode as described on page 32. This function allows the person to be in a vehicle without alarm annunciation and it also suppresses the Personal Node being detected as a potential hazard by other vehicles.
<i>Broadcast Me mode</i>	If approved for use at your site, a user can activate Use Broadcast Me alert as described on page 35. This functions notifies all SafeDetect equipped vehicles with an audible and visible alert. The meaning and response to this function is defined at your site.



Vehicle Operator response when receiving a *Broadcast Me* alert is determined by the on-site operational and HSE policies and procedures.



Personnel who use Personal Nodes with the SafeDetect™ solution need to be deemed competent in the principles of proximity detection in relation to the EMERST standards.

3.2 Working with Trax™ (stand-alone)

The Trax system provides tracking visualisation of vehicles and personnel in an underground mine. Tracking visualisation is available to vehicle operators using an In-Vehicle PC and Supervisors using a desktop PC. The wearer does not need to interact with the Personal Node when used in a standalone

Trax solution. Apart from charging and checking the device is OK when removing it from the dock, wearing the Personal Node on a belt or harness is all that is required.

3.3 Working with SafeDetect™ (stand-alone)

SafeDetect provides fast and accurate proximity detection between vehicles and pedestrians. Each proximity event represents a nearby asset (vehicle or person). SafeDetect assesses each proximity event based on the configuration and triggers simple, expressive visual cues and audible alarms to vehicle operators using an In-Vehicle PC and pedestrians wearing a Personal Node.



SafeDetect does not replace Vehicle Operator or Pedestrian vigilance. It is the responsibility of the Vehicle Operator and Pedestrians to understand, acknowledge and act on the warnings per site HSE policy and standard operating procedures.

Although SafeDetect provides audible and visible warnings, responsibility for any intervention or action remains with the Vehicle Operators and Pedestrians.



SafeDetect does not and will not stop any vehicles.

The system only detects vehicles and pedestrians fitted with SafeDetect nodes. Vehicles and pedestrians not fitted with nodes will not be detected by the system.

3.4 Configuration via MineOffice

MineOffice is the central management application for all Minetec software and hardware products. Accessible via a web interface, MineOffice is used to set-up and configure Minetec hardware as well as all desktop and mobile apps within the Minetec software suite. As appropriate, firmware and software updates can be performed remotely when within network coverage. MineOffice also enables centralised monitoring and diagnostics of Minetec products.

Initial configuration of MineOffice is handled by Minetec during deployment of the solution.

MineOffice is used for device administration and configuration. MineOffice stores asset, maps (Trax only) and configuration details, including:

- Asset Register, used to auto populate personnel and vehicle names and icons. (All solutions).
- Geometry service, contains the map for each location (Trax only)
- Configuration, contains the underlying configuration for each solution.

More information about:

- Personal Node configuration, refer to the MineOffice User Manual.



Administrative Functions requires an Administrator password.

4 WORKING WITH THE PERSONAL NODE

The Personal Node is simple to use and requires minimal interaction by the wearer for normal use as a pedestrian. Additional functions are used if the wearer enters a vehicle as a vehicle operator or passenger.

Table 3 Personal Node specifications

Parameter	Requirement		
Electrical			
Nominal Voltage	3.6 Vdc Lithium-ion Rechargeable Battery		
Capacity	13.2 Ah / 47.5 Wh		
Charge Time	Up to 6 hours, depending on existing charge state		
Operating Time	> 18 hours when fully charged, for a new battery at approximately 20°C		
Physical			
Dimensions	154 x 75 x 49 mm (excluding standard belt loop)		
Weight	0.56 kg (including standard belt loop)		
Enclosure Material	Glass fibre reinforced Nylon (halogen free)		
Flammability	UL 94, V-0 compliant		
RF Interfaces			
2.4 GHz Wireless Mesh	2402 MHz to 2473 MHz		
Channel	Configurable selection 1 to 11		
Tx Output Level	+18 dBm @ UFL connector		
Modulation	802.11b (DBPSK-2)		
Antenna	Internal, 2.6 dB gain		
5.8 GHz WASP	5725 MHz to 5850 MHz		
Channel	1 to 8 overlapping channels	Channel Bandwidth	18.8 MHz
Tx Output Level (Peak)	27.0 dBm EIRP		
Modulation	QPSK		
Antenna	Internal		

See the *Personal Node Data Sheet* for full specifications.

4.1 User interface

The Personal Node has a simple user interface as shown in the following views:

- [Figure 1 Personal Node - isometric view](#) below.
- [Figure 2 Personal Node - top view](#) below.
- [Figure 3 Front view](#) on page 13.
- [Figure 4 Rear view](#) on page 13.

Figure 1 Personal Node - isometric view



Figure 2 Personal Node - top view





Figure 3 Front view Figure 4 Rear view
Figure 5 Swivel belt clip - Slot



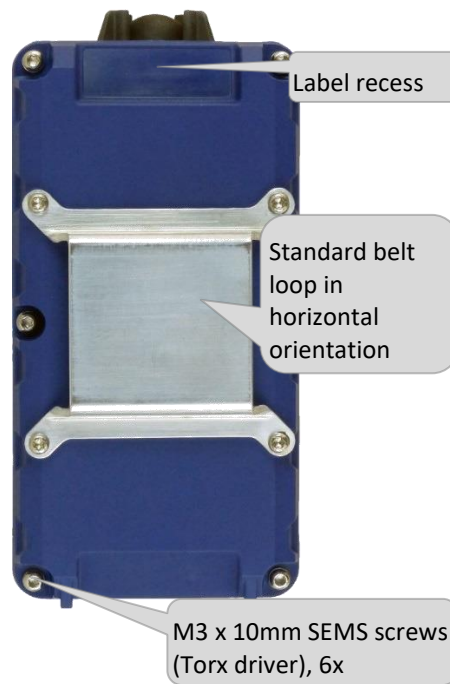


Figure 6 Swivel belt clip - Pin



To ensure that the Personal Node cannot be turned off accidentally, or forgotten to be turned on, it does not have an ON/OFF switch. The Personal Node is only off when it has a totally flat battery or when it is being charged in the Personal Node Charging Dock. The device turns on automatically when removed from the Personal Node Charging Dock.

4.1.1 Proximity event alarms

A visible and audible alarm annunciates when a proximity event triggers indicating a vehicle has been detected within one of the proximity zones. The audible alarm is an intermittent beep with a configurable duty cycle. The LEDs colours are also configurable.

The configurable parameters of the alarm are a tone frequency between 500 Hz and 3000 Hz and a typical duty cycle in the range of 10%-50%. The default alarms are shown in [Table 4 Basic default alarms](#) on page 14.

Table 4 Basic default alarms

Zone/Function	Radius (m)	LED colour	LED cycle	LED repeat	Audio (Hz)	Audio cycle	Audio repeat
ALERT	Disabled	N/A	N/A	N/A	None	N/A	No
ALARM	100	Yellow	Flash every two seconds	Yes	2000	Beep in sync with LED	No
SLOW	50	Orange	Flash once per second	Yes	2000	Beep in sync with LED	No
STOP	20	Red	Flash twice per second	Yes	2000	Beep in sync with LED	Yes
IVD zone detected	Defined by vehicle setup.	Red	Solid	N/A	2000	Constant tone	N/A
IVD ² zone activated	Within vehicle offset. Refer Fleet map.	Green	Solid	N/A	No	No	N/A
<i>Broadcast Me</i>	Any range	White	Flash once per second	Yes	500	1 beep per second	Yes

As part of a start-up check, the audible alarm also annunciates for a few seconds when removing the Personal Node from the charging dock. For more details on the audible alarms, see [About patterns](#) on page 22.



Patterns are Site specific and are factory configurable.

² Note that the STOP alarm annunciates when a Personal Node exits the IVD zone.

Confirm the Site Zone/Functions and expected LED colours at your site during training.

4.1.2 LED interface

The visible alarms for each zone consist of the LEDs flashing in synch with the audible alarms described in [Table 4 Basic default alarms](#) on page 14. For more details on the visible alarms, see [About patterns](#) on page 22.

The LEDs also flash when removing the Personal Node from the charging dock to check that they are working. The *Status* and *Charge* LEDs are on top for ease of checking the device status when worn on a belt.

The four high intensity LEDs are placed to ensure light radiates over a broad spatial volume for high visibility when a proximity alarm is triggered. You do not have to have direct line-of-sight to the LEDs but should be able to see the radiated light.



If the Personal Node is totally covered, the visible alarm may not be visible.

4.1.3 Multi-function push button

The Personal Node has a single multi-function button as seen in [Figure 2 Personal Node - top view](#) on page 12.



The multi-function push button is only used in SafeDetect™ and has no purpose in a stand-alone Trax™ solution.

The button has the functions described in [Table 5 Multi-function push button \(defaults\)](#) on page 16.



As the Personal Node multi-function push button is configurable, users should confirm the purpose and operation of each function during site induction and/or training.

Table 5 Multi-function push button (defaults)

Scenario	Feature	Function	Action	Notes
Personal Node alarm is triggered by a nearby vehicle or vehicles. User is aware of all potential hazards and wants to mute the alarm.	Proximity event alarm	Mute <i>If permitted by HSE and operational procedures.</i>	Momentary press and release.	Muted alarms cannot be un-muted for that zone however a new alarm is triggered by a closer threat. For example, if the same vehicle moves to a closer zone or a different vehicle enters the muted zone.
User wants to broadcast an alert to vehicles.	<i>Broadcast Me mode</i>	Activate		
User wants to stop broadcasting an alert to vehicles.	<i>Broadcast Me mode</i>	Deactivate	Press & hold for 1.5 seconds.	<i>Broadcast Me</i> alert is cancelled. See Use Broadcast Me alert on page 35.
User wants to enter a vehicle as a driver or passenger and is within the IVD approach range. The IVD alarm annunciates.	IVD mode	Activate		Only effective if within the configured IVD range of a vehicle. See Use In-Vehicle Detection (IVD) mode on page 32.
User wants to exit a vehicle and be alerted of any nearby vehicles. User is within the IVD cancellation range.	IVD mode	Deactivate	Momentary press and release twice within 2 seconds.	Manual deactivation to ensure Personal Node is operational as soon as possible. See Use In-Vehicle Detection (IVD) mode on page 32.
User wants to exit a vehicle and be alerted of any nearby vehicles. User is outside the IVD cancellation range (eg forgot to cancel manually).	IVD mode	Deactivate	No action required.	Automatically deactivated when outside of the configured IVD range of a vehicle in case user forgets to deactivate manually.

4.2 Functions

The basic user functions for are limited to:

- Monitoring and responding to:
 - *Start-up* sequence. See [Table 8 Start-up sequence](#) on page 23. ○ *Status* and *Charge* LEDs. See [About patterns](#) on page 22. ○ *Proximity event alarms*. See [Procedure 2 Using a Personal Node](#) on page 31.
- Activating and cancelling:
 - *IVD mode* to enter a vehicle. See [About In-Vehicle Detection](#) on page 20.
 - *Broadcast Me* alerts per site procedures. See [About Broadcast Me](#) on page 21.

Refer to the functions listed in [Table 6 Function overview \(defaults\)](#) on page 18

4.3 Features





To prevent accidental shut down, the Personal Node has no user on/off switch.

Used in Minetec solutions, the Personal Node:

- Has ingress protection of IP66/67 (Dust and water tight).
- Automatically turns off when placed in the Personal Node Charging Dock.
- Automatically turns on when removed from the Personal Node Charging Dock.
- Performs a start-up sequence when removed from the Personal Node Charging Dock.
- Uses over-the-air configuration - performed by the System Administrator.
- Does not requires any cables.
- Requires minimal user interaction.

The Personal Node also includes a small recess at the top of the back cover suitable for adding customised self-adhesive labels. The Mine Operator can decide which information, if any, is added to this recess. Typically the label would be, for example, a barcode, alphanumeric identifier (eg PN1014) or an asset number. The recess size is 37 x 12 mm. If required, optional adhesive backed clear label protectors (Minetec M1011031 Label Protector Kit containing 20 clear adhesive label protectors) can be attached to the top of the label to minimise scuffing. The label protectors are sized to the recess so if the label is not self-adhesive, allow for some overlap of the label protector to secure the label, which should be no larger than 33 x 8 mm.

Table 6 Function overview (defaults)

System	Function/Feature	In Dock	Interface Elements	Action/Behaviour	Purpose	Further reading
SafeDetect and Trax	On charge	Yes	Charge LED	Solid red	Health	Regular operations on page 24
	Fully charged			Solid green		
	Charge fault			Flashes red indicating, for example, a battery fault or dirty contacts.		
	Start-up sequence	No	All LEDs & Audible alarm	1. <i>Status + Charge</i> flash blue once in synch with 2x red side LEDs. 2. All four LEDs flash red three times in synch & audible alarm. 3. <i>Status</i> LED flashes once every two seconds → Device OK.		Start-up sequence on page 23
	Device OK			Flashes green, once every two seconds		Regular operations on page 24
	Low batt on start-up			Flashes red.  <u>Do not use a Personal Node with low battery at start-up as functionality is inhibited.</u>		Irregular operations on page 26
	Low battery			Flashes orange, once per second		
	Faulty device			Flashes red.  <u>Do not use a faulty device as functionality is inhibited.</u>		
Proximity event detected	Mute alarm	No	All LEDs	All LEDs flash in synch with audible alarms in Table 4 Basic default alarms on page 14.	Operations	Regular operations on page 24
			Push button	Momentary press and release per Table 5 Multi-function push button (defaults) .		

SafeDetect only	IVD mode	Push button & Status LED	Press button twice within 1.5 seconds → Status LED solid, any IVD audible alarm mutes. See Table 5 Multi-function push button (defaults) on page 16.	Use In-Vehicle Detection (IVD) mode on page 32
	Broadcast Me alert	Push button and all LEDs	Press and hold button for two seconds. → All LEDs flash white, an audible alarm annunciates (if configured), and <i>Broadcast Me</i> alert broadcasts. See Table 5 Multifunction push button (defaults) on page 16.	Use Broadcast Me alert on page 35

4.4 About warning zones

Each Personal Node is configured with pre-defined warning zones centred on the user wearing the device. The Personal Node annunciates an alarm (visible and audible) when a vehicle enters one of the warning zones.



While the exact nature of the visible and audible alarms is configurable, this manual describes a default configuration. The user experience may differ from this at different sites so always check the configuration at your site.

Each zone defines a physical area around the wearer and has the default ranges shown in [Figure 7 First 3 default zones](#) below. The user at the centre of the zone represents your vehicle.

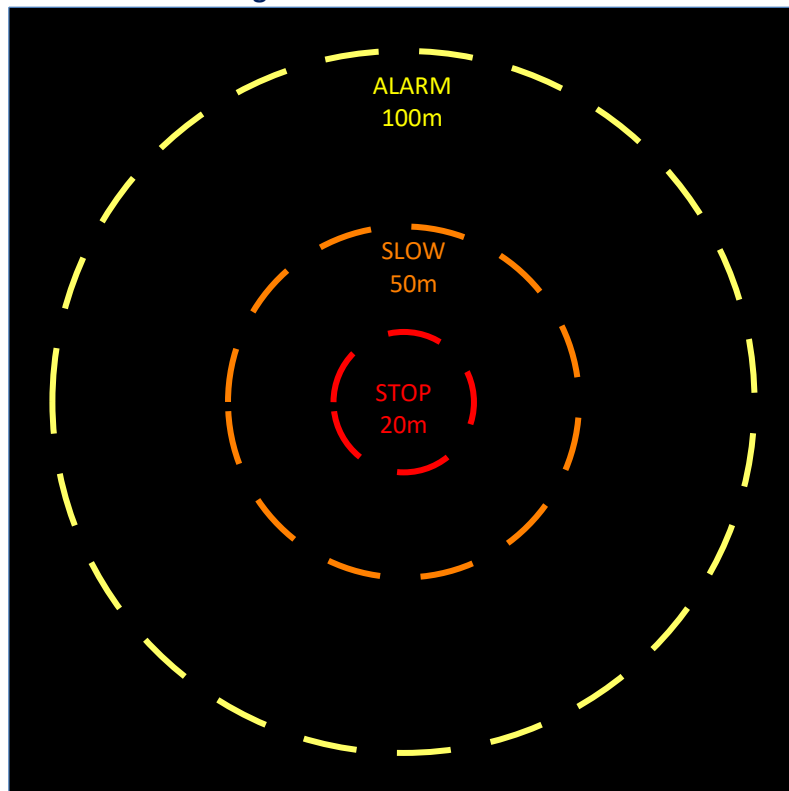
Note that:

- Up to four zones around a user can be configured: ALERT, ALARM, SLOW and STOP representing, respectively, the lowest to highest risk due to an approaching vehicle.
- The default thresholds are set to 80, 60, 40 and 20 m respectively.



Zone sizes may differ per site.

Figure 7 First 3 default zones



Zone size can be configured by a System Administrator on-site, depending on the range of proximity detections required. Zones measure radially out from each Personal Node. See [Zone sizes](#) on page 69 for further information.

4.4.1 Zone tolerance

In the SafeDetect system, warning zones have a small tolerance to prevent the situation where an alarm is repeatedly annunciating as a vehicle moves around in a small area of a zone boundary. The tolerance of 5% is provided on the exit side of a warning zone so that, for example, if a warning zone is set at 20 m, the vehicle can move 21 meters away from the user and not trigger a new alarm when moving back within the 20 m warning zone. The tolerance was designed to prevent unnecessary zone transitions and is safe and practical.

4.5 About In-Vehicle Detection

If a user enters a vehicle as a Vehicle Operator or passenger, the Personal Node is put into In-Vehicle Detection (IVD) mode to suppress the proximity alarm on both the Personal Node and the In-Vehicle PC. The IVD function uses two small zones within which the Personal Node audible alarm can be suppressed for the whole time the user is within that zone. The user is now within the vehicle’s warning zones and uses the In-Vehicle PC to detect and view approaching potential hazards.



Refer to the *SafeDetect Operator Manual* for details on the In-Vehicle PC.

To reduce the number of unwanted automatic IVD cancellations (eg the user is moving in or around a large vehicle), the IVD function effectively uses inner and outer zones that:

- Activates on entry to the inner zone.
- Deactivates 5 s after exit from the outer zone.



The IVD range is configurable by the System Administrator.

4.5.1 IVD Principle

IVD relies on the principle that users are not only responsible for their own safety but also have a responsibility to Vehicle Operators that ensures they see the correct information on their In-Vehicle PC.

[Table 7 IVD examples](#) below shows correct (✓), incorrect (✗) and doubtful (?) results if not using IVD correctly. At all stages below, vehicles will be able to see each other as they use Mobile Nodes.


Table 7 IVD examples

Scenario	After entering a haul truck	After exiting a haul truck
Three people in a haul truck using IVD mode as designed.	<ul style="list-style-type: none"> • Vehicle Operators cannot 'see' any pedestrians. ✓ • The users' Personal Nodes will not annunciate an alarm when approaching another vehicle. ✓ 	<ul style="list-style-type: none"> • Vehicle Operators 'see' three users as a potential hazard. ✓ • The users' Personal Nodes will annunciate an alarm when approaching another vehicle. ✓

<p>Instead of using IVD mode, three users in a haul truck mute their Personal Nodes.</p>	<ul style="list-style-type: none"> • Vehicle Operators 'see' three pedestrians displayed. The Operators cannot sight the pedestrians and if they should be visible then the Operators may doubt the display. ✘ • The Personal Nodes persist to announce an alarm when a greater threat is perceived (eg gets closer to another vehicle) which will distract all on board. ✘ 	<ul style="list-style-type: none"> • Vehicle Operators can 'see' three people on the In-Vehicle PC as a potential hazard, but they may still doubt the display ? • The Personal Nodes will announce an alarm when approaching another vehicle. ✓
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4.6 About *Broadcast Me*

If required, a Personal Node user can activate the *Broadcast Me* function.

This function continuously broadcasts the unique ID of the Personal Node (eg PN007) and when the broadcast is received by a nearby vehicle, the In-Vehicle PC shows a coloured flag  (colour reflects vehicle zone in which pedestrian detected) next to the Personal Node's ID in the detections list and an audible alert is sounded.

The *Broadcast Me* function may be configured for a different purpose at each site, so a Vehicle Operator's response is guided by the Contractor's own operational and HSE policies, guidelines and procedures.

For example, the *Broadcast Me* function could be used:

- To alert nearby Vehicle Operators that the user needs urgent assistance. In this case the coloured flag and audible alert could tell the Vehicle Operator to: "Render assistance to the person who activated the *Broadcast Me* function".
- To set-up a 'personal work zone' around the Personal Node. In this case the coloured flag alert and the audible alarm could tell the Vehicle Operator: "Keep away from the user who activated a personal safety zone".


The above applications of the *Broadcast Me* function require two totally opposite responses from vehicle operators, so the exact response expected from Vehicle Operators will be defined by the Contractor's site procedures. Alternatively, the *Broadcast Me* function could be used for any purpose defined by the Contractor.

It is important to note that SafeDetect™ operates as a mesh network so that the *Broadcast Me* signal is only detected by vehicles within range (peer-to-peer). As such, the *Broadcast Me* function should not be relied upon as the only method for alerting others of an emergency.

Following are the default *Broadcast Me* features for the out-of-the-box system. These features are factory configurable by Minetec:

- For the Personal Node user, the *Broadcast Me* function:
 - Is activated by the user.
 - Continues until the user manually cancels the broadcast.
 - Causes all Personal Node LEDs to flash white.

Note that for the Vehicle Operator, the In-Vehicle PC displays a:

- Coloured flag  displays next to the Personal Node's ID. Colour reflects vehicle proximity zone.
- STOP label as a warning message overlay.
- An audible alert is sounded that can be muted using the In-Vehicle PC mute function.

Check how the *Broadcast Me* function is used at your site during training.





Only the user who initiated the *Broadcast Me* alert can cancel it.
Broadcast Me alerts takes precedence over IVD mode.
 Proximity event alarms take precedence over the *Broadcast Me* alert.



The SafeDetect system does not define the purpose of this alert.
Broadcast Me alerts are detected on the In-Vehicle PC.
Broadcast Me alerts are not detected by other Personal Nodes.
Do not rely on this function as the only method for alerting others of an emergency.

4.7 About patterns

The four high intensity LEDs and audible sounds are used to communicate the state of the various functions performed by the Personal Node ranging from, for example, battery health to a proximity event alarm. The visible LEDs and audible sounds convey each state with a pre-defined pattern. Each pattern consists of the combination of the audible sound plus the number of LEDs, LED colour, LED sequence, illumination frequency or persistency.



Patterns are factory configurable.
 Confirm the expected LED colours at your site during training.

The audible alert/alarm is multi-purpose and is interpreted in context with the situation and LED pattern as described in the following pages.

4.7.1 Start-up sequence

A Personal Node performs a start-up sequence when it is removed from the Personal Node Charging Dock (dock). The start-up LED pattern in [Table 8 Start-up sequence](#) below, confirms it is ready to use.

Advise the System Administrator if the start-up sequence fails at any of the stages shown below.



Only remove a Personal Node from the dock if the *Charge* LED is solid green. A red *Charge* LED indicates the battery is not fully charged.

Table 8 Start-up sequence


Stage 1	Stage 2	Stage 3	Stage 4
On Charging Dock	Removed from Charging Dock		
The device is fully charged when the <i>Charge</i> LED is green.	The <i>Status</i> and <i>Charge</i> LEDs briefly glow blue and the two side LEDs briefly glow red.	All LEDs flash red synchronously with the unit beeping three times.	The <i>Status</i> LED starts to flash green once every 2 seconds.






4.7.2 Regular operations

Regular operations cover all functions designed to make the user safer and/or trackable, depending on the systems deployed at your site.

Table 9 Regular operating patterns

Operation/Function	Pattern	LED Display
<p>Normal operation: All Minetec solutions + NORMAL PATTERN (SafeDetect™ and Trax™)</p> <hr/> <p>This is the default status. When used with SafeDetect, the wearer can now detect, and be detected by, vehicles. When used with Trax, the wearer can now be tracked on a mine map in Trax MineView and on a zonal map in Trax TagBoard.</p>	<p>The <i>Status</i> LED flashes green once every 2 seconds; no audible alert.</p>	

<p>Normal operation (SafeDetect™ only) PROXIMITY EVENT PATTERN</p> <hr/> <p>A visible and audible warning is active, as one or more vehicles are nearby. Audible warning will stop when the device is muted, visible warning will continue. Respond to all warnings in line with onsite operational and HSE policies and procedures</p>	<p>All LEDs flash in synchronisation with the audible alarm appropriate for the zone.</p> <p>For the default patterns, see Table 6 Function overview (defaults) on page 18 and Proximity event alarms on page 13.</p>	
<p>Normal operation (SafeDetect™ only) Broadcast Me PATTERN</p> <hr/> <p>To cancel <i>Broadcast Me</i>, press and hold the device button for two seconds.</p>	<p>All LEDs continuously flash white along accompanied by any configured audible alert.</p> <p>For the default patterns, see Table 6 Function overview (defaults) on page 18 and Proximity event alarms on page 13.</p>	

Operation/Function	Pattern	LED Display
<p>Normal operation (SafeDetect™ only) IVD PATTERN</p> <hr/> <p>The Personal Node is suppressed from being detected by mobile nodes. Used when entering a vehicle.</p>	<p>The <i>Status</i> LED is a solid colour; no audible alert.</p> <hr/> <p>The LED colour reflects the current status (green for normal, orange for low battery etc) and activating IVD just prevents the Status LED from flashing.</p> <hr/> <p>This example shows IVD when in normal operation with a green Status LED →</p>	

4.7.3 Irregular operations

Irregular operations cover all functions that require attention from the user or the System Administrator.




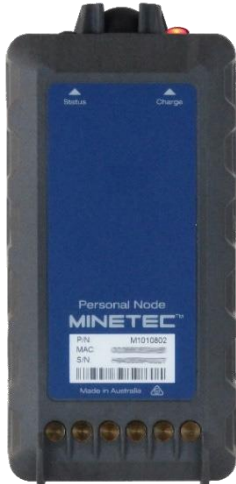
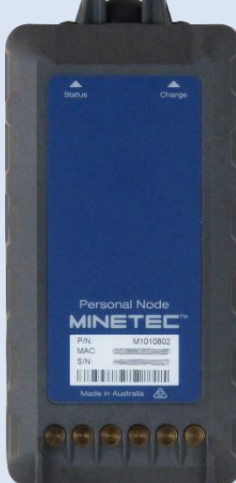
Use caution if your Personal Node displays any of the irregular patterns.

Each of the patterns shown in [Table 10 Irregular operating patterns](#) below requires the user action indicated, irrespective of the Minetec solution deployed at your site.

Table 10 Irregular operating patterns

Personal Node Operation/Function	Pattern	LED Display
<p>Action required LOW BATTERY DURING OPERATIONS</p> <p>There are between approximately 30 minutes and 3 hours of operating time left before the unit stops working. Arrange for a fully charged replacement Personal Node if necessary.</p>	<p>Status LED turns orange resulting in one of the following:</p> <ul style="list-style-type: none"> Status LED flashes orange (not IVD mode). Status LED is solid orange (IVD mode). <p>Note that proximity event alarms take precedence over battery alerts.</p> <p>A persistent but muted proximity event alarm (eg in high traffic areas) will prevent a battery alert from annunciating.</p>	

Personal Node Operation/Function	Pattern	LED Display
<p> The Personal Node should not be used if any of the following patterns display.</p> <p>Action required LOW BATTERY AT START UP</p> <p>Replace the Personal Node in the charging dock. Refer to Personal Node troubleshooting on page 57.</p>	<p>Status LED flashes red once a second when the Personal Node is removed from the charging dock.</p> <p>The Personal Node should not be removed from the dock unless the Charge LED is solid green.</p> <p> The audible alarm is disabled for a low battery at start-up condition.</p>	

Personal Node Operation/Function	Pattern	LED Display
<p>Action required DEVICE FAULT</p> <hr/> <p>Replace the device. Refer to Personal Node troubleshooting on page 57.</p>	<p><i>Status</i> LED flashes red once a second when the Personal Node is out of the dock.</p>	
<p>Action required CHARGING FAULT (EG BATTERY FAULT OR DIRTY CONTACTS)</p> <hr/> <p>Refer to Personal Node troubleshooting on page 57.</p>	<p>The <i>Charge</i> LED flashes red while in dock.</p>	
<p>Action required DEVICE FAULT OR FLAT BATTERY</p> <hr/> <p>Replace the Personal Node in the charging dock. Refer to Personal Node troubleshooting on page 57.</p>	<p>No LEDs illuminated.</p>	

5 EVERYDAY OPERATION

The Personal Node requires minimal user interaction, limited to the following procedures:

- [Procedure 1 Charging a Personal Node](#) on page 30.
- [Procedure 2 Using a Personal Node](#) on page 31.
- [Procedure 3 Activating IVD - SafeDetect operating](#) on page 32.
- [Procedure 4 Activating IVD - SafeDetect not operating](#) on page 33.
- [Procedure 5 Cancelling IVD mode](#) on page 34.
- [Procedure 6 Activating the Broadcast Me function](#) on page 35.
- [Procedure 7 Cancelling Broadcast Me function](#) on page 35.



Do not assume that all vehicles can 'see' you on an In-Vehicle PC. For example, some vehicles may not have an In-Vehicle PC.

5.1 Wear the Personal Node



Ensure the Personal Node faceplate faces away from the body

A Minetec Personal Node is typically worn by a user on their belt and weighs just over 500 g.

A Personal Node has a long battery life, exceeding any standard shift period, and when placed in the Personal Node Charging Dock, is fully charged before the next shift.

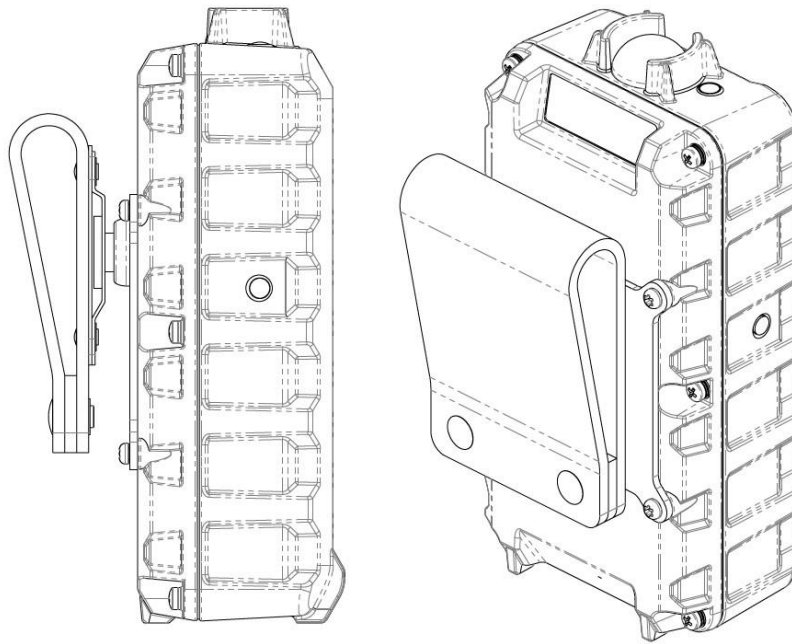
When wearing or carrying a Personal Node, consider the following safety and operational guidelines:

- To reduce exposure to RF energy, always wear or carry the device with the faceplate facing away from the body. This is best achieved when using the supplied belt loop or detachable swivel belt clip.
- Do not leave a Personal Node on the dash of a vehicle as it:
 - Will be a hazard in a vehicle accident.
 - May be damaged if left in the sun for extended periods.
 - You may forget to replace it on your belt when exiting the vehicle.
- Ensure the Personal Node LEDs are not completely covered. The LEDs do not need to be directly viewable, but the emitted light should be able to be seen considering the ambient lighting.
- Ensure the Personal Node is not covered to the point that the alarms become inaudible.
- If carrying in a jacket or vest pocket (not recommended) then:
 - Ensure the faceplate faces away from the body.
 - The device cannot rotate in a pocket.

5.1.1 Standard belt loop

The Personal Node is supplied with a standard belt loop that fits most belts or harnesses. The Personal Node remains in a fixed position and cannot be removed unless it is unthreaded from the belt/harness. Two views of the standard loop are shown in [Figure 8 Standard belt loop](#) below.

Figure 8 Standard belt loop



5.1.2 Detachable swivel belt clip

An optional detachable swivel belt clip can be ordered and consists of two parts; the slot and loop attaches to the belt or harness and the pin and plate attaches to the Personal Node as shown in [Figure 9 Pin and plate](#) and [Figure 10 Slot and belt loop](#) below.

The pin and plate replace the standard belt loop on the Personal Node.

Figure 9 Pin and plate

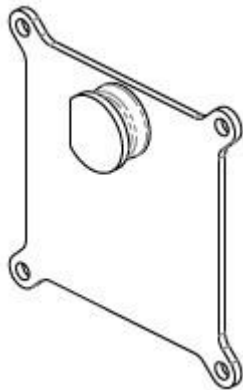
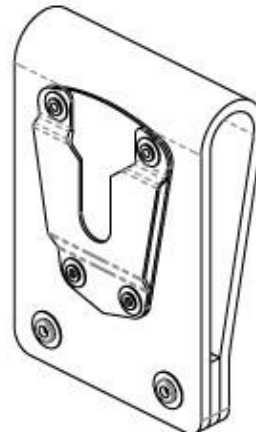


Figure 10 Slot and belt loop



The swivel belt clip permits the Personal Node to swing on the belt and can be removed by rotating the Personal Node vertically through 180°.



While providing greater flexibility, the wearer needs to be more attentive so that if the Personal Node is removed temporarily, then he/she does not forget to re-attach it.

5.2 Operate a Personal Node

The following procedures are performed anytime a Personal Node is required to be used by personnel or visitors entering an area with vehicular hazards. For personnel, these procedures are typically at the start and end of the shift.

Procedure 1 Charging a Personal Node

A user performs this procedure at the end of a shift or when a Personal Node needs charging.

Charging and full charge are indicated by the integrated *Charge* LED on each Personal Node.

Refer to [About the Personal Node Charging Dock](#) on page 36 for details of the charging dock.



Personal Nodes should be charged when not in use.

Step	Action/Response	Comments
1) Check dock has power.	Ensure the Personal Node Charging Dock is powered on and the large LED is solid green	About the Personal Node Charging Dock on page 36 A running fan is audible in a typical office environment.
2) Remove Personal Node	Remove the Personal Node from your belt or harness.	
3) Insert into dock and confirm charging.	<ol style="list-style-type: none"> 1) Place the node in the dock ensuring it is firmly and positively seated. 2) Confirm that the <i>Charge</i> LED is solid red. 	<p>A red <i>Charge</i> LED indicates the device is still charging.</p> <p>When the <i>Charge</i> LED is green the device is fully charged.</p>

Procedure 2 Using a Personal Node

This procedure covers a user obtaining a Personal Node when entering site operations. Exact actions and responses in the operation of the Personal Node are defined by the on-site operational and HSE policies and procedures communicated to you at training.

Step	Action/Response	Comments
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<p>1) Obtain a Personal Node.</p>	<p>Remove a Personal Node from the dock by selecting a device with a solid green LED.</p>	<p>A Personal Node automatically turns on when removed from the dock.</p>
<p>2) Check the Personal Node is working.</p>	<p>Confirm the Start-up sequence detailed on page 23. If the pattern is incorrect, refer to Personal Node troubleshooting on page 57.</p>	<ol style="list-style-type: none"> 1) The Status and Charge LEDs glow blue and the two side LEDs glow red. 2) All LEDs flash red three times. 3) The unit beeps three times. 4) The <i>Status LED</i> starts to flash green (once every 2 seconds) indicating the device is ready to use.
<p>3) Place node on you belt or harness.</p>	<p>Attach the Personal Node by passing one side of your belt through the metal bracket the back of the unit.</p> <hr/> <p>The Personal Node is ready for proximity event detection (i.e. to detect, and be detected by, vehicles)</p>	<p>An optional swivel belt clip is available that allows a Personal Node to attach directly to a belt without having to unbuckle the belt and pass it through the bracket. Contact Minetec for further details.</p>
<p>4) Enter site operations.</p>	<p>Pay attention to any visible or audible patterns.</p> <p>For example:</p> <ul style="list-style-type: none"> • Proximity event detected in SafeDetect. • Low Battery voltage, etc. 	<p>Table 9 Regular operating patterns on page 24. Table 10 Irregular operating patterns on page 26.</p>
<p>5) Respond to any patterns (SafeDetect only)</p>	<p>Take note of, and respond to, any visible or audible patterns.</p> <p>A momentary press and release of the button will, for example, mute a proximity alarm.</p>	<p><i>This step only applies when using SafeDetect.</i></p> <p>Users are to respond to patterns in line with on-site Operational and HSE policies and procedures.</p>
<p>6) Return the Personal Node.</p>	<p>When finished with the Personal Node, return it to the Charging Dock.</p>	<p>Procedure 1 Charging a Personal Node on page 30.</p>

5.3 Use In-Vehicle Detection (IVD) mode

In situations where a user needs to enter a vehicle as an Operator or passenger the Personal Node is put into In-Vehicle Detection (IVD) mode to suppress the proximity alarm on both the Personal Node and the In-Vehicle PC.



IVD mode is only available when within the relatively short IVD range of the vehicle.
The IVD range is configurable by the System Administrator.

Note that the driver ID can be selected from the IVD list in the Driver Identification screen on the In-Vehicle PC.

Procedure 3 Activating IVD - SafeDetect operating

Perform this procedure to activate IVD mode on a Personal Node when approaching a vehicle when the vehicle’s system is on and an alarm is triggered on the Personal Node



For a stand-alone SafeDetect system, the driver should enter IVD mode first to associate himself/herself with the vehicle as the Vehicle Operator.

Step	Action/Response	Comments
1) Approach the vehicle.	The alarm annunciates.	This will occur for each of the active warning zones but can be muted if required.
2) Enter IVD mode	When at the vehicle, press the Personal Node button twice within two seconds and confirm that: <ul style="list-style-type: none"> The audible alarm mutes. The <i>Status</i> LED illuminates solid green. 	The IVD range is configurable by the System Administrator but typically 1-5 metres from the vehicle node depending on the vehicle configuration. See IVD pattern on page 25.
3) Confirm IVD features display as appropriate.	If the vehicle has an In-Vehicle PC, confirm that the Personal Node ID is: <ul style="list-style-type: none"> Added to the IVD list on the Driver ID screen. Removed from the warning zone panel and warnings list. The audible alarm mutes. 	Some LVs may operate without an In-Vehicle PC.

Procedure 4 Activating IVD - SafeDetect not operating

Perform this procedure to activate IVD mode on a Personal Node when approaching a vehicle where the SafeDetect system is off. IVD mode is only possible when the SafeDetect system is on.



For a stand-alone SafeDetect system, the driver should enter IVD mode first to associate himself/herself with the vehicle as the Vehicle Operator.

Step	Action/Response	Comments
1) Enter the vehicle	Follow site procedures.	No alarms will annunciate if the system is off.
2) Start the system.	<p>The system starts when the vehicle power supply is applied.</p> <hr/> <p>The vehicle nodes are active within 5 seconds of power applied so the vehicle is visible to other vehicles and pedestrians within 5 seconds.</p> <hr/>	The In-Vehicle PC starts automatically within 40 seconds.
3) Confirm the In-Vehicle PC is operational	Refer to the <i>SafeDetect Operator Manual</i> for details on the In-Vehicle PC.	Eventually the Personal Node proximity alarm activates and the alarm pattern exhibits. The In-Vehicle PC also annunciates an alarm.
4) Enter IVD mode.	<p>Press the Personal Node button twice within two seconds and confirm that:</p> <ul style="list-style-type: none"> ○ The audible alarm mutes. ○ The <i>Status</i> LED illuminates solid green. 	See IVD pattern on page 25.
5) Confirm IVD on vehicle display	<p>In the vehicle, confirm on the In-Vehicle PC that the Personal Node ID is:</p> <ul style="list-style-type: none"> • Added to the IVD list. • Removed from the warning zone panel and warnings list. • The audible alarm mutes. 	<p>Tap the vehicle icon in the centre of the screen to open the Driver Identification screen which includes the IVD list.</p> <p>Refer to the <i>SafeDetect Operator Manual</i> for details on the In-Vehicle PC.</p>

Procedure 5 Cancelling IVD mode

The Personal Node IVD mode is cancelled by any of the following events:

- 1) Manual deactivation by pressing the device button twice within two seconds. This is the recommended and expected default action.
- 2) Automatic deactivation when the:
 - a) Driver walks outside the IVD outer zone from the vehicle and the user has forgotten to cancel IVD mode. Refer [About In-Vehicle Detection](#) on page 20.
 - b) System is turned off.




Once IVD mode is cancelled, the user will still be within the STOP zone and the Personal Node STOP zone alarm annunciates.

Use this guide to manually cancel the *Broadcast Me* function.

Step	Action/Response	Pattern/Comments
1) Person cancels IVD mode.	Press the button twice within two seconds. IVD mode is cancelled and the STOP zone alarm annunciates.	The Personal Node alarm annunciates as the user is still very close to the vehicle.

5.4 Use *Broadcast Me* alert

A Personal Node user can activate the *Broadcast Me* function.

This function continuously broadcasts the unique ID of the Personal Node (eg PN007) and when the broadcast is received by a nearby vehicle, the In-Vehicle PC shows a coloured flag  next to the Personal Node's ID in the detections list and an audible alert is sounded. See [About Broadcast Me](#) on page 21 for details.



Note if *Broadcast Me* is activated while in IVD mode, the *Broadcast Me* function takes precedence.

Procedure 6 Activating the *Broadcast Me* function

Use this guide to activate the *Broadcast Me* function on the Personal Node. This function operates in conjunction with IVD mode so can be used by users and Vehicle Operators with a Personal Node.

Step	Action/Response	Pattern/Comments
1) Person activates <i>Broadcast Me</i> function	Press and hold the device button for two seconds. The Personal Node does the following: <ul style="list-style-type: none"> All LEDs flash white. An audible alarm annunciates. <i>Broadcast Me</i> function signal broadcasts 	
2) Vehicle Operator Responds to the alarm	Respond accordingly.	Vehicle Operators are to respond to <i>Broadcast Me</i> function in line with on-site Operational and HSE policies and procedures.

Procedure 7 Cancelling *Broadcast Me* function

Use this guide to cancel the *Broadcast Me* function.

Step	Action/Response	Pattern/Comments
<p>1) Person cancels <i>Broadcast Me</i> function</p>	<p>Press and hold the device button for two seconds. The Personal Node does the following:</p> <ul style="list-style-type: none"> • All LEDs stop flashing. • The audible alarm stops. • <i>Broadcast Me</i> function cancel signal broadcasts. • Returns to the previous operational state prior to <i>Broadcast Me</i> being activated. 	<p>Only the user who initiated the <i>Broadcast Me</i> alert can cancel it.</p>
<p>2) Report, if required.</p>	<p>Report any instances of the use of the <i>Broadcast Me</i> function (eg if used as a distress beacon) in line with on-site Operational and HSE policies and procedures.</p>	<p>The originating and/or responding users report the incident.</p>

6 ABOUT THE PERSONAL NODE CHARGING DOCK



WARNING: This equipment is compliant with Class A of CISPR 32.
In a residential environment, this equipment may cause radio interference.

The Minetec Personal Node Charging Dock (dock) is a 10-way charging dock designed specifically for charging Minetec Personal Nodes. The dock can simultaneously charge up to ten Personal Nodes.

Each Personal Node commences a charging cycle when placed into the Personal Node Charging Dock, shown in [Figure 11 Dock - horizontal orientation](#) below, fully-loaded with 10 Personal Nodes.

Once fully charged, a Personal Node can operate for up to 18 hours at room temperature (approx. 20°C) and requires charging for 5 - 6 hours to return to full charge.



If a Personal Node is constantly alarming, say, in a STOP zone then the battery life may be reduced to about 4-5 hours.

The dock has a single green large format power LED.

Charging and full charge are indicated by the integrated *Charge* LED on each Personal Node. When the *Charge* LED is green the device is fully charged; a red LED indicates the device is still charging.

A Personal Node is automatically turned off when it is placed in the dock and automatically turns on when removed.

The dock has a 120-240 Vac input and can sit flat or stand vertically on a desk/bench or be mounted on a wall using the optional wall mount kit.

The cooling fan runs continuously and can be heard in a normal office environment. If the fan stops then stop using the dock and contact Minetec.

Figure 11 Dock - horizontal orientation

6.1 Dock location

All care must be taken when locating and using the dock to:

- Prevent damage to the charging leaf contacts.
- Prevent liquids or dirt entering the dock vents or charging slots.
- Prevent metallic objects (eg screws, swarf etc.) entering the dock vents and charging slots.
- Replace any worn, damaged or cracked power cables.

A single dock is designed to sit horizontally or vertically on a desktop surface but if space is at a premium or multiple docks are used, they can be mounted in a vertical orientation on a wall or custom-built frame. Refer [Figure 12 Desktop only - horizontal](#) and [Figure 13 Desktop/wall - vertical](#) below. If placed on a horizontal surface, ensure that the dock is in a convenient location for users to comfortably remove Personal Nodes smoothly without pulling or twisting the nodes. The dock should also be placed in a suitable location to avoid liquid spills or debris entering the vent holes or the charging slots.

The dock will eventually accumulate dust and debris from the environment so for best performance and longevity, consider housing docks in a cooled and air-filtered rooms and/or cabinets. In any case:

- Keep the dock free of dust and dirt build-up, as this may reduce its effectiveness. If there is a large amount of dust, this should be cleaned off, using a firm brush or compressed air if permitted and available at your site.
- Do not use harsh abrasive materials on the body or charging contacts.
- Persistent dirt can be removed using a slightly damp soft cloth (use only a mild detergent).
- Keep all liquids away from the power supply connections.

- See [Personal Node Charging Dock checks](#) on page 51 for maintenance activities. **Figure 12**

Desktop only - horizontal**Figure 13 Desktop/wall - vertical**

6.2 Dock vertical mounting details

See the *Personal Node Charging Dock Data Sheet* for full specifications.

See [Table 12 Dock weights](#) on page 42 for weight information.

Each Personal Node Charging Dock has the following electrical and environmental requirements:

Table 11 Dock specifications

Parameter	Requirement
Input Voltage	90 – 240 Vac +/- 10%, 47 – 63 Hz
Fusing	Double pole, 2 x 5 A
Input Current	3.4 A Max.
Outputs	10 slots, 3.3 – 5.5 Vdc, Max. 4.2 A per port
Operating Temperature	-10°C to 40°C
Storage Temperature	-20°C to 60°C
Operating Relative Humidity	5% to 95% (non-condensing)

Figure 14 Dock side view (mm)

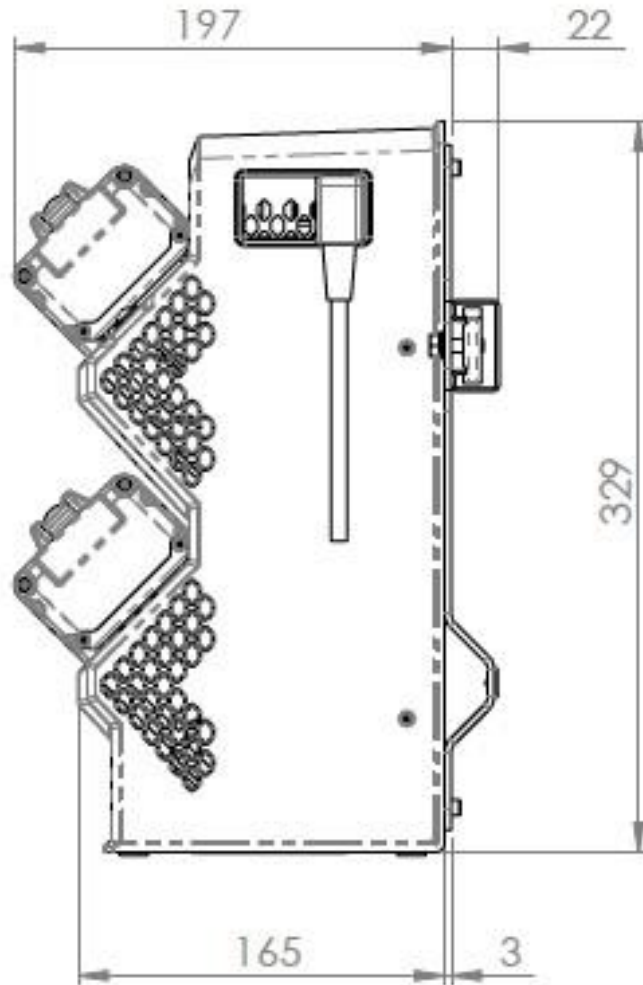


Figure 15 Dock horizontal view and spacing (mm)

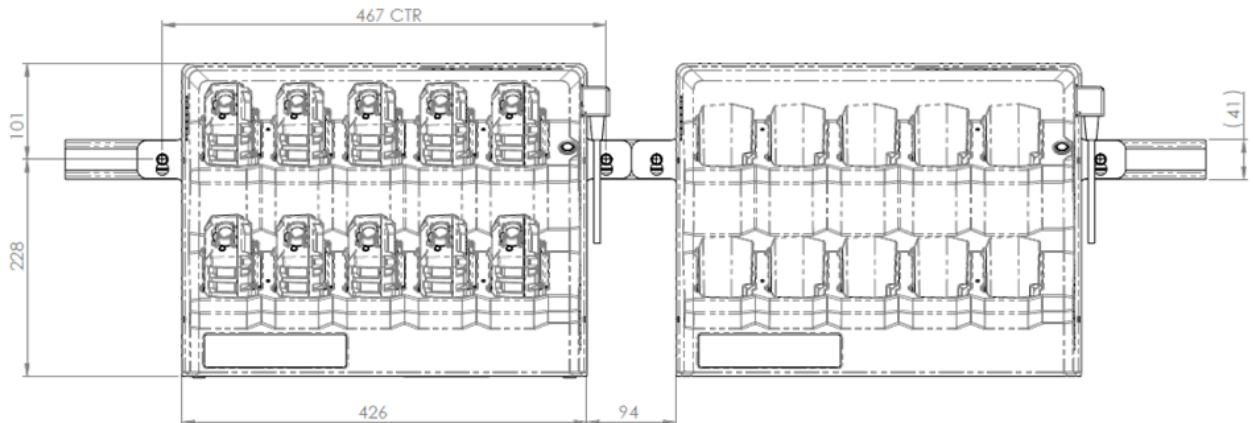
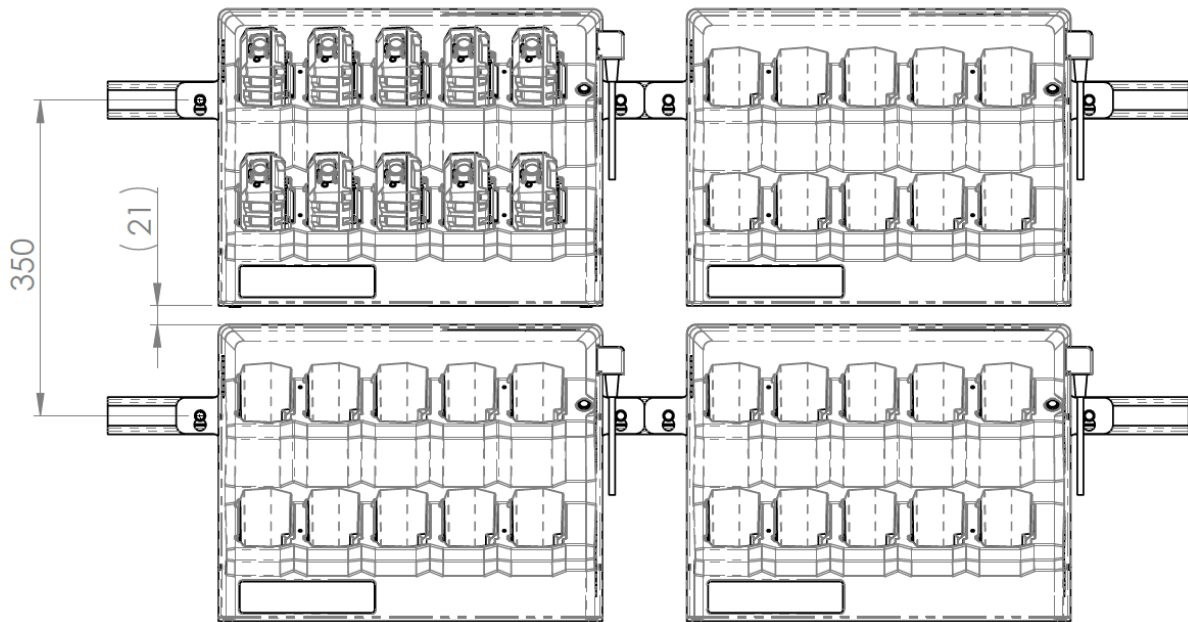


Figure 16 Dock vertical spacing (mm)



6.3 Wall mounting a single dock

Wall mounting options depend very much on the type of wall or frame (eg gypsum board, rock, steel etc.) and integrity of the mounting surface.



As every site is different, Minetec is unable to provide detailed wall mounting instructions but this section provides information to guide the wall mounting of docks at your site.



~~Wall mounting of docks must be performed in accordance with the on-site operational and HSE policies and procedures.~~

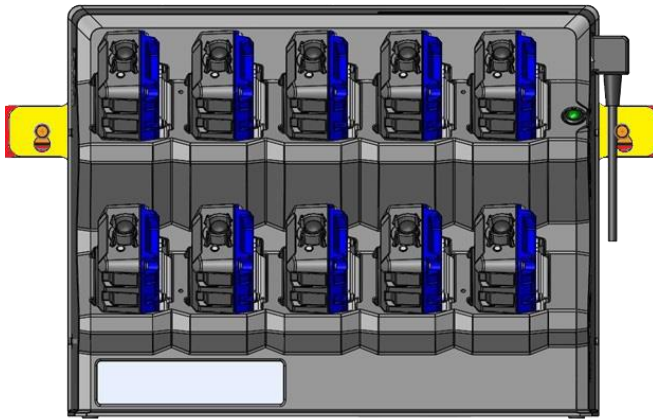
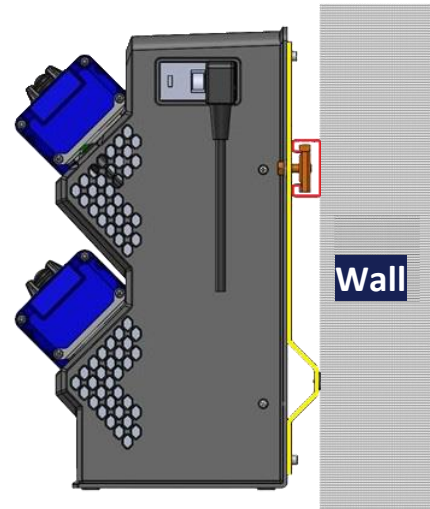


Figure 17 Wall mounted - front

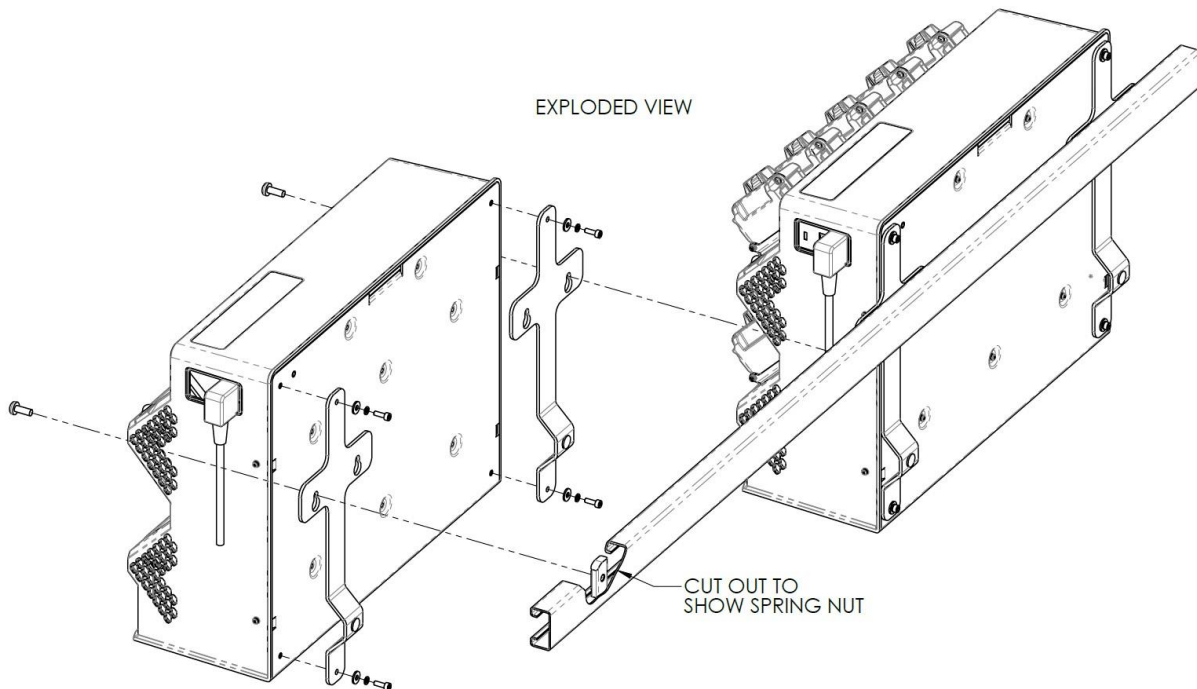
Figure 18 Wall mounted - side



Where:

- 'T' type bracket (yellow).
- EzyStrut E4000 channel (red).
- Spring nuts (orange).

Figure 19 Wall mounting (exploded view)



6.3.1 Wall Bracket Kit

Minetec supplies two 'T' type wall mount brackets in the optional M1010996 Wall Bracket Kit as seen in [Figure 20 'T' type wall mount bracket](#) below. These brackets provide a keyhole mounting system.

These brackets are designed to mount a dock to a single horizontal length of 'C' channel with the profile of EzyStrut E4000 Ribbed Channel, 41x21mm, and 1.6mm thick. The profile of the channel is shown in

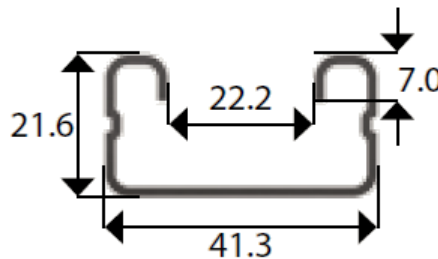
[Figure 21 EzyStrut E4000 Ribbed Channel](#) below. The channel material may be aluminium, mild steel or stainless steel.

The M1010996 Wall Bracket Kit also includes two spring channel nuts and pan head bolts to suit the EzyStrut E4000 Ribbed Channel.

Figure 20 'T' type wall mount bracket



Figure 21 EzyStrut E4000 Ribbed Channel



6.3.2 Load-bearing capacity

Before mounting the dock, ensure that the wall or frame on which the dock(s) is to mounted will support the loads indicated in [Table 12 Dock weights](#) below.

The net weight of a single fully laden dock including a Minetec bracket set and the minimum length of EzyStrut mild steel channel is 12.82 kg.

Table 12 Dock weights

Item	Weight (kg)	Note
Dock with standard power lead	6.26	Without any nodes.

Personal Node with standard loop	0.56	Default
Personal Node with swivel pin	0.60	Optional
Dock including 10x Personal Node	11.86	Fully laden charging dock.
M1010996 Wall Bracket Kit	0.3	2x 'T' type brackets. 2 spring nuts for EzyStrut E4000 channel.
EzyStrut E4000 Ribbed Channel, 41x21mm, 1.6mm thick (mild steel)	1.27 kg/m	Channel is not supplied by Minetec. M1010996 Wall Bracket Kit is compatible with this profile.
520 mm of EzyStrut E4000	0.66	Minimum length to suit a single dock.

At the time of writing, the load rating for EzyStrut E4000 Ribbed Channel (mild steel) is as shown in [Table 13 EzyStrut E4000 loads](#) below. These loads and spans must be considered when installing the channel. Multiple docks can be mounted on a single length of channel using appropriate mounting points for the distributed load per the table below. The load values shown are in accordance with Australian/New Zealand standard AS/NZS4600:1996, using a minimum yield stress for Fy of 210 MPa on plain channel/strut. These results are based on a uniformly loaded, simply supported span. Deflection has been calculated using standard formulae at the maximum permissible stress.

Table 13 EzyStrut E4000 loads

Span (mm)	Max. Allowable Load (kg)	Deflection at Allowable Load (mm)
250	350	0.31
500	175	1.22
750	116	2.76
1000	88	4.89
1250	70	7.65
1500	58	11.02
1750	50	15
2000	44	19.59
2250	39	24.82
2500	35	30.61
2750	32	37.04
3000	30	44.15

Procedure 8 Wall mounting a dock



The Contractor needs to ensure that wall surfaces and mounting methods are suitable to hold the loading from all fully laden Personal Node Charging Docks.

The Contractor is responsible for wall mounting.

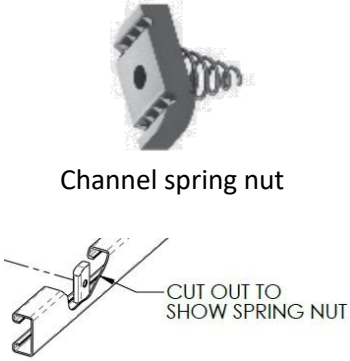


If mounting multiple docks, read [Wall mounting multiple docks](#) on page 45, before proceeding.

Follow these guidelines if the Personal Node Charging Dock (dock) is to be mounted on a wall using the optional M1010996 Wall Bracket Kit. Keyholes in the mounting bracket permit a single person to perform the install process.

Step	Action/Response	Comments
1) Prepare the dock.	If powered on: <ul style="list-style-type: none"> Remove all Personal Nodes. Turn of the power. Disconnect the power source. Remove the power cable from the dock. 	
2) Remove the feet.	<ul style="list-style-type: none"> Lay the dock on a clear surface with the larger baseplate (back) facing up and smaller baseplate (bottom) facing you. Remove the four rubber feet from the larger baseplate. 	The feet are secured with M4x16 (304 stainless steel) socket cap screws.
3) Attach the wall mount brackets.	Lay each bracket on the larger baseplate with the: <ul style="list-style-type: none"> Brackets as shown in Figure 20 'T' type wall mount bracket on page 41 and mounted to the dock as shown in Figure 19 Wall mounting (exploded view) on page 40. Brackets flat on the baseplate with the knee bend facing up. Two holes in the bracket spine (centre, top and bottom) aligned with the two feet mounting holes on the larger baseplate. The outer arm of each bracket extending beyond the dock. Attach the brackets with the M4x16 stainless steel socket cap screws and washers. 	See Figure 17 Wall mounted - front and Figure 18 Wall mounted - side on page 40 showing the 'T' type bracket (yellow) and EzyStrut E4000 channel (red). The M4 screws are tightened with 1.8 Nm torque setting (dry). The order from the outside is: 1) Screw head. 2) Flat washer. 3) Spring washer. 4) Bracket. 5) Dock.

Section 6 About the Personal Node Charging Dock

Step	Action/Response	Comments
<p>4) Prepare the wall or frame.</p>	<p>Install the using the EzyStrut E4000 Ribbed Channel, 41x21mm or equivalent. Ensure that the channel is fixed to the wall with appropriate fixings that are:</p> <ul style="list-style-type: none"> • Suitable for the type of wall. • Spaced to support the load. 	<p>See Figure 17 Wall mounted - front and Figure 18 Wall mounted - side on page 40 showing the 'T' type bracket (yellow), EzyStrut E4000 channel (red) and spring nuts (orange).</p> <p>Table 12 Dock weights on page 42.</p> <p>Table 13 EzyStrut E4000 loads on page 42</p>
<p>5) Locate the dock position.</p>	<p>Mark the channel at two points 467 mm apart.</p>	<p>The dock will be centred between these marks. See Figure 15 Dock horizontal view and spacing (mm) on page 39.</p>
<p>6) Insert channel nuts</p>	<p>At each mark on the channel:</p> <ul style="list-style-type: none"> • Insert channel spring nut with the spring towards the channel base and the nut horizontal. • Push the nut into the channel compressing the spring. • Rotate the nut 90° clockwise to a vertical orientation. • Release the pressure on the spring, the nut is located within the channel. • If necessary, slide the nuts to align with the original locating marks. 	 <p>Channel spring nut</p>
<p>7) Insert mounting screws</p>	<p>Partially screw the pan head bolts into the channel spring nuts.</p>	<p>Leave enough space behind the heads to accept the bracket thickness.</p>
<p>8) Hang the dock.</p>	<ul style="list-style-type: none"> • Lift the dock and align the large aperture (13 mm diam.) of the keyholes to the channel nuts. • Place the keyhole larger aperture over the protruding pan head bolts. • Lower the dock so that the small aperture (7.5 mm diam.) sits on the pan head bolts. 	

<p>9) Secure.</p>	<p>Tighten the pan head bolts to 6 Nm torque setting (dry). The pan heads use a slotted driver.</p>	<p>It is essential that the dock is firmly secured.</p>
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Section 6 About the Personal Node Charging Dock

6.4 Wall mounting multiple docks

Multiple Personal Node Charging Docks can be mounted on a suitable wall surface in various configurations; side-by-side and/or above/below.

The key considerations for mounting multiple charging docks are:

- **Weight:** Ensure the vertical wall(s) or frame(s) can support all docks when fully laden with 10 Personal Nodes each. See [Load-bearing capacity](#) on page 42.
- **Power:** Ensure sufficient power outlets and power supply for the all docks under full load. See [Table 11 Dock specifications](#) on page 38.
- **Cooling:** Ensure sufficient ventilation/cooling for all docks. See [Dock vertical mounting details](#) on page 38
- **Accessibility:** Personnel must have clear access to insert and remove Personal Nodes without the need to lean, bend or stretch awkwardly. See [Dock location](#) on page 37.

Use the following diagrams to plan the installation of multiple units on a vertical surface.

Follow [Procedure 8 Wall mounting a dock](#) on page 43 for the wall mounting of a single Personal Node Charging Dock.

7 MAINTENANCE STRATEGY

7.1 Mine Operator Maintenance Strategy



All maintenance to be performed under prevailing site operational and HSE procedures.

A set of preventative maintenance work instructions should be developed on site from the information in this section and using the Mine Operator's Work Instruction template and containing the appropriate safety (eg PPE) and job hazard analysis (or equivalent) information.

It is recommended that all Minetec equipment is checked and maintained under the existing site preventative maintenance program.

Personal Nodes and Personal Node Charging Docks should be checked and cleaned on a regular basis. For expediency, align maintenance and care checks with existing preventative maintenance schedules.

In any case perform the maintenance checks at intervals as indicated in [Table 14 Maintenance Schedule](#) on page 49.

All preventative maintenance activities to be conducted in accordance with industry best practice, such that the condition of the equipment and performance of the system does not degrade other than as can reasonably be accounted for through normal age, wear and tear.



If any device is deemed not fit-for-purpose and if required, implement the site 'lock out, tag out' program. Replace any faulty devices per site operational and HSE procedures.

7.2 Maintenance and Network Management Services

Minetec can provide *Maintenance and Network Management Services* as part of a formal Operational Support Plan with four support tiers and four priority levels.

This Support Plan and its associated services uses some principles from the ITIL® service management framework. ITIL® is an internationally recognised framework that is widely adopted. ITIL® focuses on service delivery and continuously improvement of IT systems to meet business needs. Specifically the Support Plan methodology considers the volumes of 'Service Transition' aims, 'Service Operation' aims and 'Continual Service Improvement' of ITIL® in the design and delivery of the services listed in this Support Plan.

Contact Minetec's Global Product Support Manager on + 61 8 9259 4955 for further details.

7.3 Maintenance Work Instructions

The guidelines in this document are generic and should be used as a basis to develop site-specific work instructions aligned with the Site Operators HSE policy and procedures including consideration of, but not limited to, the following:

- Maintenance programs (preventative/corrective job plans, technical instructions or similar).
- Hazard identification and risk analysis (eg Job Safety Analysis/Job hazard analysis).
- Coordination with other work (operations or maintenance).
- Lock-out/Tag out system.

- Standard operating procedures.
- Job-specific considerations:
 - Roles and competencies.
 - Specialist tools and/or materials.
 - Specialist PPE.
 - Material Safety Data Sheets.

If site-specific Work Instructions (WI) or Standard Operating Procedures (SOP) exist for any of the tasks described in this section, use those documents in preference to these guidelines.

Site Work Instructions take precedence over these guidelines provided they:

- Are current and complete.
- Are approved by the Mine Operator.
- Are specific to site and/or vehicle type.
- Do not conflict with the safety instructions within these guidelines.

7.4 Maintenance precautions



Before commencing maintenance, ensure all relevant onsite permissions have been obtained and all required hardware and cabling is available. Ensure each vehicle is isolated before starting maintenance, as per site operational and HSE procedures.

Before making any changes to Minetec hardware or associated cables, connectors or power sources, read the following precautions:

- 1) [Safety](#) on page ii.
- 2) [General precautions](#) on page 60.

7.5 Spares management

Each site should maintain agreed spares held in stores and managed in an existing spares register. An FMEA³ assists in defining the spares holding. Any spares holding to have due consideration to equipment in for repair, new product warranty and any prevailing Minetec Operational Support Plan.

The hardware and software revision status of spares to be compatible with deployed systems (SafeDetect, Trax and/or SMARTS).

7.6 Data management

Depending on the site Mine Operator's maintenance strategy, changes to Personal Nodes should be recorded and updated in one or more of the following:

- Site assets register.
- MineOffice database (configurations).
- Maintenance System database.

For Personal Nodes, changes include replacement, configurations and assignment of devices to personnel, if supported at your site.

³ Failure Modes and Effects Analysis to evaluate and identify fail and to failure modes and impacts.

7.7 Special tools and materials

Special tools and materials should be specified per maintenance task and therefore as part of the Work Instructions to be developed per site.

7.8 Substitution

Hardware, cables, connectors or any accessories should be replaced, as required, with an item of the same type and specification. If this is not possible then substitution may be needed, in which case:

- **Contact Minetec Support for substitute component or confirmation of suitability.** The proposed substitute device must be of equivalent or superior performance, tolerances, materials, reliability and technical specification to the replaced item, and
- Determine that system performance is unaffected by the use of the substitute item, including conducting any necessary qualification testing.

8 MAINTENANCE ACTIVITIES

The Personal Nodes (nodes) and Personal Node Charging Docks (docks) do not require any specialised maintenance other than basic operational checks and cleaning. Also, see [Troubleshooting](#) on page 56.



For sites with many hundreds of nodes, consider identifying nodes with labels to indicate a 'maintenance group' with groups being checked on a staggered maintenance cycle.



Personal Node configuration checks are not required unless the device is not functioning as expected.

Each Minetec device should be checked according to the following Maintenance Schedule as a minimum.

Table 14 Maintenance Schedule

Activity	Frequency	Purpose	Duration	Resources
Personal Node checks below	Daily	To check and clean a Personal Node.	2 minutes	User
Personal Node Charging Dock checks on page 51	Weekly	To check and clean a Personal Node Charging Dock.	10 minutes	Electrician

8.1 Personal Node checks

The Personal Node has an internal antenna and an LED interface shown in [Figure 1 Personal Node - isometric view](#) and [Figure 2 Personal Node - top view](#) on page 12.

The Personal Node should be kept clean to provide:

- Ease of use (eg push button, belt clip).
- Ensure best charging performance.
- Visible alarms (LEDs) can be seen easily.
- Audible alarms can be heard. This is particularly important to prevent progressive degradation of the audible alarms.
- Best RF conditions for communications.

The Personal Node has ingress protection of IP66/67 (Dust and water tight) and requires minimal maintenance. In general, Personal Node care includes:

- Do not use harsh abrasive or conductive materials on the body or charging contacts.
- Keep the device free of dust and dirt build-up, as this may impact the devices RF path and useability. If there is a large amount of dirt or dust, this can be cleaned off, using a firm brush or compressed air, if permitted and available at your site.
- Persistent dirt can be removed using a slightly damp soft cloth (use only a mild detergent).

8.1.1 Before you start

Before commencing any work, ensure that you have:

- All required onsite permissions.
- Planning approval and permit to work documents per operational and HSE.
- Site 'lock out tag out' system (eg out of service tags).

- All required hardware is available (eg spares battery packs).
- Appropriate PPE (eg gloves for cleaning fluids).

Guide 1 Checking Personal Node

This guideline provides basic checks of the Personal Node for use in SafeDetect or Trax. If the device has shown any faults (in or out of the dock) then refer to the [Personal Node troubleshooting](#) on page 57.



This guideline excludes SafeDetect functional and alarm checks.



Wear protective gloves if handling electrical contact cleaner and refer to the MSDS.

Refer to the following when performing the operational checks:

- [Table 9 Regular operating patterns](#) on page 24.
- [Table 10 Irregular operating patterns](#) on page 26.

Check the following and act accordingly:

Step	Check	Action	Remediation	Notes/References
1)	Charging	Check the Personal Node is charging in the dock. CHARGE LED should be solid red (charging) or solid green (charged).	Perform troubleshooting.	Personal Node troubleshooting on page 57. Note that if SafeDetect is operational at site and vehicles are nearby, the Personal Node may start to alarm. This is normal.
2)	Start-up	Remove the Personal Node from the dock and check the Personal Node start-up pattern. See Table 8 Start-up sequence on page 23.		
3)	Ready for use	Check Status LED is correct. STATUS LED flashes green, once every two seconds		
4)	Cleanliness	Check the body and mounting clip of the Personal Node is clean and clear of any accretions (mud, dust etc).	If required, the outside surface can be cleaned with a damp cloth.	Do not use any harsh abrasives, liquids or detergents. Do not wash with high pressure water.

5)	Charging contacts	Check the charging contacts of the Personal Node are clean and clear of any accretions (mud, dust etc).	Clean the six charging contacts on the Personal Node with cotton buds and electrical contact cleaner.	Refer MSDS for electrical contact cleaner used at your site.
Step	Check	Action	Remediation	Notes/References
6)	Final check	Replace the Personal Node in the dock and confirm charge function. CHARGE LED should be solid red (charging) or solid green (charged).	Perform troubleshooting.	Personal Node troubleshooting on page 57. Note that if SafeDetect is operational at site and vehicles are nearby, the Personal Node may start to alarm. This is normal.

8.2 Personal Node Charging Dock checks



Do not open the Charging Dock unless you are qualified and an authorised electrician/electronics service personnel.

Unplug the dock from the power source **before** opening or cleaning.



Follow on site procedures that align with AS/NZS 3760 to Test & Tag each Personal Node Charging Dock after the first 12 months.

The Personal Node Charging Dock has no ingress protection (IP00) so should be checked and cleaned on a regular basis for dust build up in and around the cooling fan.

The fan runs continuously so the amount of dust deposited inside the dock is proportional to the dust in the environment. Check the dock for build-up of dust. If required, the outside surfaces can be cleaned with a damp cloth. Do not use any harsh abrasives, liquids or detergents.

If the fan vent or the charging slots of the dock accumulate dirt or dust, unplug the dock from the power source before cleaning with the following techniques in order of preference:

- 1) Vacuum clean.
- 2) Blow clean with filtered, dry compressed air, if permitted and available at your site. 3) Wipe clean with a damp cloth taking care with the leaf contacts.



If compressed air is permitted and available at your site, direct air at an angle to the surface to blow dust away from the surface taking care not to force dust into the fan vent.

If required, unplug the dock from the power source and clean the six charging leaf contacts within each charging slot with cotton buds and electrical contact cleaner.

8.2.1 Before you start

Before commencing any work, ensure that you have:

- All required onsite permissions.

- Planning approval and permit to work documents per operational and HSE.
- All required hardware and cabling is available.
- Positive electrical isolation using site 'lock out tag out' system (eg padlock isolators).
- Appropriate PPE.

Before commencing any electrical work, ensure that:

- You have read and understood the [Safety](#) on page ii.
- All electrical work to be done by qualified, authorised and deemed competent persons.
- The work area is clear and free from hazards.
- All relevant onsite permissions and permits to work have been obtained.
- Power is isolated, as per site operational and HSE procedures.
- All safety precautions are in line with Mine Operator policy for working on electrical items.
- All required hardware and cabling is available.
- If operating in sub-zero temperatures, also see [Cold weather operation](#) on page 61.

Guide 2 Checking the Personal Node Charging Dock



Use site Work Instructions if available.
WIs are prescriptive, specific to a job and aligned to the Mine Operator HSE.



Do not open the Charging Dock unless you are qualified and an authorised electrician/electronics service personnel.

Check the following and act accordingly:

Step	Check	Action	Remediation	Notes/References	
		The following steps to be performed by qualified electrician.			
1)	Power protection.	Check power protection is installed and functioning.			
2)	Earthing.	Check dock is grounded correctly.	Refer to the site corrective maintenance procedures to make good any of these issues.	Table 11 Dock specifications on page 38.	
3)	Power source.	Check voltage is within specifications for dock and the power supply is clean.			
4)	Ensure dock is safe to work on.	Isolate power supply.	Follow on-site operational and HSE practises to isolate the power supply.	Unplug from supply or isolate power if hardwired to supply.	


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Step	Check	Action	Remediation	Notes/References
5)	Power cable integrity	Check for significant signs of wear or degradation due to mechanical wear, heat/cold or chemical attack. Look for signs including kinks or sharp bends, abrasion, splits, fraying, blistering, swelling, brittleness, cracking, discolouration or nicks in the insulation.	Replace power cables as required.	
6)	Power cable continuity	If power is not getting to any device but power supply is OK.	Replace power cables as required.	
7)	Power cable penetrations	Check power cables entering penetrations use serviceable glands or grommets in good condition (i.e. not perished, broken or otherwise damaged.)	Replace grommets/glands as required.	For example, if docks are installed in cabinets.
8)	Power cable exposure	Check that power cables are not exposed to: <ul style="list-style-type: none"> • A risk of being stepped on or kicked during normal operations. • Extremes of environment. • Chemicals (eg hydrocarbons). 	Install physical barriers, weather shields and/or retrofit new conduit.	For example, if docks are installed in high general use areas or sitting on desktops.
9)	Fixings	Check power cable/conduit is fixed and secured using P-clamps and/or cable ties to minimise vibrational flexing and maximise bend radii.	Replace and/or add or clamps and cable ties.	
10)	Strain relief	Check power cables are not under strain.	Relieve strain on cable by: <ul style="list-style-type: none"> • Remove cause, if possible. • Reposition clamps and/or ties. • Release some of the cable from the service loop. 	Locate the service loop. Existing clamps and ties need to be released to pull the cable.

11)	Cleanliness, fan vent	Check the fan vent for accumulation or accretions (mud, dust etc). The dock will accumulate dust and debris from the environment if not enclosed in a vented/filtered enclosure.	Check internally if outside of vent encrusted or particularly dirty.	
Step	Check	Action	Remediation	Notes/References
		The following steps may be performed by the electrician, a maintenance technician or similar.		
12)	Cleanliness, dock body	Check the dock body for accumulation or accretions (mud, dust etc).	If required, the outside surface can be cleaned with a damp cloth.	Do not use any harsh abrasives, liquids or detergents. Do not wash with high pressure water.
13)	Charging contacts	Check the charging contacts of the dock are clean and clear of any accretions (mud, dust etc).	Clean the six charging contacts (per charging bay) with cotton buds and electrical contact cleaner. Refer MSDS for electrical contact cleaner used at your site.	DO NOT USE harsh abrasives (eg sandpaper) or conductive materials (eg steel wool)
14)	Dock mounts and fasteners	Check for missing, damaged or loose mounts and fasteners.	Tighten any loose mounts or fasteners. Replace any missing fasteners.	Wall mounting a single dock on page 39. Wall mounting multiple docks on page 45.

		The following steps to be performed by qualified electrician.		
15)	Restore power	De-isolate power supply.	Follow on-site operational and HSE practises to de-isolate the power supply.	Unplug from supply or isolate power if hardwired to supply.
16)	Check Power LED	Check power LED is on when power restored.	Refer to the site corrective maintenance procedures.	

9 TROUBLESHOOTING

Contents

- 9.1 Personal Node troubleshooting 57
- 9.2 Personal Node Charging Dock troubleshooting 58

9.1 Personal Node troubleshooting



If a Personal Node is deemed unserviceable, implement the site 'lock out, tag out' program and return for repair using the [RMA Procedure](#) on page 66.



Wear protective gloves if handling electrical contact cleaner and refer to the MSDS.

A 'lock out, tag out' program could require, for example:

- A physical tag be attached to the device identified as, eg 'tagged out of service'.
- Tagging to occur before taking a replacement device.
- The device set aside and not replaced in the dock.
- Reporting to the Supervisor, or equivalent, before starting your next scheduled task.

Table 15 Personal Node troubleshooting table

Problem	Test	Action for failed test
1) Physical damage.	Inspect the device for obvious physical damage and ensure that it appears to be in good physical order. Check for: <ul style="list-style-type: none"> • Signs of breakage or dropping. • Tampering. 	Stop using the device. Have the device checked by qualified and authorised personnel. See your Supervisor to obtain a replacement.
2) Environmental problems.	<ul style="list-style-type: none"> • Device is wet (eg condensation). • Device covered in dirt or mud. 	Clean and dry the device.
3) Battery fault or dirty charging contacts	A flashing red <i>Charge</i> LED with the Personal Node docked could be a faulty battery OR dirty charging contacts on the Personal Node or Charging Dock. <i>Note that a solid red Charge LED is charging OK and solid green Charge LED is fully charged.</i>	<ul style="list-style-type: none"> • Clean contacts on Personal Node and dock. <i>Refer MSDS for electrical contact cleaner used at your site.</i> • Try a different charging slot. • If a slot is faulty, mark the slot as U/S (eg paper tape and marker pen) and advise Supervisor. • If <i>Charge</i> LED flashes in different slots and after cleaning all contacts then battery is faulty.
4) Incorrect start-up sequence.	<ul style="list-style-type: none"> • Status LED flashing at startup. • LEDs flash red continuously. • All LEDs are red and remain on. • No audible alarm at start-up. 	Return to dock for at least 10 minutes and until the <i>Charge</i> LED on the device indicates solid green. See Supervisor if problem persists.

<p>5) Low battery (voltage) during operations.</p>	<p>Flashing orange <i>Status</i> LED - low battery (voltage).</p>	<p>Replace the unit into the dock and charge for at least 6 hours. After charging, remove the device and observe the start-up sequence. See Supervisor if problem persists.</p>
<p>Problem</p>	<p>Test</p>	<p>Action for failed test</p>
<p>6) Low battery (voltage) at start-up</p>	<ul style="list-style-type: none"> • Flashing red <i>Status</i> LED when removed from the dock - low battery (voltage) at start-up. • Audible alarm not working. 	<p>Replace the unit into the dock and charge for at least 6 hours. Check that the Charge LED is not flashing (see 3) on page 57). If problem persists then device is faulty. Implement the 'lock out, tag out' program and advise your Supervisor.</p>
<p>7) Internal device fault.</p>	<p><i>Status</i> LED flashes red when device is out of the dock.</p>	<p>Internal fault detected. Contact your Supervisor and obtain a replacement.</p>
<p>8) No LEDs at start up or during operations.</p>	<p>Has the device been out of the dock for 10 hours or more? Is the Charging Dock plugged in and showing connected power?</p>	<p>Replace the unit into the dock and charge for at least 6 hours. After charging, remove the device and observe the start-up sequence. See Supervisor if problem persists.</p>
<p>9) Alarms when removed from charger.</p>	<p>A vehicle is within range. This may occur even though you may be inside an office.</p>	<p>Normal behaviour. Follow the standard operating procedures.</p>

<p>Problem</p>	<p>Test</p>	<p>Action for failed test</p>
<p>Physical damage.</p>	<p>Inspect the device for obvious physical damage and ensure that it appears to be in good physical order. Check for:</p> <ul style="list-style-type: none"> • Power cord or plug damage. • Signs of breakage or tampering. • Device was dropped or submerged. • Liquid in charging slots. 	<p>Stop using the device. Have the device checked by qualified and authorised personnel. See your Supervisor to obtain a replacement.</p>
<p>Environmental problems.</p>	<ul style="list-style-type: none"> • Is the device dry? • Is the device covered in dirt or dust? 	<p>Clean and dry the device and restart it.</p>

Nodes not charging.	Battery fault or dirty charging contacts	Clean contacts on Personal Node and dock.
---------------------	--	---

9.2 Personal Node Charging Dock troubleshooting



If a dock is deemed to defective after using this troubleshooting table, tag the dock as defective using the 'lock out, tag out' program used at your site.



Wear protective gloves if handling electrical contact cleaner and refer to the MSDS.

This could require, for example:

- A physical tag be attached to the dock identified as, eg 'tagged out of service'.
- Tagging to occur before using another dock.
- The dock unplugged and set aside.
- Report to the Supervisor, or equivalent, before starting your next scheduled task.

Table 16 Charging Dock troubleshooting table

Problem	Test	Action for failed test
		Refer MSDS for electrical contact cleaner used at your site.
4) Power LED off.	Power LED not working.	Check power cable, switch. Replace fuse.
5) Fan not working	Cannot hear the fan running. Check power cable, switch.	Contact your Supervisor as the fan may need to be replaced.

10 GENERAL PRECAUTIONS

To prevent damage to the devices product and to ensure the correct operations, please read these precaution statements before installing or troubleshooting any devices.



CAUTION

Do not attempt to service any device unless both qualified and authorised my Minetec in writing, and as indicated in this document.

- If applicable, disconnect devices from all power sources before cleaning. Do not use liquid or spray detergents for cleaning. Use a soft, lint-free cloth to wipe screens and a damp cloth to wipe the exterior of any device. Do not use paper towels to clean the screen.
- Follow the maintenance and cleaning instructions in [Maintenance activities](#) on page 49.
- Minimise the exposure of devices to ultraviolet light for extended periods (eg direct sunlight) as this can damage the device surfaces (eg make them more brittle).
- Keep the device away from excessive moisture and extreme temperatures.
- Do not subject the device to sudden and severe temperature and/or humidity changes. This could cause moisture condensation inside the unit, which could damage the device. In the event of moisture condensation, allow the device to dry out completely before use.

10.1 Personal Nodes

To ensure the Personal Node is always on during operations there is no user-operated off switch.

10.2 Charging Docks

When connecting and disconnecting the power cable, ensure that:

- When disconnecting a cable:
 - Hold and pull the connector body. Do NOT pull on the cable.
 - As you disconnect the connectors, keep them evenly aligned to avoid bending any connector pins.
- Before connecting a cable, make sure both connectors are correctly oriented and aligned.

10.3 Electrostatic discharge

If authorised to open any device be aware that static electricity discharge can damage system boards and other electronic components. If working inside the device, you should take the following steps to prevent damage from electrostatic discharge (ESD):

- Handle all components at an ESD workstation. Follow proper ESD procedures, including wearing ESD wrist straps, to reduce the risk of damage to components. If possible, use antistatic floor pads, workbench mats and wrist straps.
- When unpacking a static-sensitive component from its shipping carton, do not remove the component from its antistatic packing until you are ready to install the component. Immediately before removing the component, ground yourself and the antistatic packaging at an ESD

workstation or ground. This will discharge any static electricity that may have built up in your body and on the packaging.

- Always move or transport a sensitive component in an anti-static container.
- Handle components and circuit boards with care. Hold circuit boards and modules by their edges or mounting brackets. Do not touch components or connectors on the circuit boards.

Section 10 General precautions

- Do not handle or store system boards near strong electrostatic, electromagnetic, magnetic, or radioactive fields.

10.4 Cold weather operation

Cold weather is defined to be temperatures between 0°C and -40°C.



Use frequent cable anchoring in sub-zero temperatures to further reduce flexing.


For installation, maintenance and repairs, it is good practice to consider the following in sub-zero temperatures:

- Mount all devices in controlled environments (eg workshop).
- Use numerous anchoring points for the cable conduit to minimise both vibration and flexing.
- Do not attach devices or cable conduit to any moving surfaces.
- Limit work to workshops in controlled environments.
- Allow sufficient time for equipment and materials to acclimatise to workshop temperatures before starting work.

11 GLOSSARY

Term	Detail
°C	degree Celsius
A	ampere
Ah	ampere-hour
Broadcast Me	In SafeDetect, Broadcast Me is a function of the Personal Nodes that broadcasts a continuous alert that can be detected by vehicles within range. A detected Broadcast Me alert is flagged on the vehicle's graphical display device and typically sounds an audible alarm. Vehicle Operator response when receiving the broadcast is determined by the on-site operational and HSE policies and procedures.
Charging Dock	The Minetec Personal Node Charging Dock (dock) is a 10-way charging dock designed specifically for charging Minetec Personal Nodes. The dock can simultaneously charge up to 10 Personal Nodes.
Control Room	The control room is where the Scheduler for operating and monitoring the Minetec solutions and is typically a surface-based room established as the communication hub for the mine. This could be the Shift Boss's office, Mining Managers office or similar.
CSIRO	Commonwealth Scientific and Industrial Research Organisation, the Australian federal government scientific research agency.
EMESRT	Earth Moving Equipment Safety Round Table, a global initiative involving major mining companies that engages with key mining industry Original Equipment Manufacturers (OEMs) to advance the design of the equipment to improve safe operability and maintainability beyond Standards.
ESD	Electrostatic Discharge
Fleet map	A Site Fleet map is a document that details specific capabilities, features, and installation and configuration requirements related to each Profile type. See entry for Profile type.
FMEA	Failure Modes (and) Effects Analysis is a systematic method for evaluating a process to identify how and where it may fail and to assess the effect of each failure mode.
Fy	Yield strength
Guideline	Steps to perform a task intended to align with and /or incorporate within the Mine Operator's own documentation to comply with site operational and safety strategies.
h	hour
Hazard	A hazard is a source of danger. The hazard is a physical system with kinetic or potential energy that could inflict harm or damage. The source of energy could be, for example, chemical energy, electrical energy, gravitational potential energy etc. In the context of SafeDetect, each moving vehicle is a hazard. To be 'detected' as a hazard the vehicle must be fitted with SafeDetect. In SafeDetect, the term 'hazard' refers to vehicular hazards and excludes any other mine site hazards (chemical, electrical etc.).
HSE	Health, Safety and Environment or equivalent system (eg OHS, EHS) at your site.
Hz	hertz
ICT	Information and Communications Technology is an extended term for information technology (IT) and includes telecommunications.

In-Vehicle PC	<p>The Minetec In-Vehicle PC (IVPC) is a ruggedized Android based PC hosting pre-loaded Minetec software and pre-configured for a deployment of Minetec productivity, tracking and/or ranging solutions.</p> <p>The In-Vehicle PC is permanently mounted in a vehicle, powered by the vehicle's DC power supply and is used by the Vehicle Operator in one or more of the Minetec solutions.</p> <p>There are variants of the In-Vehicle PC depending on the system requirements at your site. For example, a CAN bus interface.</p>
IP66	IP66 = protected from total dust ingress & protected from high pressure water jets from any direction.
IVD	In-Vehicle Detection - When a pedestrian wearing a Personal Node enters a vehicle, they must activate IVD mode to prevent warnings being triggered. The user activates IVD mode to confirm that they are

Term	Detail
	inside a vehicle as either the Vehicle Operator or a passenger. See the Personal Node User Manual for details.
LED	Light Emitting Diode
m	metre
Mesh Network	A wireless network topology in which each node relays data for the network. All mesh nodes cooperate in the distribution of data in the network. Mesh networks can relay messages using either a flooding technique or a routing technique. Mesh networks can be considered a type of an ad-hoc network
Mine	<p>A surface or underground mine. Note that Minetec hardware products are suitable for hard-rock mines or surface mines.</p>  <p style="text-align: center; border: 1px solid red; padding: 2px;">Minetec products are not suitable in mines with a combustible atmosphere.</p>
Mine Operator	The company that operates a mine on a day-to-day basis. This may be a Mine Contractor or the owner operating as an Owner-Operator.
MineOffice	MineOffice is the management tool for configuring all Minetec software and wireless-enabled hardware products. Accessible via a web interface, MineOffice is used to set-up and configure Minetec hardware as well as all desktop and mobile apps within the Minetec software suite. As appropriate, firmware and software updates can be performed over the air or via an Ethernet network. MineOffice also enables centralised monitoring and diagnostics of Minetec products.
Mobile Node	The Minetec Mobile Node is a vehicle-mounted, low-power tracking ^{3F4} and proximity ^{4F5} detection device specifically designed for harsh mining environments. Also, see entry for Node. In general, LVs would have one mobile node installed whereas HVs would typically have two mobile nodes installed.
MSDS	Material Safety Data Sheet providing information relating to occupational safety and health for the use of various substances and products.
Node	Broad term covering all Minetec wireless devices used for ranging, positioning, tracking and/or proximity detection in Minetec solutions. When used for positioning, all Minetec nodes use the CSIRO WASP technology including ToA techniques for accurate ranging and operate in two wireless frequency bands; 5.8 GHz for WASP and 2.4 GHz for data transfer.
Pattern	In the context of the Personal Node, patterns represent a combination of the audible sound plus the number of LEDs, LED colours, LED activation sequence, illumination frequency or persistency. Each pattern has a unique meaning and relates to the state of a Personal Node function. For example, a proximity event pattern, and a low voltage battery pattern will both display a distinct and unique combination of LEDs and audible sounds with an unambiguous interpretation.
PC	Personal Computer
Pedestrian	A person on foot, as opposed to being in a vehicle. Also, see entry for Person

⁴ In the TRAX™ solution, nodes enable high-precision positioning and continuous tracking of mining personnel and vehicles, respectively.

⁵ In the SafeDetect™ proximity detection solution, nodes communicate with nearby SafeDetect equipped vehicles, providing audible/visible alarms to personnel and Vehicle Operators (via display devices), improving the safety of personnel and mobile assets.

Person	Relates to all people exposed to a potential unwanted event scenario PUE 1 Equipment to Person from the EMESRT Performance Requirement (PR-5A). In the context of TRAX and SafeDetect, a person must be wearing a Personal Node. Also, see entry for Vehicle.
Personal Node	The Minetec Personal Node is a battery-powered tracking ^{5F6} and proximity detection ^{6F7} device, worn by personnel. Personal Nodes are preconfigured for use in Minetec TRAX and/or Minetec SafeDetect to

Term	Detail
	track or alert the wearer to nearby vehicular hazards, respectively. See Node and the Personal Node User Manual for more details.
Personnel	Personnel are people in a surface-based or underground mine. Personnel include, but are not limited to: <ul style="list-style-type: none"> • Vehicle and Fixed Plant Operators. • Fitters and Maintenance crew. • Sub-contractors and Visitors. • System Administrators and ICT technicians. In the context of this document, all personnel use Minetec hardware and/or software.
PPE	Personal Protective Equipment
Procedure	Steps to perform a system task using Minetec hardware or software. Generally, these steps describe how the Minetec system works and are independent of the Mine Operator's own documentation. Procedures may be incorporated in site procedures if appropriate.
Proximity alarm	A proximity alarm triggers if a vehicle or pedestrian enters one of your warning zone.
PUE	Potential Unwanted Event as categorised in EMESRT Design Philosophy DP-5 and EMESRT Performance Requirement PR-5A.
RF	Radio Frequency covers electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz. RF current is carried via coaxial transmission lines.
Risk	In the context of SafeDetect, a risk is the likelihood that a hazard will cause harm (Risk = Hazard x Exposure) where: <ul style="list-style-type: none"> • Hazard = something that can cause harm (viz. vehicles). The more vehicles, the greater the risk. • Exposure = measurable degree (eg proximity, time) to which a person is exposed to the hazard. The closer the proximity the greater the exposure and therefore the risk. The longer a person is exposed to the hazard, the greater the risk. SafeDetect provides passive hazard awareness (an alarm) to reduce Operator risk by making the Operator aware of exposure to a hazard.
s	second
SMARTS	Minetec's SMARTS is the integration of asset, task and KPI management. It is a mine development and production scheduling solution providing tools for the planning, execution, reporting and evaluation of operational and maintenance tasks in a mine. SMARTS provides intuitive and real-time visibility of individual tasks within the mining cycle and the ability to modify tasks in response to real-time issues.

⁶ When used with the Minetec TRAX™ solution, Personal and Mobile Nodes enable high-precision positioning and continuous tracking of mining personnel and vehicles, respectively.

⁷ When used with the Minetec SafeDetect™ proximity detection solution, Personal and Mobile Nodes communicate with nearby SafeDetect equipped vehicles, providing audible/visible alarms to personnel and Vehicle Operators (via display devices), improving the safety of personnel and mobile assets.

System Administrator	The System Administrator (or simply, Administrator) has high-level system access to make changes to the software configuration and databases. Administrative functions, including the set-up and configuration of the hardware, software and infrastructure, are performed by the System Administrator. The Administrator would typically be an on-site mining engineer. A trained ICT technician may also perform some of the hands-on Administrator functions. The System Administrator may other roles (eg Scheduler, Mine Administrator)
ToA	Time of arrival (TOA or ToA), sometimes called time of flight (ToF), is the travel time of a radio signal from a single transmitter to a remote single receiver.
TRAX	Minetec's TRAX combines wireless data communications and high-precision wireless tracking. TRAX uses the CSIRO Wireless Ad-hoc System for Positioning (WASP) including Time of Arrival (ToA) techniques for accurate ranging. TRAX provides accurate locations even in the harsh environment of an underground mine. The combination of tracking and real-time data communications provides the capability to locate, communicate and facilitate mining operations.
V	volt
Vac	Voltage, alternating current
Vdc	Voltage, direct current
Vehicle	Vehicles are mobile equipment that are driven and operated an on-board Vehicle Operator, an on-board computer (viz. autonomous) or a remote operator. In all cases the vehicle has self-contained drive and steering systems. In the context of the TRAX and SafeDetect systems, a vehicle must have at

Term	Detail
	<p>least one configured Minetec Mobile Node. In the context of the SafeDetect system, all vehicles are exposed to potential unwanted event scenarios PUE 1 Equipment to Person and PUE 2 Equipment to Equipment from the EMESRT Performance Requirement (PR-5A).</p> <p style="text-align: center; color: blue;">Vehicles without suitably configured Minetec equipment are not covered by the Minetec solution and are outside the scope of this document.</p>
Vehicle Operator	A Vehicle Operator is a person who drives a vehicle equipped with Minetec equipment (eg for TRAX, SafeDetect, SMARTS). The vehicle may be, for example, an LV or an HV.
W	watt
Warning zone	<p>Warning zones (or simply, zones) are concentric doughnut shaped areas centred on the Local Object (LO) with the:</p> <ul style="list-style-type: none"> • Inner zone being a solid circular area. • Inner zone representing the highest risk area. • Outer zones representing lower risk areas, the further from the LO, the lower the risk. • Zones showing as, for example, dashed circles on a graphical display device. • Zones being configurable in number and radius from the LO. • Zones are visible on an In-Vehicle PC display with SafeDetect. • Zones are not visible on a Warning Device (deprecated device).
WASP	Wireless Ad-hoc System for Positioning is a system developed by CSIRO and productised by Minetec used to locate personnel and vehicle assets with sub-metre precision in an underground mining scenario. WASP technology has been deployed by Minetec as part of the TRAX system for locating and tracking in underground mines.
Wh	Watt-hour
Wireless	Wireless networking in general with bands other than the standard Wi-Fi.
Work Instruction	A document providing detailed instructions on how to perform a specific task. The instructions typically contain sections/steps for preparation, isolation and safety, installation or commissioning, testing and handover or post work instructions. Photographs and/or diagrams should be included for positive identification of components and locations. Work Instructions are typically created by the Mine Operator to align generic Minetec procedures and guidelines with on-site HSE policies and procedures.
Zone	In TRAX TagBoard, a defined geographical area of a mine. Also, see Taggable zone and Hidden zone.

12 SUPPORT

Help using software or hardware

If you need help with using Minetec software or hardware, in the first instance, contact your Supervisor or the person who delivered your training.

Hardware faults and software bugs

Supervisors/System Administrators

Please refer to the Minetec Operational Support Plan for details on the level of support to be provided to your site.



Contact Minetec Support Services before returning any hardware, via either the online support portal or the details provided on the back cover.

If the device or the application does not behave as expected perform, the troubleshooting steps in the Troubleshooting section(s). If the device or application is still not performing correctly, report the fault to your Supervisor to lodge a request for a Return Materials Authorisation (RMA) number and complete the RMA form.

To ensure Minetec support personnel can identify the issue quickly, the report should include the following items:

- Username.
- Time of occurrence.
- Brief description of problem.
- Steps taken before the problem occurred.
- If applicable, a screenshot of the error message or visual indication of unexpected behaviour.
- Description of the expected behaviour (as perceived by you).

RMA Procedure

Devices identified as faulty should be returned to Minetec Support after obtaining a Return Materials Authorisation (RMA) reference number. Without the RMA a device may not be accepted. Each separate item of kit requires an individual RMA number.

The procedure to return a faulty item is:

- 1) Perform the troubleshooting steps in this document as appropriate for the device(s) and establish that a fault exists.
- 2) Contact Minetec Support Services for the RMA reference number.
- 3) Complete the RMA form with as much detail as possible indicating the test performed. Note that you can reference specific tests with the number in the first column of each troubleshooting table.
- 4) Return the device(s) and RMA form(s) to Minetec.



Personal Node lithium ion batteries must be run flat (>24 hours) if airfreighting.

13 APPENDICES

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13.1 About Minetec technology

Minetec hardware is broadly categorised as:

- Vehicle hardware installed on each vehicle in the fleet.
- Personnel hardware including the Personal Node and Charging Dock.
- Infrastructure including devices and ethernet cable for Wi-Fi communications and data backhaul.

See [Table 17 System hardware](#) below and [Table 18 Communications technology](#) below for a summary of the hardware and technology used in each system. Note that the systems use common hardware so that multiple systems can be deployed with minimal additional hardware required.

For Trax and *SafeDetect*, all Minetec ranging devices use the CSIRO⁸ Wireless Ad-hoc System for Positioning (WASP) technology including Time of Arrival (ToA) techniques for accurate ranging.

Table 17 System hardware

System	Personal Node	In vehicle PC	Mobile Node	PDPU8F ⁹	Access Point	Bridge	Ethernet cable & Backhaul Cabinet
Category	Personnel	Vehicle			Infrastructure		
Trax ¹⁰	Y	Y	Y	N	Y	Optional	Y
SafeDetect ¹¹	Y	Y	Y	HV	N	N	N
SMARTS ¹²	N	Y	N		Y	N	Y

Y= Yes, required by the system; N = No, not required; HV = used in Heavy Vehicles with multiple Mobile Nodes.

Mobile and Personal Nodes operate in the following wireless bands:

- 5.8 GHz for WASP.
- 2.4 GHz wireless band creating wireless mesh networks.

Table 18 Communications technology

Communications technology	In-Vehicle PC	Personal Node ¹³	Mobile Node ⁶	Wi-Fi WASP Access Point	Wi-Fi WASP Bridge
5.8 GHz WASP for ranging.	N	Y	Y	Y	Y
2.4 GHz mesh networking between nodes and Vehicle PC	Y	Y	Y	N	N
2.4 GHz Wi-Fi client-server networking.	Y	N	N	Y	Y
Ethernet LAN for comms & backhaul	N	N	N	Y	Future

Y= Yes, device uses this technology; N = No, device does not use this technology.

⁸ Commonwealth Scientific and Industrial Research Organisation; Australian federal government scientific research agency.
⁹ Power Distribution and Protection Unit, usually only required for heavy vehicle installations.
¹⁰ Trax is a tracking /positioning system that uses all hardware required by the two other systems.
¹¹ SafeDetect is a peer-to-peer proximity detection system and **does not use** an infrastructure.
¹² SMARTS is a productivity and scheduling solution and **does not use** Personal or Mobile Nodes. ¹³ Mobile and Personal Nodes **do not use** standard 2.4Ghz Wi-Fi.

13.2 Zone sizes



Irrespective of the zone sizes configured at your site, common road sense applies.

Your site has already determined and set the zone sizes. The correct zone sizes should be reflected in your standard operating procedures.

SafeDetect is a passive system that advises the users of potential hazards and does not actively control equipment or provide emergency stops. It is worth noting, for example, that even though a Vehicle Operator may be aware of you and other users on their In-Vehicle PC, the stopping distance for a vehicle approaching you is the sum of the distances travelled during the following time delays:

- 1) System delay – The system has a small 'signal processing delay'. The system delay is typically no more than about a second. During this time a vehicle will travel a distance before the driver sees or hears any alarm.
- 2) Driver reaction time – This is the distance travelled between the driver seeing the stop alarm and then applying the brakes. Reaction times vary with age and fatigue and may be as short as 200 ms or as much as about 1.5 seconds.
- 3) Braking delay – distance travelled after the driver applies the brakes; the braking distance varies on vehicle type, speed and the road surface conditions (wet, dry, sealed, unsealed, slope, camber etc.).

[Table 19 Vehicle speed examples](#) below shows the distances travelled by a vehicle in one second. Two vehicles travelling towards each other will close the distance at twice these rates. Considering all the factors mentioned above, the stopping distance may be significant, and zones are sized accordingly.

Table 19 Vehicle speed examples

Vehicle Speed (km/h)	Distance travelled in 1 s
50	13.9 m
40	11.1 m
36	10.0 m
30	8.3 m
20	5.5 m
10	2.8 m

5

1.4 m

13.3 EMESRT alignment

The Minetec SafeDetect system aligns with elements of the EMESRT Design Philosophy (DP-5) for Machine Operation Controls and the Performance Requirement (PR-5A) for Vehicle Interaction Systems as follows. The EMESRT performance requirements are discussed in [EMESRT PR-5A summary](#) below. SafeDetect is based on 'cooperative' objects (equipment and personnel) equipped with Minetec nodes and does not provide any active intervention control functions.

As such:

- SafeDetect **does** the following to prevent an unwanted vehicle interaction:
 - Provides Level 7 Operator Awareness.
 - Provides Level 8 Advisory Controls.
 - Applies only to the following potential unwanted events:
 - *Equipment to Person.*
 - *Equipment to Equipment.*
- SafeDetect **does not**:
 - Provide Level 9 – Intervention Controls.
 - Apply to the following potential unwanted events:
 - *Equipment to Environment.*
 - *Loss of Control* potential unwanted events.

What is EMESRT?

The Earth Moving Equipment Safety Round Table (EMESRT) is a global initiative involving major mining companies. EMESRT engages with key mining industry Original Equipment Manufacturers (OEMs) to advance the design of the equipment to improve safe operability and maintainability beyond Standards. For more information, see <http://www.emesrt.org/about-us/>

EMESRT PR-5A summary

The *Vehicle Interaction Defensive Controls Model* in PR-5A depicts nine defensive layers which provide differing levels of process controls to prevent an unwanted vehicle interaction.

PR-5A specifically relates to the last three levels of defence for "systems to manage residual interactive risk". These last three levels, grouped as the 'React' phase, are:

- **Level 7** – Operator Awareness:
Technologies that provide information to enhance the operator ability to observe and understand potential hazards in the vicinity of the equipment.
- **Level 8** – Advisory Controls:
Technologies that provide alarms and/or instruction to enhance the operator ability to predict a potential unsafe interaction and the corrective action required.
- **Level 9** – Intervention Controls:
Technologies that automatically intervene and take some form of equipment control to prevent or mitigate an unsafe interaction.

The above process controls apply to the potential unwanted event (PUE) scenarios of:

- **PUE 1** Equipment to Person.
- **PUE 2** Equipment to Equipment.

- **PUE 3** Equipment to Environment.
- **PUE 4** Loss of Control.

Refer to the *Vehicle Interaction Scenario Performance Requirement Definitions in EMESRT Performance Requirement PR-5* for details.

MINETEC™
STOP WORKING IN THE DARK

For all support requests contact Minetec Service Support:

Toll Free: 1800 MINETEC (Australia only)

Phone: +61 8 9259 4955

Email: support@minetec.com.au

Minetec Pty Ltd | Unit 2 | 29 Wellard Street | Bibra Lake | Western Australia | 6163 | Australia

Returns with a valid RMA should be sent to:

Minetec Pty Ltd | 2 Second Avenue | Mawson Lakes | South Australia | 5095 | Australia