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Vehicle Hardware Installation Guide

Automotive Electrician

02/10/2019

Currency

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⚠️ Conformity of devices with regulations, standards and directives may be compromised if the devices are not installed, maintained and operated according to this document.

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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.

General Safety

To ensure your own personal safety and prevent electrical damage and/or fire, please read these safety statements before installing any devices. Use extreme care and caution when installing or removing devices.

⚠	CAUTION Do not attempt to service any device unless you are experienced, qualified and authorised by Minetec in writing, and as indicated in this document.
⚠	Always use care when handling or operating Minetec 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, note all cautions or warnings on a device.
- 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, use additional common-sense precautions 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 events occur or are suspected, immediately have the device checked by qualified and authorised personnel:
  - A power cord or plug has damage (if applicable).
  - A device has obvious signs of breakage or tampering.
  - A device has physical damage (eg due to dropping or crushing).
  - A device has water or any other liquid damage (eg due to submersion, high-pressure spray).
  - A device does not work as expected after using these guidelines.

Cabling precautions

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).
  - Power/RS232 conduit is 16 mm diameter.
  - Power only conduit is 13.3 mm diameter.

In-Vehicle PC safety

The In-Vehicle PC has an LCD display that generates heat and requires special safety considerations to prevent burns and/or fire.

The In-Vehicle PC should be easily seen and accessed but not impinge on or interfere with vehicle functions or other installed systems. Ensure that the installation process and resulting installed hardware must not create a hazard including, for example, but not limited to:
- Obstruct the Vehicle Operator's vision.
- Impinge on the Vehicle Operator's immediate work area (eg touching arms or legs etc.).
- Impede or affect safety devices such as air bags, handrails, Roll Over protection Systems (ROPS), Falling Object Protection System (FOPS), etc.
- Cause damage to the system that you are installing (eg an external antenna).
- Cause damage to the vehicle or its safety systems from:
  - Weight of the device.
  - Drilling, cutting or grinding performed to mount the device. For example, bare metal surfaces treated to prevent corrosion.

The In-Vehicle PC generates heat.

> ⚠️ To prevent burns or fire hazard, do not cover the In-Vehicle PC when it is operating.

To protect the processor from overheating, regularly clean off any dust or dirt build-up from the heat-sink on the rear panel and note that:
- The heat sink relies on air convection for cooling.
- Because the In-Vehicle PC is fanless, do not mount or operate horizontally as this will prevent suitable airflow for convection cooling.
- The area above and below the heatsink should not be obstructed, because this will prevent airflow for convection cooling. Overheating can cause a variety of problems, including premature aging and failure of components or mechanical failure of the unit.

Do not open the In-Vehicle PC unless you are qualified and an authorised electronics service personnel. For authorised electronics service personnel opening an In-Vehicle PC, take note of the following:
- Turn off the IVPC and any peripherals.
- Disconnect the IVPC and peripherals from their power sources or subsystems, to prevent electric shock and/or damage to the system board.

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- To help avoid possible damage to system boards, wait ten seconds after turning off the IVPC before removing a component, removing a system board, or disconnecting a peripheral device from the IVPC.
- Follow the guidelines provided in Electrostatic discharge on page 7.

WARNING
Voltages as high as 40Vdc could be present inside the IVPC enclosure when the power cord is plugged into a vehicle with 24Vdc batteries. Disconnect the power cord from its source before removing the chassis cover. Turning the IVPC off (via the Power On/Off button) does not remove power to all internal components.

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1 ABOUT THIS DOCUMENT

⚠️ **Contact Minetec if unsure about any of the information or guidelines in this document.**

⚠️ **To prevent damage to Minetec devices or the Mine Operators assets, and to ensure your own personal safety, please read the General Safety on page ii before installing any devices.**

This document provides guidelines for installing Minetec devices in a vehicle and is one of a set of documents that outlined in the roadmap diagram below. Most devices consist of hardware, cabling, software and/or firmware. This document is written for technically qualified and authorised people who install Minetec hardware on or in a vehicle. This includes, for example, Automotive Electricians and similar roles.

Install
ICT Technician or Electrician

This document.
Installing infrastructure hardware.

Configure
System Administrator
& ICT Technician

MineOffice Manual

Configure hardware
and software

Learn
Vehicle Operator
& Pedestrian

*Site training materials and
Change Management plan*

Attend training and learn
how to use the system(s).

Operate
Vehicle Operator
& Pedestrian

*User manuals for SafeDetect,
Personal Node, Trax and SMARTS*

Follow site HSE policy and
standard operating procedures.

Maintain
ICT Technician or Electrician

*Vehicle Hardware
Maintenance Guide*

Follow site HSE policy and
maintenance procedures

The guidelines in this document are generic and do not apply to a specific vehicle type.

The guidelines need to be modified to suit a specific make/model of vehicle with consideration to specific vehicle configurations and other equipment already installed on the vehicle.

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.

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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.

Document conventions used throughout are described in:
- Notes and icons on page 3.
- Glossary on page 43.

All drawings and schematics shown in this document are uncontrolled.
The English version of this document takes precedence over any translated versions.

Exclusions:

This document excludes firmware and software configuration. Refer to the relevant configuration manuals (eg *MineOffice User Manual*).

1.1 Document revision

Please ensure that you are referring to the most recent document version.

Document information			
Release Date	Document Version	Author	Notes
27/02/2019	1	Corbet Stain	GA1 release
2/10/2019	1.1	Corbet Stain	GA2 release, Serial cable update, removed consumable kits, cease wrapping of Deutsch plugs.

1.2 Reference material

In addition to any Work Instructions that are specific to the site and/or vehicle type, the following documents support and supplement the information in this document.

Document	Notes
Mine Operator Work Instructions	Developed per site
Site Fleetmap	Project deliverable
Vehicle Profile Type Layout	Project deliverable
PDPU Assembly Guide	Delivered with device
Mobile Node Assembly Guide	Delivered with device
In-Vehicle Assembly Guide	Delivered with device
PDPU Data Sheet	On request
Mobile Node Data Sheet	On request
In-Vehicle PC Data Sheet	On request
Hardware Placement and Wiring Schematics (examples)	See Appendix 3.3.1 on page 9
Vehicle Hardware Maintenance Guide (incl. Troubleshooting)	To maintain vehicle hardware

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1.3   Audience

Installation of hardware is a specialist task that is to be performed by trained and competent personnel. It is essential that the technician installing the equipment has knowledge and experience in the installation of general electronic and/or communications systems on mining equipment. In some cases (eg for Heavy Vehicles) more than one technician may be required to install the kit.

The intended audience for this document includes, but is not limited to:
- Automotive Electricians.
- ICT Technicians.
- Vehicle Maintenance Supervisors.
- Fleet Managers.

1.4   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.
ELECTRIC SHOCK RISK	This symbol indicates that the device, or a related procedure, represent a potential electrical shock hazard.

2   ABOUT THE HARDWARE

This document covers the following hardware, including the cabling and connectors, installed in a vehicle:

- Power Distribution Protection Unit (PDPU) on page 15.
- Mobile Nodes on page 22.
- In-Vehicle PC on page 28.

2.1   Systems

The hardware described in this document is used in one or more of the Minetec systems:

1) SafeDetect™ - A high-precision proximity detection system for vehicles and Pedestrians in surface and underground mines.
2) TRAX™ - A high-precision underground tracking system powered by TRAX hardware, using CSIRO's WASP™ (Wireless Ad-Hoc System for Positioning) technology.
3) SMARTS™ - A mine development and production scheduling solution providing tools for the planning, execution, reporting and evaluation of operational and maintenance tasks in a mine.

For TRAX and SMARTS, this document only covers the installation of vehicle-mounted devices. See the separate *Infrastructure Installation Guidelines* for infrastructure devices.

All networked devices are configured by the System Administrator or authorised ICT Technician according to the *Mine Office User Manual*.

Hardware can be installed in HVs or LVs in several typical installation arrangements. Figure 2 Typical HV hardware (not to scale) on page 5 shows an example of the mounting positions used when fitting the hardware on an HV. An example of the mounting positions for an LV are shown in Figure 1 Typical LV hardware (not to scale) below. These two example arrangements are applicable to both a TRAX and a SafeDetect installation.

Some hardware has additional installation considerations depending on whether the vehicle is a closed cabin or open cabin vehicle, as outlined in Installation planning guidelines on page 6.

Additional hardware placement drawings for different types of vehicles and hardware arrangements are provided in Hardware placement and wiring schematics on page 9.
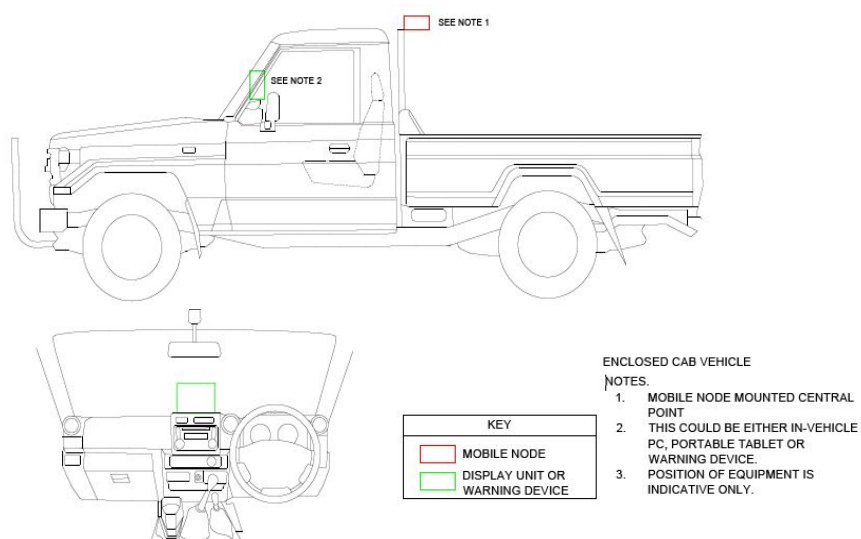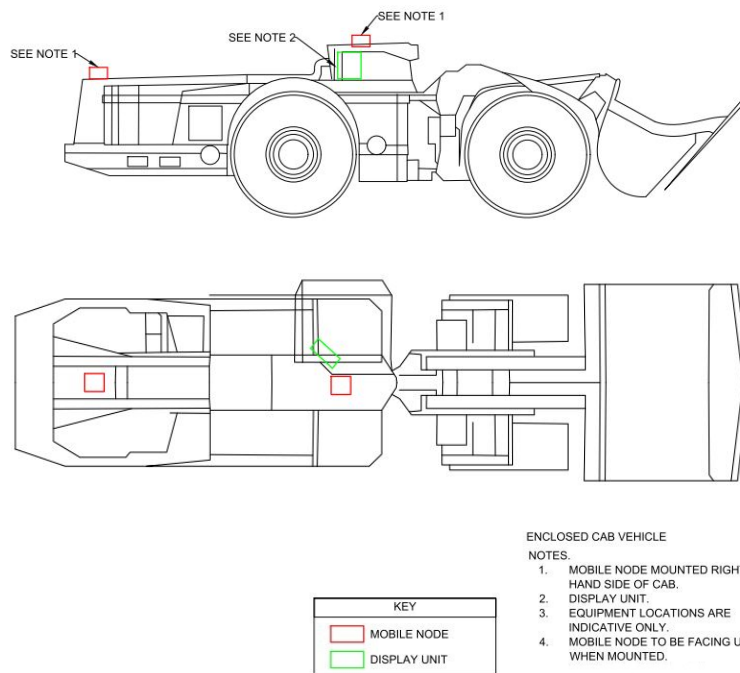
Figure 1 Typical LV hardware (not to scale)

Figure 2 Typical HV hardware (not to scale)

2.2   Vehicle Profile Type

A vehicle Profile type is a unique combination of vehicle parameters including but not limited to vehicle make, model, factory modifications and site modifications. As the physical installation of hardware typically differs for each profile type details of the hardware locations, vehicle dimensions and device configurations are provided in the site Fleet Map design document.

Factors affecting the physical installation include, but are not limited to:
- System options – multiple Minetec systems, multiple mobile nodes.
- Vehicle make (eg Toyota).
- Vehicle model (eg LandCruiser).
- Model variants (eg dual cab, RHD).
- Factory modifications (eg ROPS).
- Field modifications (eg FOPS).
- On-site HSE and operational policies and procedures (eg power system isolation).

2.3   Work Instructions

The guidelines in this document are generic and are intended to guide and advise for an ad-hoc installation of hardware to any type of vehicle. Accordingly, these guidelines are not aligned to a specific Vehicle Profile Type as defined above. Site-specific Work Instruction provide detailed installation steps and any critical information such as attachment techniques, fasteners used and electrical cable routing. Work Instructions are specific to your site and a vehicle profile type.

> Site-specific Work Instructions supersede the equivalent guidelines in this document.

3   INSTALLATION PLANNING GUIDELINES

This section provides planning guidelines to be considered before starting installation.

3.1   General precautions

To prevent damage to the devices product and to ensure the correct operations, please read these precautionary statements before installing 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.

- For display devices with an LCD screen:
  - LCD screen surfaces are easily scratched. Avoid touching screens with sharp objects.
  - Some display devices come with a screen protector. If a protection film is not provided, consider using a generic non-adhesive screen protector (designed specifically for use on portable devices with LCD panels) to help protect the screen from minor scratches.
  - Improperly fitted screen protectors may interfere with the operation of touch screen.
- 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.
- 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.

3.1.1   In-Vehicle PC

The following general precautions should be noted for the best performance and longevity of the In-Vehicle PC (IVPC).

- Do NOT leave or store the IVPC in an environment where the storage temperature is below -40°C or above 80°C, as damage to the device may result.
- The IVPC has a lithium ion battery pack fitted to provide a UPS function to keep the IVPC running in case of power failure. Only replace with a Minetec supplied battery.
- The IVPC system board has a 3 Vdc (BR1632 or CR1225) lithium battery. This is used to keep the real-time clock running when main power is disconnected. Replace ONLY with the same or equivalent type of battery.

> ⚠ An In-Vehicle PC is only to be opened by qualified and authorised electronics service personnel.

3.1.2   Cables and connectors

To minimise damage, do not unnecessarily bend or wrap cables. Also refer to Cold weather operation on page 8 for additional hints on working with cables in sub-zero temperatures.

When handling cables, ensure that:

- When disconnecting a cable:
  - o Hold and pull the connector body. Do NOT pull on the cable.
  - o Some connectors may be held in place with locking screws. Make certain they are not screwed in before to trying to remove the connector.
  - o Some cables may have a connector with locking tabs. If you are disconnecting this type of cable, press in on the locking tabs before unplugging the cable.
  - o 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.

3.1.3   Lithium ion batteries

           Some devices have lithium ion battery packs fitted

- If you are authorised and advised to replace a battery pack:
  - o Replace ONLY with a Minetec supplied battery pack. Installing the incorrect battery pack can result in a serious safety hazard.
  - o Replace ONLY with the same or equivalent type of battery.
- 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.

3.1.4   Electrostatic discharge

If authorised to open any device be aware that static electricity discharge can damage system boards and other electronic components (including LCD panels). 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 discharges any static electricity that may have built up in your body and on the packaging.
- Always move or transport a sensitive component in an antistatic container or antistatic packaging.
- Handle components and circuit boards with care. Hold circuit boards and modules by their edges or mounting brackets. Don't touch components or connectors on the circuit boards or module.
- Do not handle or store system boards near strong electrostatic, electromagnetic, magnetic, or radioactive fields.

3.1.5   Cold weather operation

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

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

For access and operational reasons, display devices and the PDPU and are typically mounted inside the relatively moderate environment of the enclosed cabin of a vehicle. For best wireless communications, Mobile Nodes are typically mounted on the outside of the cabin, and often in exposed locations. Mobile Nodes have been tested at sub-zero temperatures. Refer to the Mobile Node data sheet for details.

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 (eg doors or hatches).
- Limit work to workshops in controlled environments.
- Allow sufficient time for equipment and materials to acclimatise to workshop temperatures before starting work.

3.2   Planning Approval

Planning approval must be sought and gained from a suitable authority such as the vehicle OEM representative or site representative.

Due consideration must be given to:

- General Safety on page ii.
- General precautions on page 6.
- Hardware location, for example:
    - o Other installed systems.
    - o Accessibility.
    - o Minimise physical modifications.
- OHS considerations and approvals:
    - o Vehicle impact zones.
    - o Vehicle installed safety systems.
    - o Operator Safety.
    - o Ergonomics, eg operations in day/night conditions, prescription glasses, PPE.
- Impact on:
    - o Critical vehicle functions.
    - o Other installed systems.
- Power considerations:
    - o Power consumption for all systems when vehicle is operating, idling and off.
    - o Understanding that a vehicle without power is not 'visible' to other vehicles via SafeDetect.
    - o Positive electrical isolation (master or secondary isolation).
    - o Sustaining critical functions during the install (eg battery and/or starter isolation).
    - o Battery current drain by installed systems during hardware installation.
    - o Battery age and condition.

3.3   Hardware locations

Although it is not always possible to achieve the optimum mounting locations for Operators, hardware should be mounted in or on a vehicle with consideration to the aspects discussed in the following sections. This section lists special considerations when selecting the location and mounting techniques to be used for hardware.

3.3.1   Hardware placement and wiring schematics

A set of drawings appropriate to the Profile type and Minetec system to be installed were provided during the design phase. The drawings supplement this guide and can be used for reference when installing vehicle hardware.

→	Check you have the latest revision of any drawing.
→	Contact Minetec if you require assistance with obtaining or interpreting any drawings.

Once deployed, the Mine Operator maintains the set of drawings to cater for new vehicles or changes to existing vehicles.

The following is a list of typical drawings:
- Mobile Node Power Cable Assembly.
- Mobile Node Power and RS232 cable assemblies.
- PDPU – Power Cable.
- In-Vehicle PC - Power and Serial cable.
- In-Vehicle PC - Power Breakout cable.
- Light Vehicle - Hardware Placement.
- Light Vehicle - Schematic Diagram.
- Heavy Vehicle - Loader - Hardware Placement.
- Heavy Vehicle - Truck - Hardware Placement.
- Heavy Vehicle - Wiring Schematic In-Vehicle PC.
- Heavy Vehicle - Wiring Schematic – TRAX.

3.3.2   Location and mounting guidelines for all hardware

→	Vibration is typically most severe at cold-start and during idling.

Consider the following for locating and mounting hardware in a vehicle.
- Check required parts for the installation are available.
  Refer to the *Assembly Guide* for each device.
- Locate hardware for ease of access for operations and/or maintenance.
- Where supplied, consider the ease of attaching the hardware to the mounting plates before attaching the mounting plates to the vehicle.
- Secured and immobile. (eg not attached to unsecured doors or hatches).
- For hardware with an external antenna, locate the hardware to protect the antenna from breakage or damage which could impair the ability of the hardware to receive and respond to messages.
- Within reach of the vehicle power source and any other hardware that needs to connect to it.

- Minimise kinetic damage (eg from external structures, other vehicles or falling rocks).
- Minimise dust and water ingress:
  o Water ingress (eg connectors facing down).
  o Use an IP66 rated enclosure for exposed hardware not already rated to IP66 (eg In-Vehicle PC).
- Use locations and mounting techniques to minimise:
  o Excessive vibration (eg the PDPU is supplied with anti-vibration mounts).
  o Rotational forces using:
    ▪ Short single-point attachment mounting plates/adaptors.
    ▪ Multiple-point attachment for larger mounting plates/adaptors.
  o Excessive heat (eg avoid locations close to engines, exhausts, etc.).
  o Hydrocarbon contact (eg avoid locations subject to diesel, oil and lubricant escapes).
- Do not mount a hardware outside the Falling Object Protection Structure (FOPS). If this is unavoidable, it is suggested that additional protective shields or a wireless-compatible enclosure is used.
- If mounting hardware on the Roll Over Protection System (ROPS), use existing holes; if new holes are required, obtain permission from the relevant site safety representative.
- The location must not impede or affect safety hardware such as air bags, hand rails, ROPS, FOPS.

3.3.3   Wireless hardware

In addition to the General Safety on page ii, also consider the following information for all wireless hardware.

> Hardware to be located and orientated to minimise noise and optimise signal radiation.

Wireless hardware is susceptible to RF noise. Avoid placing nodes and cabling near common RF noise generators, such as high voltage cables, electric motors, solenoids and other antennas.

> To minimise noise, wherever possible, cabling should be separated from noise generators by at least 600 mm. If this cannot be achieved cables should cross at 90 degrees, which assists in minimising noise coupling.

Wireless hardware use antennas (external or internal) and require a minimum clearance of 100 mm from metal surfaces to ensure a clear RF path and minimise interference. Also ensure the device has Wi-Fi coverage around the vehicle for pairing of devices.

For best performance and integrity, follow these guidelines when installing wireless hardware:

1) Check all supplied parts required for the installation are available. Each Mobile Node comes with a power cable **or** a power and serial cable, depending on the type of installation.
2) Check and confirm any external antennae are screwed in fully to the device.
   Antennae are shipped loose in the box and may be easy to overlook.
3) Determine a physical mounting location that meets the following criteria:
   o Wireless hardware has an effective view (line-of-sight preferred) to:
     ▪ Other devices on the vehicle (eg display devices).
     ▪ Other vehicles, pedestrians and any mine communications infrastructure such as Wi-Fi WASP Bridges, Wi-Fi WASP Access Points, etc. if possible.
   o Mobile Nodes are mounted as close to the vehicle centre line as possible.
   o Hardware is not attached to a moveable part of the vehicle (including unsecured doors or hatches). Moveable parts can come loose and vibrate during operation.

  o In sub-zero weather cables and conduits should not be permitted to flex.

3.4 Electrical

This section describes, at a general level, wiring and connection considerations for all vehicle hardware.

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

3.4.1 Wiring

All wiring should be installed in accordance with *AS/NZS 4871.6:2013 - Electrical Equipment for Mines and Quarries Part 6: Diesel Powered Machinery and Ancillary Equipment*, with attention being paid to the following extract:

"2.2.14 Fixings, fastenings and supports
All fixings, fastenings and supports that restrain the wiring and associated electrical
Equipment shall—
(a) Be of adequate strength;
(b) Be installed to prevent unintended movement including vibration; and
(c) Protect the electrical equipment and associated wiring from damage."

> ✳️ Note that corresponding and equivalent standards may apply in different countries.

3.4.2 Device power

The power requirements for each device are show in Table 1 Device Power below.

Table 1 Device Power

Device	Voltage Range	Fusing	Power Consumption
In-Vehicle PC	8-39 Vdc	5 A	Up to 2.5 A current draw
Mobile Node	8-50 Vdc	3 A	3 W, 250 mA @ 12 Vdc or 60 mA @ 53 Vdc
PDPU	8-26 Vdc	10 A	Supplied from 12 V or 24 V via 10 A fuse

3.4.3　Connectors and cables

> If installing cabling, cut to length with a small service loop if needed. Remove excess

In addition to the safety precautions in Cabling precautions on page iii, when wiring and making connections, note that:

- Vehicle power is isolated according to on-site safety procedures.
- Ensure the power connector is easily accessible.
- Use an appropriate in-line fuse rating and fuse holder as specified in Table 1 Device Power on page 11.
- Connect the fuse holder to the lead wire using the provided fuse holder.
- Supply voltage (+ve) connections is kept as close to the battery as possible.
- Ensure fuse holder location is within about 25 cm of the connection to the battery positive or fuse distribution box.
- Ensure fuse holder is well away from moving parts.
- Ground (-ve) connection made to the vehicle ground as the Isolator is between Battery -ve and ground.
- If fixing cabling to ROPS/FOPS use adhesive based cable tie mounts, superglue, silicone or similar.
- Care should also be taken to ensure all device connectors are clean and free from dirt before connection. The node wiring harnesses are factory assembled with 8-way Deutsch connectors and protective boots.
- If rework is required ensure that cables are properly crimped and terminated with protective boots fitted. Alternatively, a replacement cable can be ordered.
- If connectors are in an area that is exposed to high-pressure wash down they must be protected.

> Physical shields should be used to ensure water cannot enter connections if the water pressure exceeds the IP rating of the connector.
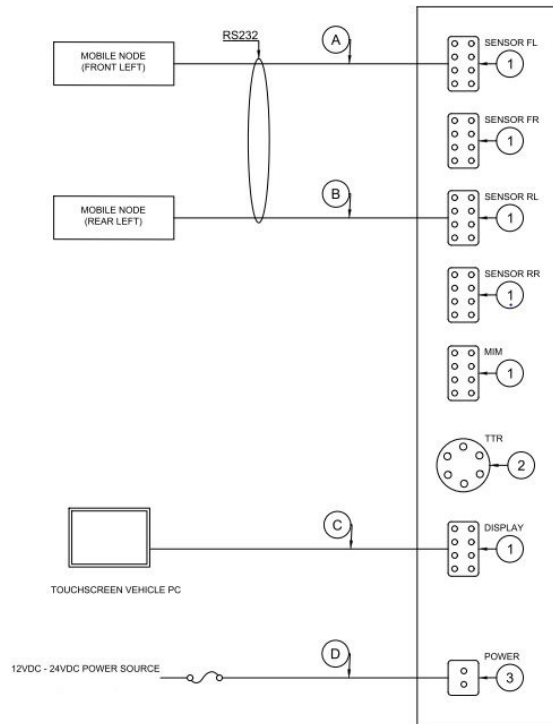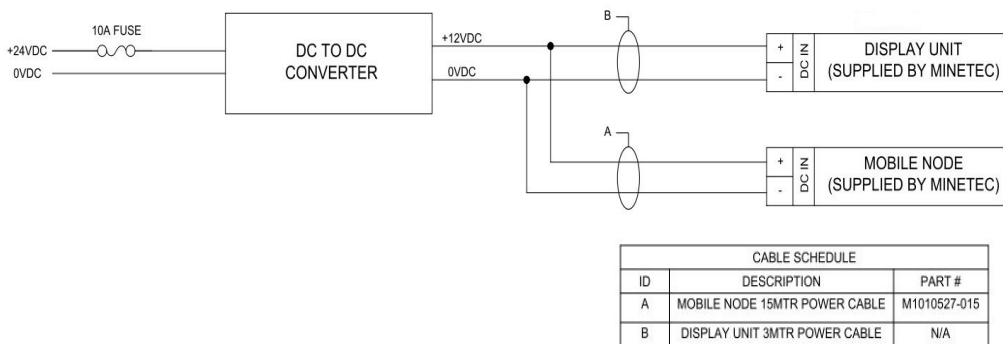
Figure 3 PDPU Sample wiring schematic

Table 2 Connectors and cables in Figure 3 PDPU Sample wiring schematic above

Reference	Description
A	6 m Power & RS232 cable assembly for front node (supplied with node)
B	15 m Power & RS232 cable assembly for rear node (supplied with node)
C	Power & RS232 cable for display device (supplied with display device)
D	PDPU Power cable (supplied with PDPU)
1	Deutsch 8-pin male connector
2	MIL-Spec 6-pin male connector (not currently used)
3	Deutsch 2-pin male connector

Figure 4 DC-DC Converter wiring schematic

CABLE SCHEDULE		
ID	DESCRIPTION	PART #
A	MOBILE NODE 15MTR POWER CABLE	M1010527-015
B	DISPLAY UNIT 3MTR POWER CABLE	N/A

4   INSTALLATION GUIDELINES

This section provides basic information about hardware and guidelines on how to install each device.

If required, refer to the Vehicle Hardware Maintenance Guide that includes troubleshooting guides.

4.1   Power access

Ensure an approved power source is available and the following are considered:
- Power consumption for all systems when vehicle is operating, idling and off.
- Understanding that a vehicle without power is not 'visible' to other vehicles via SafeDetect.
- Positive electrical isolation (master or secondary isolation).
- Sustaining critical functions during the install (eg battery and/or starter isolation).
- Battery current drain by installed systems during hardware installation.
- Battery age and condition.

> A final 'power-on' check ensures connectivity. It does not check hardware functionality.

4.2   Power distribution

Minetec devices require a stable, conditioned DC power supply. Conditioned power can be provided from the vehicle to multiple devices using the Minetec PDPU or via individual DC-DC Converters.

> The PDPU is recommended in situations where multiple devices are to be installed and/or to cater for future expansion of devices in a single vehicle.

If the PDPU is not used, each site is responsible for sourcing their own converters. If third-party devices are used, Minetec is not responsible for damage to Minetec equipment caused by electrical faults in, or caused by, third-party power DC-DC Converters.

Irrespective of the DC supply used, locate all devices so that they are easily accessible for installation and troubleshooting and preferably inside the cabin or another enclosed and protected area. Refer to the two options:

4.3   Serial Communications

Refer to the Fleet Map and Detailed Design document provided during design.

For some Heavy Vehicles (HV), as the result of the RF shielding caused by the body of the HV, serial communication may be required between the rear node of a Heavy Vehicle and the In-Vehicle PC. Serial communication is via the M1010589 Power Distribution and Protection Unit.

LV Mobile Nodes use wireless communications and generally do not require serial communication between the Mobile Node and the In-Vehicle PC.

For HV Mobile Nodes using serial communication:

- The M1010589 Power Distribution and Protection Unit is used to provide power to the Mobile Node and In-Vehicle PC as this also provides the RS232 connectivity.
- The Mobile Node must connect:
    - Using M1010528-015 Serial and Power cable.
    - To the **Sensor RL** port of the PDPU. Refer separate *PDPU Assembly Guide.*

4.4   Power Distribution Protection Unit (PDPU)

The PDPU is a vehicle-mounted voltage conditioning unit and is also used to distribute vehicle power to devices such as Mobile Nodes and the display device in the vehicle cabin. Detailed technical specifications are given in the *PDPU Data Sheet*. Before reading the guidelines, refer to the following:

- Figure 3 PDPU Sample wiring schematic on page 13.
- Figure 5 PDPU User Interface on page 16.
- Figure 6 PDPU Connection sockets on page 16.
- Table 8 Deutsch connector pin arrangements on page 52.

A PDPU is typically required where two or more Mobile Nodes are installed or are intended to be installed later. For each powered and operational device, the corresponding LED displays as solid green. In most installations the 8-pin Deutsch connecters only use the two power pins. The PDPU is bolted on to the vehicle using anti-vibration mounts and mounting bracket. To protect against impact damage and to locate centrally to all potential devices, the PDPU is ideally located in a protected area such as the cabin or similar enclosed area.

The PDPU kit on page 50, provides the components required to:

1) Attach the PDPU device to an angled mounting bracket with anti-vibration mounts.
2) Attach the PDPU power cable to the vehicle's power distribution source.
3) Terminate and connect power cables supplied separately with:
    a) The display device.
    b) Two mobile nodes.
       Additional 8-pin Deutsch connectors required for more than two nodes.
4) Protect remaining empty 8-pin Deutsch sockets with blanking plugs filled with sealing plugs.

Due to variations in mounting locations and techniques, the kit does not include fasteners to attach the angled mounting bracket to the vehicle. These must be provided by on-site.

> ⚠️ The PDPU must be mounted horizontally with connectors at the bottom and the LEDS visible. The correct orientation is important to enable the anti-vibration mounts to function, to minimise risk of water ingress and to assist in troubleshooting.

Figure 5 PDPU User Interface

Figure 6 PDPU Connection sockets

Figure 7 90° PDPU Mounting bracket

Figure 8 Anti-vibration mounting
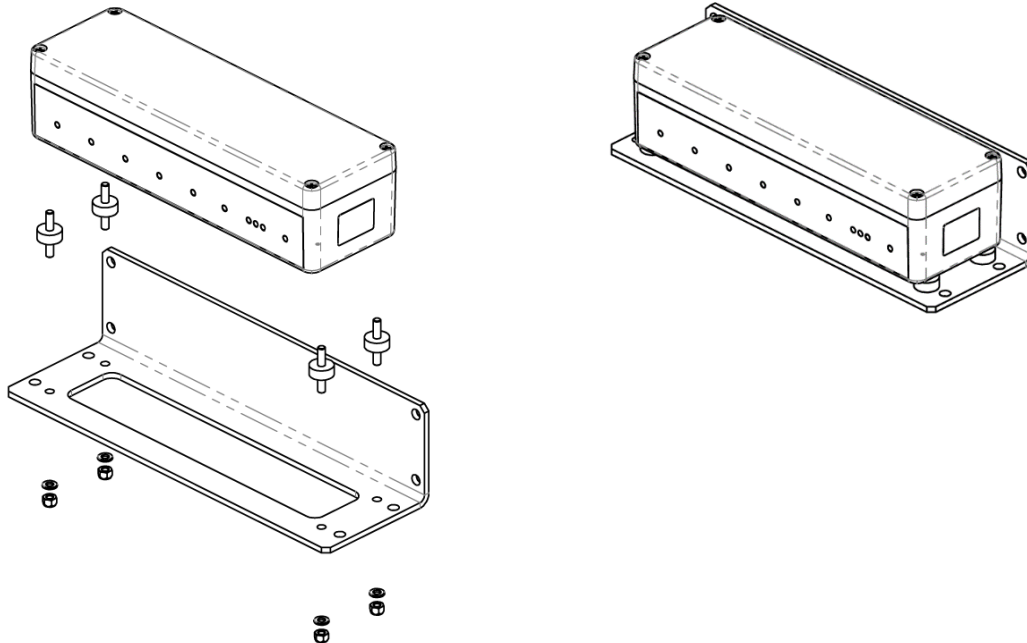
Exploded and installed views in correct orientation

Table 3 PDPU Interface and ports

LED label	LED & Port Description	Notes
SENSOR FL	Front left sensor	Power provided to the connected node. This is the default port for a single front Mobile Node.
SENSOR FR	Front right sensor	If required, power provided to the connected node
SENSOR RL	Rear left sensor	If required, power provided to the connected node. This is the default port for a single rear Mobile Node.
SENSOR RR	Rear right sensor power	If required, power provided to the connected node.
MIM	Machine Interface Module	If required, power provided to the connected MIM.
TTR	Through-the-Rock	Active but not used in the current configuration.
WD	Warning Device	Active but not used in the current configuration.
DISPLAY	Display device	Power is being provided to the In-Vehicle PC.
TAB	Tablet	Identifies that an In-Vehicle PC is connected as the display device.
POWER ON	PDPU power supply	The PDPU is powered on. There is no on/off switch.

4.4.1 Before you start

Before commencing installation, 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 General Safety on page ii.
- You have read and understood the Installation planning guidelines.
- 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.
- Vehicle is isolated, as per site operational and HSE procedures.
- All safety precautions are in line with Mine Operator policy for working on mobile machinery.
- All required hardware and cabling is available (PDPU kit on page 50).
- If operating in sub-zero temperatures, also see Cold weather operation on page 8.

Once all hardware is installed, please complete the Vehicle Installation Record on page 57 with a Minetec representative.

4.4.2   Installation – PDPU

If site-specific Work Instructions exist for any of the tasks described in this section, use those Work Instructions instead of these guidelines.

> ⭐ **Use site Work Instructions if available**.
> WIs are prescriptive, specific to Profile type and aligned to the Mine Operator HSE.

In addition to the guidelines in Location and mounting guidelines for all hardware on page 9, the following location guidelines are emphasised.

Consider the following:

- In a protected area, for example in the cabin or other enclosed area.
- Protected from damage by external structures or falling rocks
- Ensure:
    - Power cable can reach the vehicle power supply.
    - All unused ports are protected with blanking plugs filled with sealing plugs.
    - Where practicable, all used ports are shielded from dust and water ingress by using physical barriers/shields.
- Ensure the PDPU mounting location and orientation as follows:
    - Easily accessible to all other devices that need to connect to it.
    - Easily accessible for troubleshooting.
    - Mounted horizontally with the electrical connectors at the bottom.
    - PDPU enclosure is secure on the anti-vibration mounts and has no direct contact with the mounting bracket or vehicle. The aim is to minimise PDPU vibration.
    - The PDPU interface and connections are accessible for troubleshooting.

Guideline 1 Installing a Power Distribution and Protection Unit

For best performance and hardware integrity, follow these guidelines.
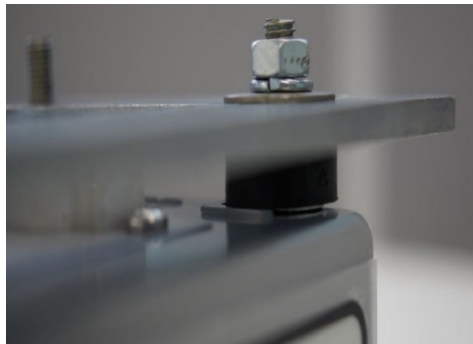
Step	Action/Response	Comments
1) Plan the installation.	Read, understand and if required action the appropriate guidelines.	Installation planning guidelines on page 6.

Perform the following steps to attach the supplied mounting bracket (Figure 7 90° PDPU Mounting bracket on page 16) using the vibration mounts.

> ⭐ For the anti-vibration mounts to perform as designed, under compression, mount the PDPU orientated as per Figure 5 PDPU User Interface on page 16. For other orientations, the anti-vibration mounts work under combined compression & shear loads with potentially reduced effectiveness.

Step	Action/Response	Comments
2) Identify the enclosure variant.	There are two variants of the PDPU casing. • **Variant 1**: If the casing has an 'L' shaped embossing as shown at the right, use, for example, a zinc-plated 3/16" or M5 flat washer as a spacer (not supplied) at all four locations. • **Variant 2**: If there is no 'L' shaped embossing, no spacing washer is required. *Variant 2 is the later build standard.*	
3) Install the anti-vibration mounts.	Screw the four mounts into the PDPU case (M6 studs). Hand tighten only. *The photo shows an older variant of the case using a spacing washer.*	
4) Attach the Mounting plate.	Slip the mounting bracket over the four studs of the anti-vibration mounts so that: • No part of the PDPU should be touching the mounting plate. • The PDPU interface to remain visible.	

Step	Action/Response	Comments
	Add a flat M6 washers to each of the four studs. *Photo shows flat washer and lock washer.*	
	Screw on and tighten the four M6 nuts (6 N m torque for nyloc nuts). Depending on the variant, use the supplied: • M6 nyloc nut & flat washer. • M6 nut, flat & lock washer.	
5) Install all cabling.	Protect all cabling using conduit and securely anchor using P-clamps and/or cable ties at suitable distances to minimise vibrational flexing and maximise bend radii.	Installation in sub-zero temperatures require more frequent anchoring to further reduce flexing due to vehicle vibration.
6) Attach the mounting plate to the vehicle.	Attach the mounting plate directly to the vehicle. *Ensure PDPU is horizontal, connectors down and LEDs visible for troubleshooting.*	Ensure all fasteners are secure and that no part of the PDPU is in direct contact with the vehicle. Fasteners are not supplied.
7) Isolate power supply.	Follow on-site operational and HSE practises to isolate the vehicle power supply.	If not already done so.
8) Connect PDPU cable.	Connect the PDPU to the vehicle 12 Vdc or 24 Vdc power supply.	Using the supplied PDPU power cable (part No. M1010692) or twin core 4mm cable.
9) Check fusing and earthing.	Ensure the following: • Suitable power protection and fusing is installed. • All negative terminations are made to the chassis earth.	Depending on-site practices, the power cabling is terminated with a waterproof inline fuse to **either**; • Main terminal on the positive (red) side of the battery, **or**; • After the isolator.

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STOP WORKING IN THE DARK

Step	Action/Response	Comments
10) Terminate device cabling	Terminate cabling installed for each device according to site practices. DO NOT CONNECT THE DEVICES TO THE PDPU	PDPU kit provides spare 8-pin Deutsch plugs to terminate device power cables.
11) Check cables.	Check all connections, cables and anchor points.	Perform these steps before restoring power.
12) Clean work area.	Remove all tools, materials and clean the work area.	
13) De-isolate power supply.	Follow on-site operational and HSE practises to de-isolate the vehicle battery.	
14) Perform power-on check and complete the commissioning checklist.	• Check POWER ON is on. • Fault find any power supply issues without any devices connected to the PDPU.	Use and complete the Vehicle Installation Record on page 57. If POWER ON is off, refer to the section *Troubleshooting - PDPU* section of the Vehicle Hardware Maintenance Guide. Note that the DISPLAY port should also show the TAB (Tablet) LED.
15) Connect and check devices progressively.	• Connect **one** device to the appropriate port. • Check the device is powered and fault find if required. Repeat the above for each device.	Per Figure 3 PDPU Sample wiring schematic on page 13, use the ports according to the node configuration for the Profile type and note that by convention: • **Single node** uses front left port. • **Two nodes** use front and rear left ports.
	Installation of the device is complete. Refer to the appropriate configuration manuals to configure the devices.	

4.5   DC-to-DC converter

If converters are used, each site is responsible for sourcing their own converters.

If not using the Minetec PDPU, a 24 Vdc to 12 Vdc converter can be used to provide a clean power source and protect installed devices from fluctuations in the vehicle power supply.

The procedure to install Minetec devices being powered by DC-DC converters follows the same general steps as in Guideline 1 Installing a Power Distribution and Protection Unit on page 18 with the following additional considerations:

- Check suitability of the technical specifications in the vendor's data sheets. The DC power feed to Minetec devices should be reliable, stable, and free of voltage spikes, voltage or current drops, induced noise. Although the devices can tolerate some power inconsistencies, a decent DC filter is the best option.
- Refer to the vendor's manuals for hints and tips on locations and other considerations.
- Follow the vendor instructions to mount the DC-DC converter.
- An additional (optional) Transient Voltage Suppression (TVS) diode can be connected across the input of the converter to protect against voltage transients induced by inductive load switching. The power harness and node harnesses are connected to the converter therefore cable routing and ease of access for installation and troubleshooting should be considered when selecting an appropriate mounting location.

> ⚠️ Irrespective of the vendor's instructions, safety precautions and general precautions in this document take precedence. Contact Minetec if in doubt.

4.6   Mobile Nodes

Mobile Nodes communicate with other wireless devices such as Personal Nodes, other Mobile Nodes and, if TRAX is installed, tracking infrastructure such as Wi-Fi WASP Bridges, Mesh Gates or Wi-Fi WASP Access Points. For best communications, Mobile Nodes are positioned on a vehicle to optimise radiation pattern of transmitted energy and minimise electromagnetic noise. At the same time Mobile Nodes must be mechanically protected.

Mobile Node – Photos	
Figure 9 Mobile Node status LEDS	**Figure 10 Mobile Node connector**
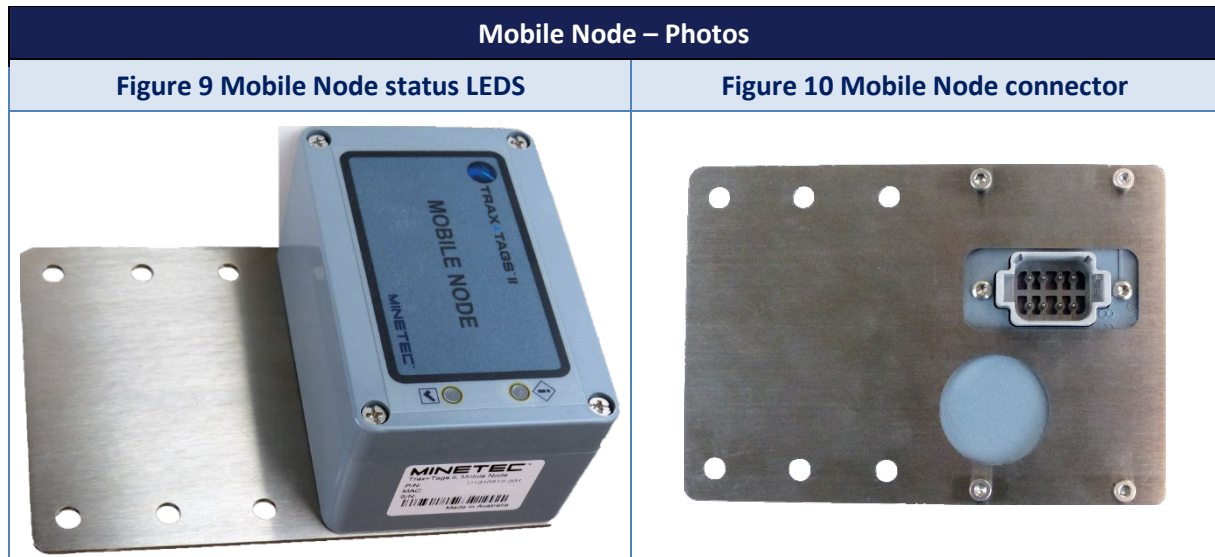
Mobile Nodes have two LED status indicators and depending on the product variant, are labelled with either the text or icons shown below.

Table 4 Mobile Node icons

Icon variant	Text variant
ⓘ	Status 1

Icon variant	Text variant
✔	Status 2
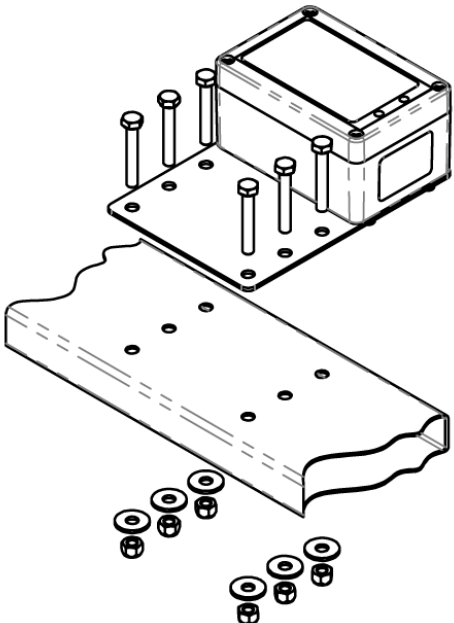
→ For installation and troubleshooting purposes, the labelling is unimportant.
If both LEDs are solid green when the mobile node is in range of another node, the
Mobile Node is functioning correctly.

Recommended placement for one and two Mobile Nodes are shown in Figure 1 Typical LV hardware (not to scale) and Figure 2 Typical HV hardware (not to scale), respectively. A diagrammatic explanation of best practice for mounting Mobile Nodes is shown in Dual Mobile Nodes on page 49.

Figure 14 Mobile Node example on page 24 shows a Mobile Node installed with a standard flat bracket.

Mobile Node – Mounting orientation	
Figure 11 Mobile Node top view	**Figure 12 Mobile Node bottom view**
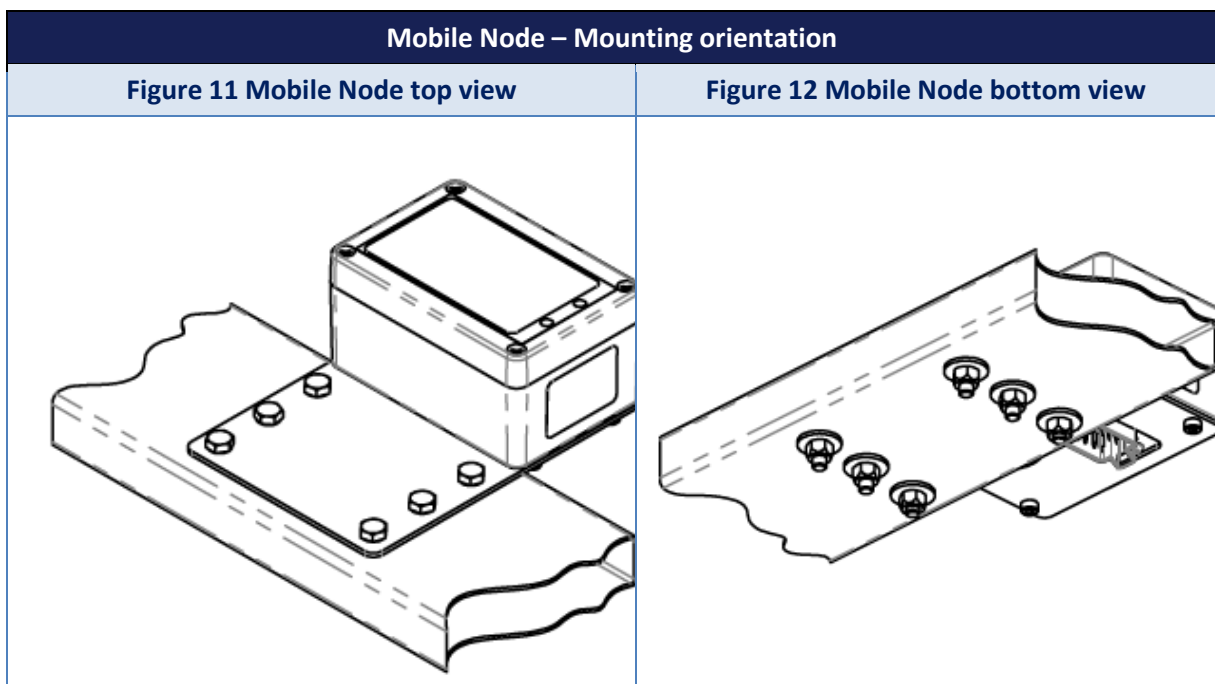
Mobile Node mounting technique	
Figure 13 Six-point mounting	Figure 14 Mobile Node example
	  Note that the four-point mounting in this example is suitable for temperate climates. Cold weather testing performed with 6-point mounting.

4.6.1   Before you start

Before commencing installation, 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 General Safety on page ii.
- You have read and understood the Installation planning guidelines.
- 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.
- Vehicle is isolated, as per site operational and HSE procedures.
- All safety precautions are in line with Mine Operator policy for working on mobile machinery.
- All required hardware and cabling is available (Mobile Node Kit on page 50).
- If operating in sub-zero temperatures, also see Cold weather operation on page 8.

For Mobile Nodes, also consider the following:
- Install with faceplate and LEDs facing up.
- Avoid metal structures within 500 mm above or to the side of nodes.
- Refer to Dual Mobile Nodes on page 49 for a diagrammatic explanation of best practice for mounting Mobile Nodes.
- For two nodes on an HV, both nodes should be:
  o   As close as possible to the vehicle centre line.
  o   The same height above the ground.

- Do not mount a Mobile Node outside the Falling Object Protection Structure (FOPS).
- Do not mount a Mobile Node on the Roll over Protection System (ROPS). If this is unavoidable, use existing holes or obtain permission from the relevant OEM representative or site safety representative.

> ➡️ Once all hardware is installed, please complete the Vehicle Installation Record on page 57 with a Minetec representative.

4.6.2   Installation – Mobile Node

If site-specific Work Instructions exist for any of the tasks described in this section, use those Work Instructions instead of these guidelines.

> ⭐ **Use site Work Instructions if available**.
> WIs are prescriptive, specific to Profile type and aligned to the Mine Operator HSE.

Mobile Nodes should be located in alignment as near to the centre line of the vehicle as possible, with no metal structures above to ensure a clear Wi-Fi signal path. When installation location cannot be aligned along the centre line of the vehicle, the Mobile Nodes should be aligned as closely as possible along the length of the vehicle, i.e. left side or right side, avoid opposing corners.

Select a location on the vehicle where the Mobile Node will be level and protected from damage by falling rocks, accidental contact with tunnel walls and external equipment such as ventilation curtains, cables or hoses.

Although there will always be vibration associated with the operation of mining equipment the Mobile Node should be positioned such that it's effects are minimised. In addition to the guidelines in Location and mounting guidelines for all hardware on page 9, the following location guidelines are emphasised.

The location on the vehicle should be selected according to the following criteria:
- Clear line-of-sight to reference nodes.
- Protected from damage by external structures or falling rocks.
- Rigid and Secure (i.e. not attached to a moveable part of the vehicle, this includes unsecured doors or hatches).
- Low vibration.
- Not subject to excessive heat (i.e. avoid engines, exhausts, etc.).
- Ease of access.
- As close to the centre line of the machine as possible.
- Minimum separation of 3 m between two Mobile Nodes positioned on a single vehicle, greater separation is desirable if possible.

> ✳️ For Heavy Vehicle using serial communication between the rear node and the In-Vehicle PC:
> - Use M1010528-015 Serial and Power cable.
> - Connect to the **Sensor RL** port of the PDPU. Refer separate *PDPU Assembly Guide.* Refer to Serial Communications on page 15.

Guideline 2 Installing a Mobile Node

For best performance and hardware integrity, follow these guidelines.

Step	Action/Response	Comments
1) Plan the installation.	Read, understand and if required action the appropriate guidelines.	Installation planning guidelines on page 6.
2) Confirm electrical needs.	• A clean 12 Vdc or 24 Vdc power source is available. • Suitable power protection and fusing is installed. • All negative terminations to be chassis earth.	Power supply is either a PDPU or other clean power source. The power cabling is to be terminated with an inline waterproof fuse to **either** the main terminal on the main +ve (red) side of the battery **or** after the isolator, depending on-site practices.
3) Install the cable.	Install the cable to ensure sufficient cable length.	Protect all cabling using conduit and secure using P-clamps or cable ties. If fixing to ROPS/FOPS use adhesive based cable tie mounts, superglue, silicone or similar.
4) Mount the device to the bracket(s).	If using a non-standard bracket, then mount the device to the bracket.	The device is delivered pre-mounted to a standard flat bracket as seen in Figure 10 Mobile Node connector on page 22.
5) Isolate power supply.	Follow on-site operational and HSE practises to isolate the vehicle power supply.	If not already done so.
6) Attach the device to the vehicle.	Install the device ensuring clear line-of-sight to tracking infrastructure wireless devices. Refer Dual Mobile Nodes on page 49.	A minimum separation of 2 m is recommended for two Mobile Nodes. Greater separation is desirable if possible.
7) Connect cabling to the device using technique appropriate to power supply	**PDPU connection:** • Use power cable (M1010527), **or** power and serial cable (M1010528), to connect the 8-pin Deutsch plug to the socket on the device. • Terminate the remote end of the cable with the supplied (in PDPU kit) 8-pin Deutsch plug.	Refer to Serial Communications on page 15. Use this option for powering the device from a PDPU. For the front Mobile Node, connect to the first (Sensor FL) port on the PDPU. For the rear Mobile Node, connect to the third port (Sensor RL).

Step	Action/Response	Comments
	DC-DC Converter connection: • Use power cable (M1010527), **or** power and serial cable (M1010528), to connect the 8-pin Deutsch plug to the device. • Terminate the open cable end, per vendor instructions used, and connect the cable.	Use this option for powering the device from DC-DC Converter or existing vehicle power source.
8) Check connections.	Check all connections, cables and anchor points.	Perform these steps before restoring power.
9) Clean work area.	Remove all tools, materials and clean the work area.	
10) De-isolate power supply.	Follow on-site operational and HSE practises to de-isolate the vehicle battery.	
11) Perform power-on check and complete the commissioning checklist.	Check the Mobile Node LEDs follow the power-on sequence described in Table 5 Mobile Node LED Status on page 28. For TRAX installations, the vehicle must be in the coverage area of tracking infrastructure wireless devices or at a dedicated testing installation.	Use and complete the Vehicle Installation Record on page 57. If either or both LEDS are not solid green, refer to the section *Troubleshooting - Mobile Nodes* of the *Vehicle Hardware Maintenance Guide*.
Installation of the device is complete. Refer to the appropriate configuration manuals to configure the devices.		

Table 5 Mobile Node LED Status

LED	LED Status (approx. times)	Reason
Status 1	Flash 5 times a second	Boot up sequence
	Short flash twice a second	Retrieving version information
	Short flash once every 2 seconds	Synced
	Solid LED	**Healthy**
Status 2	Flash 4 times a second	Upgrading firmware
	Flash once every 1.5 - 2 seconds	Boot up sequence
	Flash once a second	Retrieving version information
	Short flash twice/second. 0.1s ON, 0.4s OFF	Sync attempt
	Solid LED	**Healthy**

4.7   In-Vehicle PC

All variants of the In-Vehicle PC (IVPC) shown in Figure 15 In-Vehicle PC front view below are pre-loaded with Minetec software and configured for the deployment of Minetec solutions. The IVPC is permanently mounted in a vehicle and connected to the vehicle's DC power. IVPCs are used for TRAX, SafeDetect and SMARTS systems and are upgradable over-the-air after installation.

Figure 15 In-Vehicle PC front view

The Minetec In-Vehicle PC is pre-configured for use with Minetec software. The buttons used are:
- Power (red/green backlit).
- PC volume (orange backlit).
- Screen brightness (orange backlit).

Figure 16 In-Vehicle PC buttons

Figure 17 Dual wireless card IVPC - rear view

wlan1 - proprietary 2.4 GHz mesh wireless (Reverse polarity SMA)

wlan0 - standard 2.4 GHz client-server Wi-Fi (Reverse polarity SMA)

QC1 Power IO

QC2 Serial RS232

QC3 CAN bus - future

QC4 LAN USB

VESA mount holes

2x USB not used
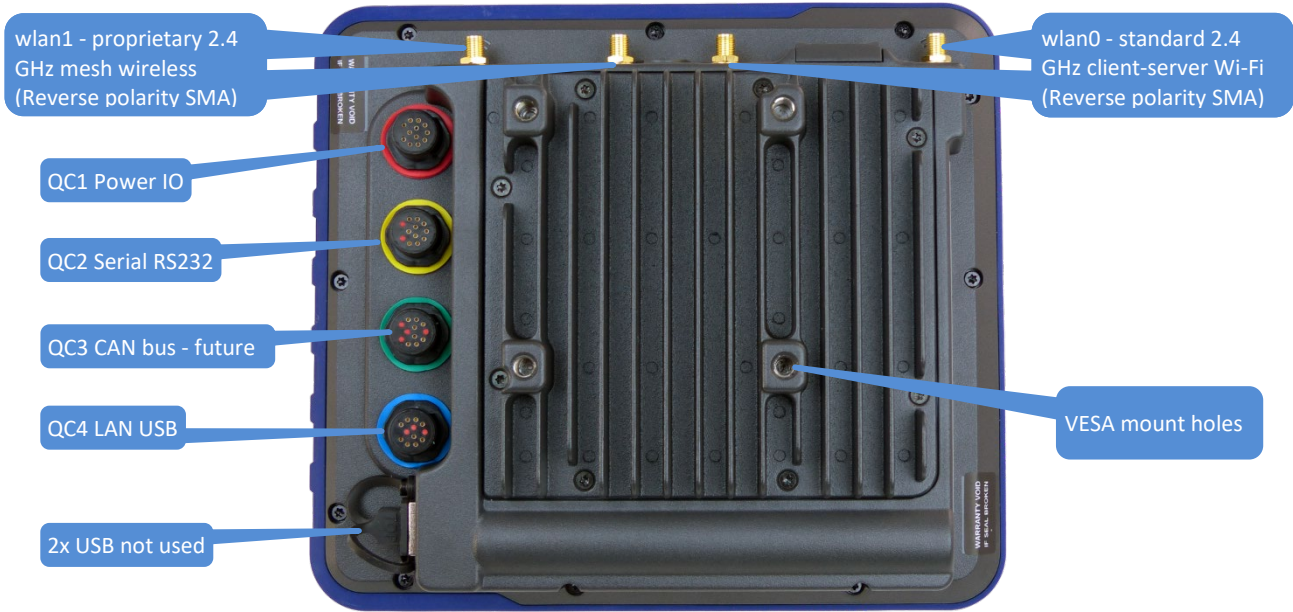
The mounting options for an In-Vehicle PC are:
- Bolted VESA standard RAM mounting bracket.
- Custom made bracket fabricated by a boilermaker on-site.

In-Vehicle PC Views and Mounting options		
Figure 18 RAM VESA standard RAM mounting bracket	**Figure 19 Industrial Evolution VESA standard bench mount**	**Figure 20 Custom bracket - VESA mounting holes**

4.7.1   Before you start

⚠️ Before commencing installation, 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 General Safety on page ii.
- You have read and understood the Installation planning guidelines.
- 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.
- Vehicle is isolated, as per site operational and HSE procedures.
- All safety precautions are in line with Mine Operator policy for working on mobile machinery.
- All required hardware and cabling is available (In-Vehicle PC Kit on page 51).
- If operating in sub-zero temperatures, also see Cold weather operation on page 8.

For In-Vehicle PCs, also consider the following:

- The In-Vehicle PC has line-of-sight to on-board Mobile Node(s).
- The Wi-Fi antenna has sufficient spacing (~100 mm) from metal surfaces.

⚠️ Do not store any items behind the In Vehicle PC as the action of placing or retrieving those items may result in damage to the In Vehicle PC antennas.

- The Vehicle Operator, in the regular operating position:
  o   Has an easy view of the IVPC, and;
  o   Doesn't have his/her vision obstructed by the IVPC.
  o   Has an easy reach to operate (eg to mute the device) when vehicle is stationary.

- When installing the PC in **closed cabin vehicles**, mount it to either the dashboard of the vehicle or to the radio mounting bay using custom or standard mounts such as VESA mounts.

- Although the IVPC is IP66 rated, when installing in **open cabin vehicles** which may be exposed to high-pressure jets or shotcrete, it is still recommended that additional protection such as an IP66 rated enclosure is used. Damage from ultra-high-pressure water or shotcrete may not covered by the Minetec warranty.

- Prior to cabling and powering the IVPC, note the following:
  o   If used, the PDPU has been installed according to the procedure provided in this document or an appropriate alternative clean power source has been identified and approved and;
  o   Suitable power protection and fusing is installed. The power cabling is to be terminated with a waterproof inline fuse to **either** the main terminal on the main positive 24 Vdc (red) side of the battery **or** after the isolator, depending on-site practices.
  o   All negative terminations are made to the chassis earth.

- Consider the current draw of the unit as this varies depending on whether the device is on battery power or is being charged from vehicle power.

➡️ Once all hardware is installed, please complete the Vehicle Installation Record on page 57 with a Minetec representative.

4.7.2   Installation – In-Vehicle PC

If site-specific Work Instructions exist for any of the tasks described in this section, use those Work Instructions instead of these guidelines.

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

	If drilling into the vehicle console, be aware of the specific location of vehicle wiring and safety systems (eg air bags).

In addition to the guidelines in Location and mounting guidelines for all hardware on page 9, the following location guidelines are emphasised.

Consider the below when locating and installing the VPC:
- Easy access from the regular operating position.
- Line-of-sight from the device to the Mobile Node.
- Installation location does not obstruct the driver's vision.
- Installation does not cause damage to the vehicle from the weight of the device and does not impede or affect safety devices such as air bags, emergency stop button, ROPS, FOPS, etc.

	For Heavy Vehicle Mobile Nodes using serial communication between the rear node and the In-Vehicle PC, the M1010589 Power Distribution and Protection Unit must be used to provide power to the Mobile Node and In-Vehicle PC. Refer to Serial Communications on page 15.

Guideline 3 Installing an In-Vehicle PC

For best performance and hardware integrity, follow these guidelines.

Step		Action/Response	Comments
1)	Plan the installation.	Read, understand and if required action the appropriate guidelines.	Installation planning guidelines on page 6.
2)	Confirm electrical needs.	• A clean 12 Vdc or 24 Vdc power source is available. • Suitable power protection and fusing is installed. • All negative terminations to be chassis earth. • Consider the current draw of the unit as this varies depending on whether the device is using battery power (2A) or whether the device battery is being charged from vehicle power (5A).	Power supply is either a PDPU or other clean power source. The power cabling is to be terminated with an inline waterproof fuse to **either** the main terminal on the main +ve (red) side of the battery **or** after the isolator, depending on-site practices.
3)	Isolate power supply.	Follow on-site operational and HSE practises to isolate the vehicle power supply.	If not already done so.

Step	Action/Response	Comments
4) Install the cable.	Install the cable to ensure sufficient cable length. Do not make any connections.	Protect all cabling using conduit and secure using P-clamps or cable ties. For further detail, refer to the Heavy Vehicle or Light Vehicle wiring schematics in Appendix 3.3.1 on page 9
5) Mount the IVPC.	Install the IVPC onto a suitable mounting bracket and then onto the vehicle. Ensure all bolts are securely fastened and all cabling is secured using suitable fasteners such as P-clamps along the whole cable run.	For example, the M1011139 Bench Mount with standard VESA Plate, VPC IE. See Figure 19 Industrial Evolution VESA standard bench mount on page 29.
6) Connect cabling to the device using technique appropriate to power supply.	**PDPU connection:** • Using the supplied 3 m Power + Serial cable (M1010747), connect the two Deutsch Quick Connectors (Red & Yellow) to the respective ports on the rear of the In-Vehicle PC. • Connect the other end (8-pin standard Deutsch connector) to the Display port on the PDPU.	Use this option for powering the device from a PDPU. Also refer to Serial Communications on page 15.
	DC-DC Converter connection: • Using the supplied 3 m power + serial cable (M1010747), connect the two Deutsch Quick Connectors (Red & Yellow) to the respective ports on the rear of the In-Vehicle PC. • Connect the supplied 3 m power breakout cable (M1010749) female 8-pin Deutsch connector to the male 8-pin Deutsch connector on the Power + Serial cable installed above. • Connect the unterminated end of the power breakout cable to the alternative clean power source on the vehicle.	Use this option for powering the device from a DC-DC Converter or existing on-board power source.
7) Check connections.	Check all connections, cables and anchor points.	Perform these steps before restoring power.
8) Clean work area.	Remove all tools, materials and clean the work area.	
9) De-isolate power supply.	Follow on-site operational and HSE practises to de-isolate the vehicle battery.	

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Step	Action/Response	Comments
10) Perform power-on check and complete the commissioning checklist.	• Check the In-Vehicle PC automatically turns on within 40 seconds of vehicle power being turned on. • The power button LED is solid green. • Check that the display turns on and the relevant Minetec software starts up.	Use and complete the Vehicle Installation Record on page 57. If the power LED is not solid green, refer to the section *Troubleshooting – In-Vehicle PC* of the *Vehicle Hardware Maintenance Guide.*

<div align="center">

Installation of the device is complete.
Refer to the appropriate configuration manuals to configure the devices.

</div>

5   SYSTEM PRE-START CHECKS

Following installation and physical/continuity checking of the vehicle hardware it is commissioned as a system following the on-site commissioning strategy. To do this the In-Vehicle PC must also have the appropriate version of the software pre-loaded and all wireless devices have been configured using, for example, MineOffice.

→	A vehicle cannot be commissioned unless all wireless devices are pre-configured.

Use the guidelines in this section to determine if the vehicle hardware are functioning as expected. Use this guideline to create procedures for:

- Commissioning a new system.
- Checking a system after maintenance.
- Operational prestart checklist.
- If site-specific commissioning procedures exist for any of the tasks described in this section, use those procedures instead of these guidelines.

★	**Use site procedures if available**. WIs are prescriptive, specific to Profile type and aligned to the Mine Operator HSE.

Follow these guidelines before using a vehicle to ensure it is:

- Visible to other vehicles and Personal Nodes if using SafeDetect.
- Can be located if using TRAX Tagboard.
- Can be tracked if using TRAX MineView.

Incorporate these guidelines into one or more of the following:

- Commissioning procedures.
- Commissioning checklists.
- Prestart checklists.

★	Pre-start checks are required for commissioning and are also used in daily operations to check the system is functioning.

Depending on the site commissioning strategy, HSE and operational procedures and policy the following documents would be the minimum requirements to commission a Minetec system in a vehicle:

1) Site commissioning procedures.
2) Site commissioning checklists and test records.

5.1   Before you start

⚠	Before commencing commissioning, 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 installed. - Electrical isolation using site 'lock out tag out' system has been removed. - Appropriate PPE.

Before commencing commissioning, ensure that:

- All relevant onsite permissions and permits to work have been obtained.

- Vehicle is de-isolated, as per site operational and HSE procedures.
- All safety precautions are in line with Mine Operator policy for working on mobile machinery.
- All software has been installed. This is done prior to vehicle installation.
- All devices are configured. This is done prior to vehicle installation.
- You have access to a fully charge Personal Node.
- You have access to a display station (eg in the Cap Lamp Room, Portal or other local station). The display station contains a stationary installation of the hardware and software to be used to for functional checks of Personal Nodes and/or vehicles within range.

Guideline 4 Personal Node prestart check

After performing maintenance on Minetec vehicle hardware, the hardware should be checked that it can detect a functioning Personal Node by alarming in *SafeDetect* or visually tracking in *Trax*. Follow this guideline to confirm the Personal Node is functioning in *SafeDetect* and/or *Trax*.

Incorporate these guidelines into the site operating personnel prestart checklist. Use this guideline to determine if your Personal Node is functioning as expected.

⚠️ **Do not assume that all vehicles can 'see' you on an In-Vehicle PC.**
For example, vehicles operating in simplex mode do not have an In-Vehicle PC.

Step	Action/Response	Comments
1) Obtain a Personal Node.	Remove a Personal Node from the dock by selecting a device with a solid green LED.	Located, for example in the Cap Lamp Room.
2) Check the Personal Node is working.	Confirm the start-up sequence. If the pattern is incorrect, refer to *Personal Node troubleshooting* in the Personal Node User Manual.	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 *Status* LED starts to flash green (once every 2 seconds) indicating the device is ready to use.
3) Place node on you belt or harness.	Attach the Personal Node by passing one side of your belt through the metal bracket the back of the unit.	The Personal Node is ready for hazard detection (i.e. to detect, and be detected by, vehicles)

Step	Action/Response	Comments
4) Check visibility of Personal Node in *SafeDetect* and/or *Trax*.	Check that the Personal Node ID displays on the display station: • For *SafeDetect*, check that the Personal Node alarms and shows the STOP zone for the display station. • For Trax, your Personal Node ID displays on Tagboard (zone) or MineView (map). *Available tests may vary between sites depending on availability of display stations and/or nearby vehicles.*	If a vehicle is nearby: • Ask the Operator if they can see your Personal Node on their In-Vehicle PC (Trax or *SafeDetect*). • Check that the Personal Node alarm annunciates and shows the correct zone for the nearby vehicle (*SafeDetect* only).

Guideline 5 Vehicle prestart check

Follow this guideline after performing maintenance on Minetec vehicle hardware to ensure it is visible to other vehicles and personnel using *SafeDetect* and/or *Trax*. Incorporate these guidelines into the vehicle prestart checklist.

> * This guideline assumes the vehicle is fitted with an In Vehicle PC.

Use this guideline to determine if your vehicle hardware is functioning as expected. Use these guidelines to create procedures for:

• Checking a system after maintenance.
• Operational prestart checklist.

> ⚠ **Do not assume that all vehicles can 'see' you on an In-Vehicle PC.**
> For example, vehicles operating in simplex mode do not have an In-Vehicle PC.

Step	Action/Response	Comments
	For SafeDetect and/or Trax	
1) Obtain your Personal Node.	Perform Guideline 4 Personal Node prestart check on page 35.	Proceed with the following steps if the Personal Node is OK.
2) Start the vehicle.	Start the vehicle according to site HSE and operational procedures.	Includes all vehicle pre-start checks.
3) Confirm In-Vehicle PC start-up.	Confirm the following on the IVPC: 1) The graphical display starts automatically. 2) *SafeDetect*/*Trax* starts automatically within about 40 seconds of the device start. 3) In *SafeDetect*, tap the vehicle icon at the centre of the diagram to display the *Driver Identification* screen.	If the device does not start automatically then start the device manually with a single long press of the power button. The device is on when you can see the power LED and the screen is illuminated.

Step	Action/Response	Comments
	For *SafeDetect* only	
4) Confirm Mobile Nodes are WORKING.	Check that vehicle node(s) are operational and status for each installed node is WORKING on the *Driver Identification* screen.	Node status (*SafeDetect*) is also reflected in the vehicle icon indicated by a green dot for each of the front and rear nodes (only if two nodes installed).
5) Confirm system is WORKING.	Check the following: • System status value is WORKING in the *Driver Identification* screen. • No fault messages display on the main screen.	⚠ If a fault detected, contact your Supervisor.
6) Confirm alarms.	Confirm that the: • Personal Node and the In-Vehicle PC both sound an alarm. • In-Vehicle PC screen displays the Personal Node ID in the STOP zone.	
7) Place the Personal Node in IVD mode.	Press the Personal Node button twice within two seconds and confirm that the *Status* LED illuminates solid green.	The Personal Node alarm is muted.
8) Confirm the In-Vehicle PC recognises IVD mode.	On the In-Vehicle PC, confirm that the Personal Node ID is: • Added to the IVD list on the Driver ID screen. • Removed from the detection zone panel and event list. • The audible alarm mutes.	
	For SafeDetect* and/or *Trax	
9) Check visibility of vehicle in *SafeDetect* and/or *Trax*.	For *SafeDetect* /*Trax*, check your vehicle displays on the display station: • Check you can see your vehicle on a display station (eg at the portal or other local display stations). • Check you can see the display station on your In-Vehicle PC. *Available tests may vary between sites depending on availability of display stations and/or nearby vehicles.*	If a vehicle is nearby: • Ask the Operator if they can see your vehicle on their In-Vehicle PC (Trax or *SafeDetect*). • Check that the vehicle alarm annunciates and shows the correct zone for a nearby vehicle (*SafeDetect* only).

⚠ **Do not assume that all vehicles can 'see' you on an In-Vehicle PC.**
For example, vehicles operating in simplex mode do not have an In-Vehicle PC.

6   TROUBLESHOOTING

If the troubleshooting procedures in this section do not help resolve an issue, contact Minetec.

Contents

> ⚠️ If unsure about any troubleshooting steps, contact Minetec Support for advice or assistance

6.1   Troubleshooting - PDPU

The troubleshooting steps below cover the physical installation and power connections of the PDPU. Data communication protocols are beyond the scope of this manual.

⚠	Warranty is void if unit is opened

If the troubleshooting steps in the following table do not fix the problem, then contact Minetec via the RMA Procedure on page 47.

Check for	Test	Action for failed test
1) Physical damage.	Visually inspect the device for obvious physical damage and ensure that it appears to be in good physical order.	Contact your Supervisor to obtain a replacement.
2) Environmental problems.	• Grit, dirt or water in connections? • Is the device covered in dirt?	Clean and dry the device and restart.
3) Connectors	• Check all connections are secure and clean. • Check connectors are in the correct port.	Connect connectors to the correct ports. Clean dirty connections.
4) Power supply.	POWER ON LED	If off, then no power to PDPU: • Check cable continuity. • If still not working, check the vehicle battery. • Change the cable/connectors if needed.
5) Mobile Node(s) connected.	Check each attached device power LED (eg SENSOR FL).	If off, then no power supplied to device: • Plug into another port and check power indications.
6) A display device is connected.	DISPLAY LED	If none, then no power to display device. See actions below.
7) Display device identified.	The TAB LED should be illuminated (TAB = Tablet ie IVPC).	No data communication to/from device: • Check the cable is connected to Display port on PDPU. • Change cable first and test again. If still not working, change PDPU unit.

6.2   Troubleshooting - Mobile Nodes

For a TRAX installation, the vehicle must be in the coverage area of the tracking infrastructure wireless devices or at a dedicated testing installation.

For a vehicle power-on check, check the status of indicator LEDs described in Table 5 Mobile Node LED Status on page 28 to check if the device is functioning correctly. If the Mobile Node is not display a healthy state, then perform the following hard power reset.

6.2.1   Hard power reset

Note that Mobile Nodes have two LED status indicators and depending on the product variant, is labelled with either the icons or text shown below.

Icon variant	Text label variant
ⓘ	Status 1
✔	Status 2

A hard power reset is the simplest way to test a Mobile Node for correct functionality.

The hard power reset is done by removing the power to the Mobile Node for **at least 10 seconds**. This can be done by isolating and de-isolating the machine (thereby cutting power to the node).

6.2.2   Healthy Mobile Node

Depending on the proximity of other wireless ranging devices, for example a Wi-Fi WASP Bridge or another Mobile Node (either on the same or different vehicle), a power reset should result in one of the following LED sequences.

- If the Mobile Node is **in range** of a wireless ranging device then both status LEDs should remain solid after a reset. In this situation the hard reset results in the following:
  - Status 1 LED flashes for ~5 seconds and then remains constantly on (solid).
  - Status 2 LED flashes for ~5 seconds and then remains constantly on (solid).
  - Approximately 10 seconds after a reset, both LEDs should be solid.

- If the Mobile Node is **out-of-range** of all other wireless ranging devices then the node automatically resets after approximately 30-40 seconds the above process starts again, this is also a healthy state for an out-of-range Mobile Node.

If there are two Mobile Nodes on a vehicle then the LEDs should remain solid all the time because they can establish communication between one another. This is a useful test configuration if, say, no tracking infrastructure (TRAX only) wireless devices are available.

Once Mobile Node is installed and established to be healthy it can communicate with other wireless ranging devices. Data communications (syncing) with other nodes or tracking infrastructure wireless devices is indicated by flashing Status 2 (✔) LED. Refer to Table 5 Mobile Node LED Status on page 28.

6.2.3   Unhealthy Mobile Node

A Mobile Node may potentially have a problem if it cannot reach either of the two healthy states described in Healthy Mobile Node on page 40. Any of the following sequences, following a hard power reset, indicate a potential problem with the Mobile Node:

- Both status LEDs continue to flash for longer than about 60 seconds.
- Either or both LEDs go solid immediately.
- Either or both LEDs are continuously off (typically a power issue).

Refer to Table 5 Mobile Node LED Status on page 28 for details when troubleshooting and if the problem persists, contact Minetec via the RMA Procedure on page 47.

Check for	Test	Action for failed test
1) Physical damage.	Visually inspect the device for obvious physical damage and ensure that it appears to be in good physical order.	Contact your Supervisor to obtain a replacement.
2) Environmental problems.	• Is the device dry? • Is the device covered in dirt or dust?	Clean and dry the device and restart it.
3) Orientation.	• Is horizontally orientated? • Is 100 mm clear of metal surfaces? • Is at least 300 mm from another RF source.	Reinstall Mobile Node per guidelines.
4) Mobile Node health.	Both LEDs solid Green	Normal operations and working as expected
	Both LEDs are solid for about 30-40 seconds, then Status 1 ⓘ restarts and flash for 10-20 seconds and the process keeps repeating.	Probably was in range but currently out-of-range of other wireless ranging devices. Relocate vehicle into coverage area and re-test.
	Both LEDs flash continuously for > 60 s	Unable to connect; perhaps out-of-range of other wireless ranging devices. Relocate vehicle into coverage area and re-test.
	Both LEDs are solid green for 3 seconds then turn off and don't come back on	Internal power – Power fault. Replace device
	Both LEDs flashing: • Status 1 ⓘ every 0.5 s • Status 2 ✔ every 2 s	Disconnected – Cannot connect to the network. Relocate vehicle into coverage area and re-test.
	Either/both LEDs are continuously off.	• Check power supply continuity. • Internal power – Power fault. Replace device
5) Any other problem.	If a problem is not resolved after performing the above tests and actions.	Contact your Supervisor to obtain a replacement.

⚠ Warranty is void if unit is opened

6.3   Troubleshooting – In-Vehicle PC

This table only covers the installation and mounting of an In-Vehicle PC and does not address operations of these devices. Troubleshooting is limited to mounting and connection issues.

	Check for	Test	Action for failed test
1)	Physical damage	Visually inspect the device for obvious physical damage and ensure that it appears to be in good physical order.	Contact your Supervisor and obtain a replacement.
2)	Environmental problems	• Is the device dry? • Is the device covered in dirt or dust?	Clean and dry the device and restart it.
3)	IVPC health	Check the colour-coded IVPC buttons.	Refer to Table 6 IVPC Power LED indicator below for all fault messages.
4)	Boot cycle	Should start within 40 seconds.	Advise your Supervisor.
5)	Wiring damage	Check battery terminals and power connector.	• Clean and inspect battery terminals. • Dry off any excess moisture. • Clean out power connector of foreign objects.

Table 6 IVPC Power LED indicator

Power indicator LED	Other LEDS	Status
Off.	Off	IVPC power is off.
Green (default).	Red	IVPC power is on.
Flashing orange (once per second).	Red	Operating on battery power. Check power is being supplied to the device.
Red flash once, long wait, followed by orange flash twice. Turns solid green.	Off, followed by solid red	Battery is not charged, and the device has been connected to a power source. Leave to charge for at least 30 minutes before operating.
Rapid, continuous flashing red.	Off	Faulty device. Please contact Minetec for a replacement.

⚠️   Warranty is void if unit is opened

7 GLOSSARY

Term	Detail
°C	degree Celsius
A	ampere
Access Point	A Wi-Fi WASP™ Access Point provides standard Wi-Fi access to third-party devices and provides a bridge between standard Wi-Fi and WASP network operating in the 5.8 GHz band. Daisy-chained Access Points provide ranging data backhaul and communications over a serial Ethernet backbone.
Bridge	The Wi-Fi WASP Bridge calculates the distance between itself and each detectable Mobile Node or Personal Node with an accuracy of better than one metre using the WASP positioning system in the 5.8 GHz band. A bridge provides a 'wireless bridge' between the WASP proprietary mesh network and a standard 2.4 GHz Wi Fi system.
cm	centimetre
CSIRO	Commonwealth Scientific and Industrial Research Organisation, the Australian federal government scientific research agency.
DC-DC Converter	The DC-DC Converter is a power conditioner/converter steps down voltage on a heavy vehicle from 24 Vdc to 12 Vdc to power a device. The conditioner also stabilises the power supply to all connected devices thereby preventing spikes and surges which could otherwise damage the Minetec hardware.
Display device	Any device with a user interface (UI).For example: • In-Vehicle PC that has a graphic user interface (GUI). • Personal Node that has a simple LED UI.
Display station	A display station (or display point) contains a stationary installation of the hardware (Mobile Node and graphic display) and a (SafeDetect and/or Trax TagBoard or Trax MineView) to be used to for functional checks of Personal Nodes and/or vehicles within range. Display Stations are installed, for example, in the cap lamp room, mine portal or other on site locations.
ESD	Electrostatic Discharge
Event list	In SafeDetect, this is the list in the left-hand panel. It is a list of events (detected vehicles and pedestrians), sorted in descending priority (ie closest object at the top) with the list showing: • Node icon (optional, as set by the Administrator). • Node ID. • Node distance. • Alarm icon (optional, as set by the Administrator).
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.
FOPS	Falling Object Protection Structure or Falling Object Protection System
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.
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.
HV	Heavy Vehicle (eg earth mover)
ICT	Information and Communications Technology is an extended term for information technology (IT) and includes telecommunications.

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Term	Detail
In-Vehicle PC	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. 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. There are variants of the In-Vehicle PC depending on the system requirements at your site. For example, a CAN bus interface.
IP	The Ingress Protection rating according to AS/NZS 60529, consists of the letters 'IP' followed by two digits and an optional letter. It classifies the degrees of protection provided against the intrusion of solid objects, dust, accidental contact, and water in electrical enclosures.
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 inside a vehicle as either the Vehicle Operator or a passenger. See the Personal Node User Manual for details.
IVPC	See entry for In-Vehicle PC.
LED	Light Emitting Diode
LV	Light Vehicle (eg utility)
m	metre
mA	milliamp
Mine	A surface or underground mine. Note that Minetec hardware products are suitable for hard-rock mines or surface mines. ⚠️ Minetec products are not suitable in mines with a combustible atmosphere.
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.
mm	millimetre
Mobile Node	The Minetec Mobile Node is a vehicle-mounted, low-power tracking[1] and proximity[2] 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.
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.
OEM	Original Equipment Manufacturer
PC	Personal Computer

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

[2] 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.

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Term	Detail
PDPU	The Power Distribution and Protection Unit is a vehicle-mounted device to distribute power to other Minetec devices in a vehicle. It also connects Mobile Nodes to a display device, visible to a Vehicle Operator. A PDPU is strongly recommended in a system when two or more Mobile Nodes are installed. Formerly known as the SIU (Sensor/System Integration Unit)
Personal Node	The Minetec Personal Node is a battery-powered tracking[3] and proximity detection[4] device, worn by personnel. Personal Nodes are preconfigured for use in Minetec TRAX and/or Minetec SafeDetect to 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: • 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.
Profile type	Profile types identify a group of similar Vehicles or Pedestrians and define parameters to install and configure Minetec devices within each profile type. Profile types and their parameters are defined in the Fleet Map document in the design stage. Different HV and LV profile types use a unique combination of make, model, factory modifications, site modifications etc. For example, a Toyota LandCruiser, single cab, RHD with installed ROPS, FOPS, two-way radio etc.
Reference Node	Minetec Reference Nodes are deprecated devices. They provided both a wireless communications network and fixed points of reference for Minetec's TRAX deployments.
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: • 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.
ROPS	Roll Over Protection Structure or Roll Over Protection System
s	second
Simplex	Simplex mode refers to vehicles that have a Mobile Node but no visual display. The vehicle can be seen and tracked by others but the operator cannot track or detect other vehicles or pedestrians. Also, see entry for Duplex.
Site Fleetmap	A Site Fleetmap is a document that details specific capabilities, features, and installation and configuration requirements related to each Profile type.
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.

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

[4] *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.*

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Term	Detail
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)
Tracking infrastructure	Tracking infrastructure comprises fixed wireless devices, ethernet cabling and/or fibre optic cabling to a Backhaul Cabinet. Wi-Fi WASP Bridges and Wi-Fi WASP Access Points are examples of fixed wireless devices.
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.
TVS	Transient Voltage Suppression
V	volt
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 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). ✳ Vehicles without suitably configured Minetec equipment are not covered by the Minetec solution and are outside the scope of this document.
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 Device	The Warning Device is a low-cost vehicle-mounted numerical display device using LED readouts to display potential hazards in the SafeDetect™ solution. It provides the Vehicle Operator with an audible and visible warning of vehicular hazards and personnel within the vehicle's configurable warning zones. A maximum count of nine vehicles and nine personnel can be displayed. The Warning Device is a 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.
Wi-Fi	802.11 x 2.4 GHz wireless networking technology.
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.

8   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, either via 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 hrs) if airfreighting.

9   APPENDICES

Contents

9.1   Dual Mobile Nodes

Refer to the Fleet Map design document for the actual measurements as these may differ between sites depending on vehicle modifications. In Figure 21 Mobile Node placements below, the centre-to-centre distance between the two nodes is determined using:

$$D = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2 + (Z_2 - Z_1)^2}$$

Table 7 Mobile Node placement guide

Separation	Direction	Guide
Refer diagrams below.		Recommended
Axial	Longitudinal (X)	Close to ends of vehicle and maintain good RF path to each other and other vehicles.
	Vertical (Y)	No vertical separation, parallel to long axis. (Y_2 - Y_1 = 0)
	Transverse (Z)	No transverse separation, parallel to vertical axis and as close as possible to the vehicle centreline. (Z_2 - Z_1 = 0)
Absolute	Centre-to-Centre (D)	Minimum separation of 3 metres where D is calculated in above formula.

⚠ Placement outside of these guidelines may result in reduced ranging and/or graphical display inaccuracies.

Figure 21 Mobile Node placements

© Minetec 2019
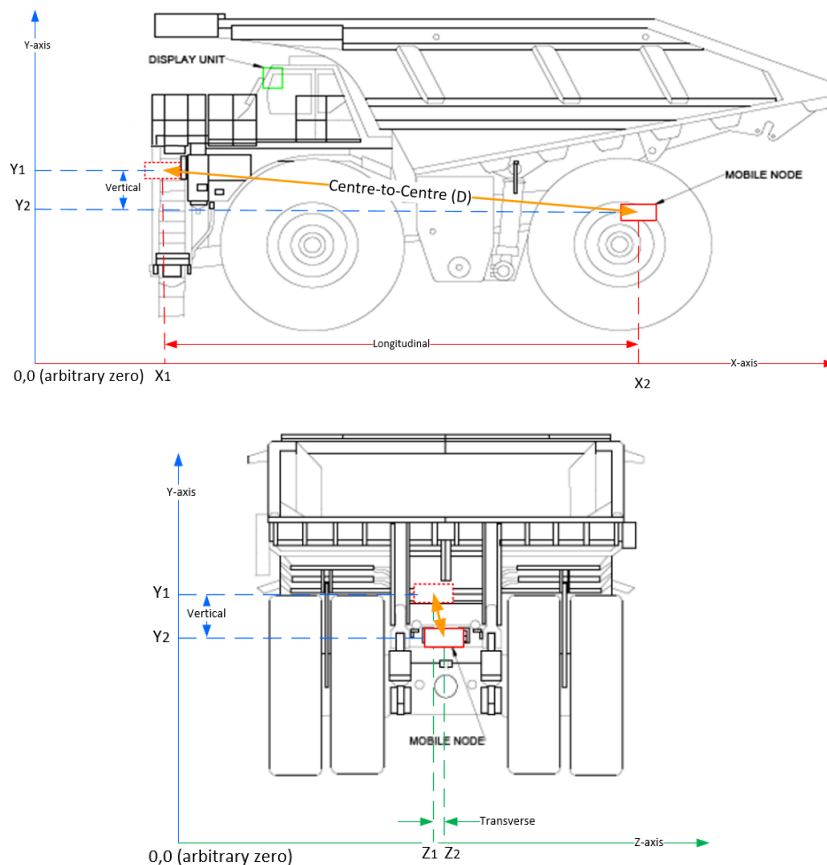
9.2   Hardware component parts

The hardware included in this guideline is supplied in the kits detailed in the following pages.

> ✳   Kit component parts are subject to change at any time.

9.2.1   PDPU kit

The Power Distribution and Protection Unit (PDPU) kit (M1010589) contains the following:
- 1 x PDPU device, M1010590, see Figure 5 PDPU User Interface and Figure 6 PDPU Connection sockets on page 16.
- 4 x Anti-vibration mounts, M1010860.
- Mounting bracket kit:
    - 1 x Angled mounting bracket, M1010813, see Figure 7 90° PDPU Mounting bracket on page 16.
    - 4 x nyloc Nut, M6, Zinc-plated, M1010873.
    - 4 x Washer, M6, Plain Flat, Zinc-plated, M1010820.

> Note that older kits may include M6 nut & lock washer instead of a nyloc nut.

- 1 x Power Cable assembly, M1010692, with 2-pin Deutsch plug and flylead.
- 1 x Deutsch connector kit, M1010806:
    - 3 x 8-pin Deutsch plugs with pins, sealing plugs and wedgelocks.
    - 3 x heat shrink.
- 4 x 8-pin blanking plugs, M101693.

9.2.2   Mobile Node Kit

The Mobile Node is supplied in a standard kit configuration (M1010512-001) which contains the following components:
- 1 x Mobile Node (M1010512-001).
- 1 x Standard flat mounting bracket (M1010487) - (already attached to Mobile Node).

Optional accessories:
- 1 x Cable, Power, 15m – (M1010527-015).
- 1 x Cable, Power and Serial RS232, 15m (M1010528-015).
- 1 x Cable, Power only cable (M1010527-015).
- 1 x Swivel Bracket, CAT Yellow (M1010738).

9.2.3   In-Vehicle PC Kit

The In-Vehicle PC is available in the following variants. The supplied kit is similar for all devices.

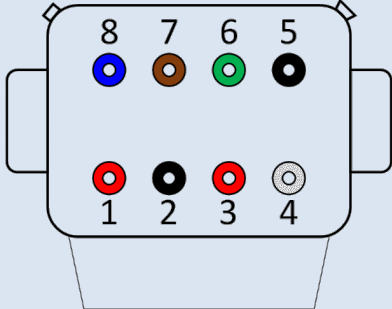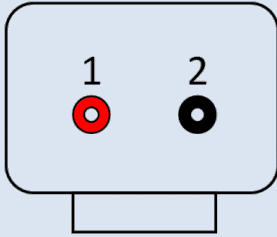| Part No	Kit	Typical Application	System	Technology
M1010733	250 nit IVPC with proprietary Wi-Fi card	Underground	SafeDetect™ only	Wireless + WASP
M1011044	1600 nit IVPC with proprietary Wi-Fi card	Surface		
M1011047	250 nit IVPC with dual Wi-Fi card + CAN Bus ports	Underground	TRAX™ and/or SMARTS™ and/or SafeDetect™	Wi-Fi + WASP
M1011048	1600 nit IVPC with dual Wi-Fi card + CAN Bus ports	Surface		

Each of the above kits is provided with a standard kit configuration including the following components:

- 1 x In-Vehicle PC with 2 x rubber USB plugs, and 1 x Deutsch QC cover attached.
- 1 x Cable, power + Serial, 3 m.
- 1 x Cable, power breakout, 3 m.
- 1 x Cover, Deutsch QC.
- 2 x Plug, USB.
- 2 x or 4x Antenna, Reverse Polarity SMA depending on systems.

9.3   Deutsch connector pin arrangements

The following Deutsch connectors are used to connect devices to the PDPU. The PDPU is provided with a 2-pin power input cable and spare 8-pin plugs used to terminate device cables for connection to the PDPU. All other cables are provided with the devices.

Table 8 Deutsch connector pin arrangements

Connector	Type	Deutsch plugs FRONT view and connections			
Sensor FL	8-pin Deutsch **Front view**				
Sensor FR					
Sensor RR					
Sensor RL					
Pin layout		**8: IO GND** 6-core blue	**7: IO 2** 6-core brown	**6: IO 1** 6-core green	**5: RS232 GND** 6-core black
		1: Power 2-core red	**2: GND** 2-core black	**3: RS232 RX** 6-core red	**4: RS232 TX** 6-core white
MIM	8-pin Deutsch	Not currently used			
TTR	6-pin MIL-Spec	Not currently used			
Power input	2-pin Deutsch **Front view**				
	Pin layout	**1: Power** 2-core red		**2: GND** 2-core black	

9.4   In-Vehicle PC Quick Connects

This section is for information only and troubleshooting should be limited to the checks described in Troubleshooting on page 38.
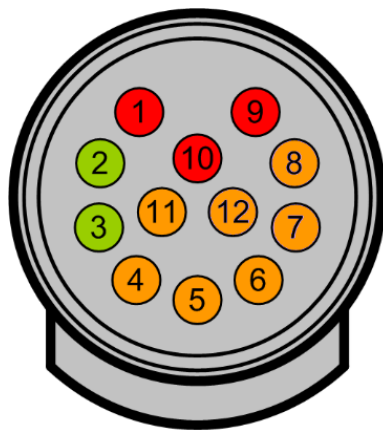
⚠️ Do not make any changes to Quick Connect connectors or wiring.

➡️ The pin assignments were correct at the time of writing.
Please check with Minetec before troubleshooting using pin assignments as these may change with hardware models and versions.

9.4.1   Power QC1

Power
Video
Digital Inputs/Outputs

Pin	Signal Name	Description
1	Power GND	Power ground return.
2	Video GND	Composite Video ground return.
3	Video In	Composite Video input.
4	D4	Digital I/O 4. Analog or Digital Input (software controllable) and open-drain Output.*
5	D3	Digital I/O 3. Analog or Digital Input (software controllable) and open-drain Output.*
6	D4 GND	Ground return for Digital I/O 4.
7	D1/2 GND	Ground return for Digital I/Os 1 and 2.
8	D1	Digital I/O 1. Analog or Digital Input (software controllable) and open-drain Output.*
9	Power In+	Power input. 12V or 24V. 9V min, 39V max.
10	ACC In	Accessory circuit input.
11	D3 GND	Ground return for Digital I/O 3.
12	D2	Digital I/O 2. Analog or Digital Input (software controllable) and open-drain Output.*

* Current limited to 50mA (with PolyFuse). 40V maximum switching voltage.

9.4.2   RS232 Serial connector QC2
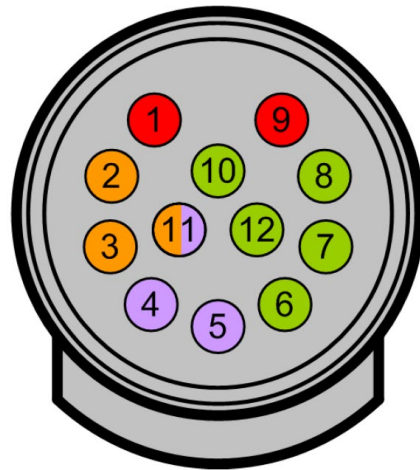
Blocked
**RS232 Port 1**
RS232 Port 2
RS232 Port 3

Pin	Signal Name	Description
1	NC	Location blocked.
2	TxD Out 3	Serial port 3 Transmit Data output.
3	RxD In 3	Serial port 3 Receive Data input.
4	RxD In 2	Serial port 2 Receive Data input.
5	TxD Out 2	Serial port 2 Transmit Data output.
6	RTS Out 1	Serial port 1 Request To Send output.
7	CTS In 1	Serial port 1 Clear To Send input.
8	RxD In 1	Serial port 1 Receive Data input.
9	NC	Location blocked.
10	TxD Out 1	Serial port 1 Transmit Data output.
11	GND 2 / 3	Ground return for serial ports 2 and 3.
12	GND 1	Ground return for serial port 1.

9.4.3   CAN Bus connector QC3
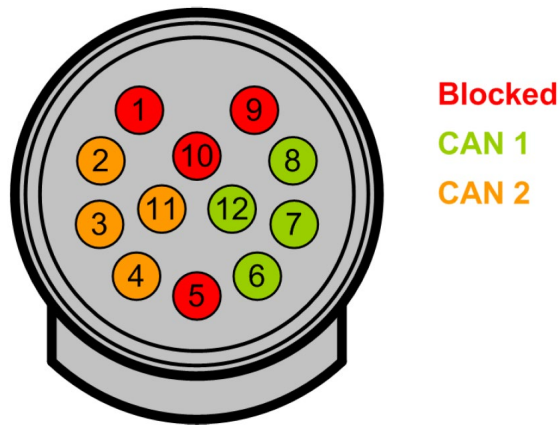
Blocked
CAN 1
CAN 2

Pin	Signal Name	Description
1	NC	Location blocked.
2	CAN HI 2	CAN port 2 HI.
3	CAN LO 2	CAN port 2 LO.
4	CAN Power 2	+12V output for CAN port 2. Current limited (with PolyFuse) to 100mA.
5	NC	Location blocked.
6	CAN Power 1	+12V output for CAN port 1. Current limited (with PolyFuse) to 100mA.
7	CAN LO 1	Can port 1 LO.
8	CAN HI 1	Can port 1 HI.
9	NC	Location blocked.
10	NC	Location blocked.
11	CAN GND 2	CAN port 2 ground return.
12	CAN GND 1	CAN port 1 ground return.

9.4.4   LAN USB connector QC4

Blocked
LAN
USB
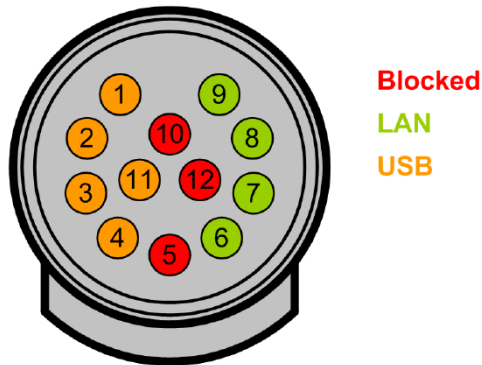
Pin	Signal Name	Description
1	USB Shield (GND)	USB cable shield. Connected to ground in the TUFF Panel PC.
2	D+	USB Data+.
3	D-	USB Data-.
4	Vbus (+5V)	+5V output for USB device. Current limited to 500mA, with electronic current limiter circuit.
5	NC	Location blocked.
6	TX+	10/100 Ethernet Transmit Data+.
7	TX-	10/100 Ethernet Transmit Data-.
8	RX+	10/100 Ethernet Receive Data+.
9	RX-	10/100 Ethernet Receive Data-.
10	NC	Location blocked.
11	USB GND	USB ground return.
12	NC	Location blocked.

9.5   Vehicle Installation Record

The Vehicle Installation Record details the as-configured and as-installed state of the hardware. It is a record of the installation work done and serves as a commissioning checklist.

> ✳   The form below is a sample checklist and does not include all hardware.

Develop the form below to address all hardware being installed at your site. Contact Minetec for advice on the parameters to be recorded.

Vehicle Installation & Commissioning Record				
Date:		Technician:		
Vehicle Number:		Start time:		End Time:
Vehicle Type:				
Vehicle Owner:		Mine Operator	Contractor	
Type of SafeDetect™ Installation:		Single node system	Dual node system	
Radio Test:				
Tx pre-install:		Rx post-install:		
Mobile Node 1 Details:				
Serial No.:		MAC Address:		
Firmware:	G2:	PIC:	WASP:	
Termination point:		Pre-isolator	Post-isolator	
Mobile Node 2 (if applicable) Details:				
Serial No.:		MAC Address:		
Firmware:	G2:	PIC:	WASP:	
User Interface Device:				
Device type:	In-Vehicle PC			
Model No.:		Serial No.:		
Firmware:		MAC Address:		
Android Version:				
SafeDetect Version:				
Location of cable entry points				
Power source				
Termination point		Pre-isolator Post-isolator N/A		
Does the unit turn on?		☐ Yes/☐ No		
Does the battery hold a charge?		☐ Yes/☐ No/☐ NA		
Zone Settings:				

Vehicle Installation & Commissioning Record				
	Alert	Alarm	Slow	Stop
Distance (m)				
Alarm frequency				
Alarm repeat				

In-Vehicle PC Start Up (if applicable):	
SafeDetect application starts automatically and cannot be minimised/disabled	☐ Yes/☐ No
Pre-Start Check displays once SafeDetect opens	☐ Yes/☐ No
Administration screen locked	☐ Yes/☐ No
Administration password set (logged in device schedule)	☐ Yes/☐ No
Detection of Mobile Nodes and Personal Nodes	☐ Yes/☐ No
Do the zone rings appear and zone alarms sound when a Mobile Node or Personal Node enters the zones as per the detailed design/fleet map documents?	☐ Yes/☐ No
Can the operator dim and brighten the screen?	☐ Yes/☐ No
Can the operator acknowledge alarms?	☐ Yes/☐ No

PDPU:			
What devices are plugged in?			
Power source:			
Termination point	Pre-isolator	Post-isolator	
Cable entry point:			
What output connectors are being used?	Sensor FL	Sensor FR	Sensor RR
	Sensor RL	Display	Power

Vehicle Installation & Commissioning Record	
Physical Installation:	
Does the installation meet OEM installation standards	☐ Yes/☐ No
Does the installation meet the fleet map configuration	☐ Yes/☐ No
Mobile Nodes not mounted under metal objects	☐ Yes/☐ No
In-Vehicle PC mounted within the Vehicle Operator's view and reach without impairing view or operation	☐ Yes/☐ No
All devices grounded correctly	☐ Yes/☐ No
All devices powered from a clean power source	☐ Yes/☐ No
Suitable power protection installed	☐ Yes/☐ No
All cabling terminated correctly	☐ Yes/☐ No
Bracket installed	☐ Yes/☐ No
Which bracket was used	Drawing Number:
Remote Support Access:[5]	
Access to Mobile Node(s)	☐ Yes/☐ No
Access to In-Vehicle PC (if applicable)	☐ Yes/☐ No
Photos of Vehicle As-built:	
Power Source Points	☐ Yes/☐ No
Fuse Locations	☐ Yes/☐ No
Cable paths including through vehicle cabin wall structure	☐ Yes/☐ No
In-Vehicle PC mounting	☐ Yes/☐ No
Mobile Node Mounting	☐ Yes/☐ No
PDPU Mounting	☐ Yes/☐ No
Uploaded to the Pillar	☐ Yes/☐ No
ROPS and FOPS integrity maintained, no hole drilled without approval from Mine Operator and vehicle OEM. If drilled who approved it, Name (Printed): _____	☐ Yes/☐ No Signature: _____
Remove Power Cable:	
Once commissioning document has been completed, has an out of service tag attached to In-Vehicle PC power cable[6]?	☐ Yes/☐ No

---

[5] *Is the Minetec equipment accessible remotely when in coverage of a Meshing Gateway?*
[6] *Out of service tag are attached after commissioning of the SafeDetect system. Once the "go live" date is reached (per Minetec schedule) the out of service tag is removed and power cable attached to the In-Vehicle PC. The Mobile Nodes remain powered from day of commissioning.*

| Vehicle Installation & Commissioning Record	
Notes:	
Vehicle Commissioning Record Sign Off:	
Installer Name (Print name)	**Signed:**
Minetec Commissioner Name (Print name)	**Signed:**
Operator[7] (Print name)	**Company[8] and Signature:**
Mine Operator (Project Team) Representative (Print name)	**Signature:**

---

[7] *The vehicle operator is signing off on operational safety and ergonomics of the Minetec In-Vehicle PC and Mobile Node(s) for the specified vehicle (vehicle number) written in at the top this installation record.*

[8] *Approved contractor vehicle operators who have been authorised by Mine Operator to sign off on the installation.*

MINETEC™
STOP WORKING IN THE DARK

9.6   Extension brackets

In addition to the standard mounting bracket supplied attached to the Mobile Node, Minetec has a range of mounting bracket extensions to suit various vehicle configurations. For example, the following extension bracket is available if required.

Figure 22 M1011146 Mobile Node Extension Bracket

STOP WORKING IN THE DARK

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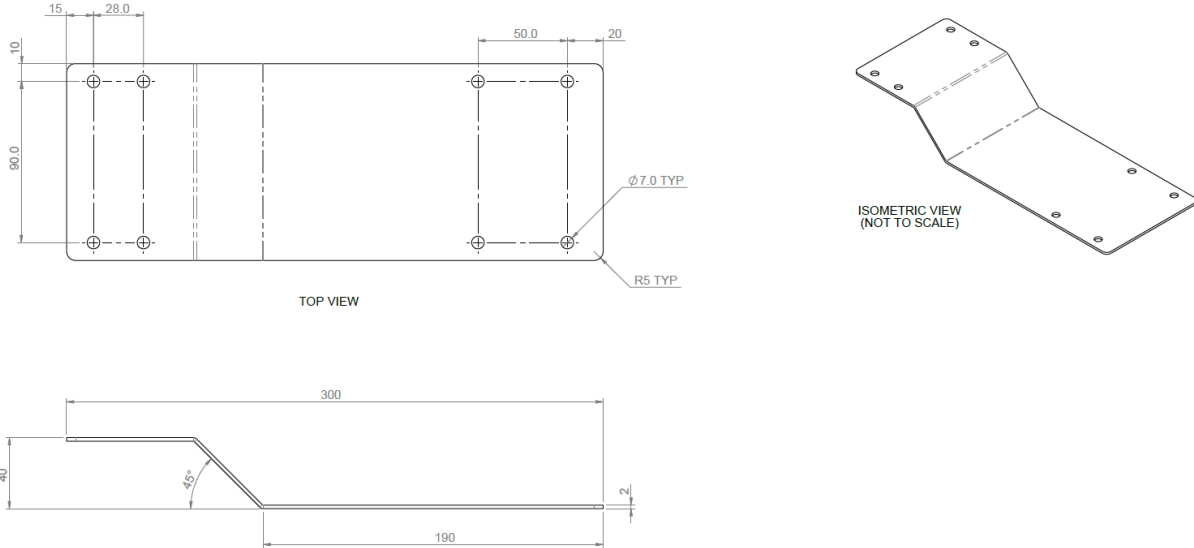
For all support requests contact Minetec Service Support:
Toll Free: 1800 MINETEC (Australia only)
Phone: +61 8 9259 4955
Email: support@minetec.com.au
Minetec Pty Ltd | Unit 2 | 29 Wellard Street | Bibra Lake·| Western Australia | 6163 | Australia

Returns with a valid RMA should be sent to:
Minetec Pty Ltd | 2 Second Avenue | Mawson Lakes | South Australia | 5095 | Australia

REGULATORY INFORMATION

Simplified EU Declaration of Conformity

Hereby, Minetec Pty Ltd declares that the radio equipment type [Refer to products listed in Table 1] complies with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address:
www.Minetec.com.au/compliance

Manufacturer address:
Minetec Pty Ltd, Unit 2, 29 Wellard Street, Bibra Lake, WA 6163, Australia

Federal Communications Commission (FCC) Statements (as applicable)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Part 15.105 NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

Compliance Statements for Canada (as applicable)

This product meets the applicable Innovation, Science and Economic Development Canada technical specifications.

RSS-Gen notice: This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions: 1) This device may not cause interference; and 2) This device must accept any interference, including interference that may cause undesired operation of the device.

INFORMATION RÉGLEMENTAIRE

Avis de conformité Canadien

Le présent produit est conforme aux spécifications techniques retenues par l'Innovation, Sciences et Développement économique Canada (ISDE).

RSS-Gen l'avis: Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: 1) l'appareil ne doit pas produire de brouillage; 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Modification

Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the device.

Toute modification non approuvée explicitement par le fournisseur de licence de l'appareil peut entraîner l'annulation du droit de l'utilisateur à utiliser l'appareil.

FCC and RSS MPE RF Exposure statement

This equipment complies with the FCC and ISED Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and all persons during normal operation.

Cet équipement est conforme aux limites d'exposition aux radiations de la FCC et d'ISDE Canada établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et toutes les personnes pendant le fonctionnement normal.

ADVICE AND SAFETY INSTRUCTIONS

For complete product specification and operational guidance, refer to the Minetec MineOffice Administrator Manual.

ASSEMBLY INSTRUCTIONS

For guidance on assembly & Installation, please refer to the Minetec MineOffice Administrator Manual.

SAFETY CONSIDERATIONS

• Keep out of reach of children, small parts are a choking hazard.
• Do not mutilate the batteries.
• Dispose of batteries as per local regulations.
• Only charge the products and accessories according to the instructions in the manual.
• Do not dispose of the devices or accessories in a fire.

Table 1: **Radio Frequency Specification**

Product	p/n	CAT p/n	Power 2401 to 2473MHz	5725 to 5850MHz*
Mobile Node	M1010512-001	5918506	18dBm	29.1dBm
Personal Node	M1010802	5908586	18dBm	27dBm
Bridge Node	M1011062	5908599	19dBm	18.7dBm
Access Point	M1011061	5908598	19dBm	18.7dBm
Vehicle PC	M1011057	5918593	19dBm	n/a

*Range and power applicable to EU products only

Table 2: **Certification Scheme**

Product	p/n	CAT p/n	FCC	ISED	SDPPI	ICASA
Mobile Node	M1010512-001	5918506	2AVQP-M1010512 / U30-G2M5477	25823-M1010512 / 8169A-G2M5477	65270/SDPPI/2019	tbc
Personal Node	M1010802	5908586	2AVQP-M1010802 / U30-G2M5477	25823-M1010512 / 8169A-G2M5477	66255/SDPPI/2020	tbc
Bridge Node	M1011062	5908599	2AVQP-M1011050 / Z9W-CM4	25823-M1011050 / 11468A-CM4	65497/SDPPI/2020	TA-2019/5196
Access Point	M1011061	5908598	2AVQP-M1011050 / N6C-SXPCEAN2	25823-M1011050 / 4908A-SXPCEAN2	66339/SDPPI/2020	tbc
Vehicle PC	M1011057	5918593	N6C-SXPCEAN2	4908A-SXPCEAN2	64569/SDPPI/2019	tbc