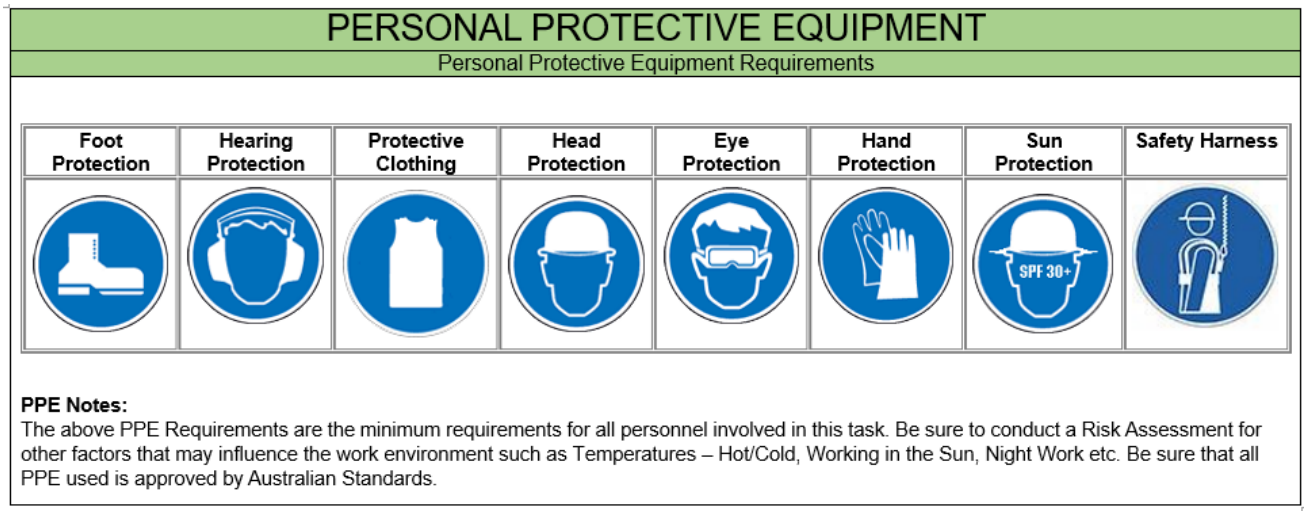
Method statement for Level 8, Level 8 Advanced Proximity Detection and Level 9 Collision Avoidance

- ISS level 9 integration
- Radar systems
- 360 camara

TABLE OF CONTENTS

Introduction

1 SAFETY WARNINGS



1.1 SAFETY

- Please read these safety instructions carefully.
- Please keep this user's manual for later reference.
- Do not use liquid or spray detergents for cleaning, use a damp cloth.
- Keep this equipment away from humidity.
- Put this equipment on a reliable surface during installation.
- Dropping it or letting it fall could cause damage.
- Position the power harness so that people cannot step on it.
- Never open the equipment. For safety and warranty reasons, only qualified MPI personnel should open the equipment.
- The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.
- Make sure the voltage of the power source is correct before connecting the equipment to the battery.

If any of the following situations arise, get the equipment checked by a qualified technician:

- If the power harness or connecting plugs looked damaged.
- If the unit has visual liquid or moisture damage.
- If you cannot get it to work per the user's manual.
- If the equipment has been dropped and damaged.
- If the equipment has obvious signs of breakage.

Do not leave this equipment in an uncontrolled environment where the storage temperature is below -20° C (-4° F) or above 60° C (140° F), as this may damage the equipment.

2 LEGAL WARNINGS

3 PURPOSE

The primary objective of an ISS unit is to alert the operator, within the operating vehicle, of a potential collision among surrounding vehicles (with an ISS installation), stationary objects and pedestrians (with PPS). The ISS essentially serves as an aid, acting as a secondary countermeasure in lieu of the operator's basic senses. The purpose of this document is to provide a contextual understanding of the hardware components, installation process, software, configuration and troubleshooting of the system.

4 LIST OF ACRONYMS AND ABBREVIATIONS

ISS: Intelligent Safety System	**CCU:** Central Control Unit
IMS: Intelligent mining system	**GND:** Ground
PPS: Personal Protection System	**VCC:** Voltage high power
RTD: Real Time Detection (ISS unit)	**GDU:** Graphical display unit.
RCM: Radio Communication Module	**RFID:** Radio Frequency Identification
GNSS: Global Navigation Satellite System	**Amps:** Amperes
LCD: Liquid Crystal Display	**LED:** Light Emitting Diode
IC: Integrated Circuit	**RTLS**: Real Time Location System
CAN: Nervous System Enabling Communication	
JIG: An item used to complete or perform a test.	

5 DOCUMENT DESCRIPTION

5.1 DOCUMENT VERSION HISTORY

Version	***Changes***	***Responsible Person(s)***	***Date***
2V0	Original Version	NN	2020-07-03
2V1	Updates to Section 4	VD	2021-08-05
2V2	Updates to Section 5.1, 5.2 and 6.1	NN	2021-09-09
2V3	Updated to new standards	TN	2022-01-17
2V4	Updated IMS-GDU configuration tool from 1.0.0.195_1.9.31.0 to 1.0.0.195_19.32.0	TN	2022-02-16
2V5	Updated to new standards	TN	2023-10-24

6 PRODUCT OVERVIEW

6.1 BASIC CHARACTERISTICS

A comprehensive outlook of the pivotal ISS components is outlined and discussed. A detailed description of the component's structure and concise understanding of its function are further elaborated in the subsequent subsections.

6.1.1 DISPLAY SYSTEM (IMS-GDU COMPACT, GRAPHIC DISPLAY UNIT)

The IMS-GDU consists of a 4.3-inch, LCD screen. This unit is responsible for illustrating the numerous other vehicles with an installed ISS within the proximity of the operating vehicle and stationary objects with antennas. Multi-coloured triangles and blocks act as legends and warnings respectively on the display for when different proximity zones of the vehicle are breached. Displays LTE signal strength, time, vehicle speed, The device should be placed in a position that does not obscure the view of the operator. The unit can scan RFID tags and LTE communication. The display connects to the RCM with a M16 connector.

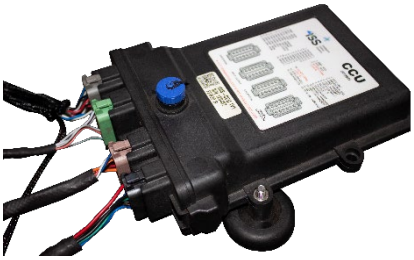
6.1.2 DISPLAY SYSTEM (IMS-GDU, GRAPHIC DISPLAY UNIT)

The IMS-GDU consists of a 4.3-inch, LCD screen. This unit is responsible for illustrating the numerous other vehicles with an installed ISS within the proximity of the operating vehicle and stationary objects with antennas. Multi-coloured triangles and blocks act as legends and warnings respectively on the display for when different proximity zones of the vehicle are breached. Displays LTE signal strength, time, vehicle speed, The device should be placed in a position that does not obscure the view of the operator. The unit can scan RFID tags and LTE communication.

6.1.3 (IMS-RCM2, RADIO COMMUNICATION MODULE)

The IMS-RCM2 unit consists of and enclosure and magnets The unit has a built RTD and LEDs. GNSS is composed of four main navigation satellite systems: being GPS (US), GLONASS (Russia), BeiDou (China) and Galileo (EU). The appropriate network is to be utilised depending on the vehicle's geographical location (longitude, latitude, and altitude). The function of this is to extract co-ordinates from orbiting satellites. The GNSS co-ordinates are routinely transmitted via RF (Radio Frequency) between vehicles (with ISS) and other location sharing objects. RTLS from the in-built RTD and surrounding RTD units are employed to refine the location of the vehicle in conjunction with the data procured from GNSS.

6.1.4 COLLISION DETECTION MODULE (IMS-CCU, CENTRAL CONTROL UNIT) - APPLICABLE FOR LEVEL 8 ADVANCED AND LEVEL 9 SYSTEMS



The IMS-CCU is a black, rigid, DEUTSCH, plastic box case with an input/output expansion module which enables additional peripherals and accessories to be connected to a single point. There are 4 CAN buses consisting of a total of 48 pins.

The buses are ordered with the names CAN system for RTD (exclusively for RTD), input/output, CAN system and general connection.

The general CAN system bus is tasked with connecting both the GDU and RCM; the general connection bus connects the handset and **power supply**; Input and output Bus connects the radars; and the CAN system bus for RTD is exclusively reserved for RTD units.

Essentially, the CCU serves as the 'heart' of the system where all peripherals/devices are connected. Relays, tracking units and Bosch plugs (connection from the vehicle) are also sent to the CCU.

6.1.5 HANDSET (IMS-E6- HANDSET)

The handset is a black, Silicon-rubber console with 7 interactive buttons used by the operator to communicate with the ISS. The buttons are labelled acknowledge, load mode, speed override, pairing, AUX1, AUX2, AUX3. The function of these buttons will be further elaborated in the device operation section. The handset must be positioned close to the operator whilst not obstructing any of the other equipment.

6.1.6 REAL TIME DETECTION UNIT (IMS- RTD)

The RTD unit is a robust plastic, black box with magnets. The outer features of the RTD consists of a USB port and harness connection. The RTD's primary role is to initiate the RTLS protocol to further enhance the Geo-Coordinates of the vehicle.

6.1.7 ISO21815 (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

The IS021815 is an integrant (black box) connected to the CCU which primarily acts as a preventative, security feature for the vehicle. The CCU relays all the essential data from the GDU for the ISO21815 to interpret via CAN HIGH and CAN LOW. The IS021815 has a set of commands, based on ethical principles prescribed by law, to execute should the vehicle encounter any of the situations or scenarios outlined. An example would be to reduce the speed of the vehicle should the driver exceed the designated speed limit.

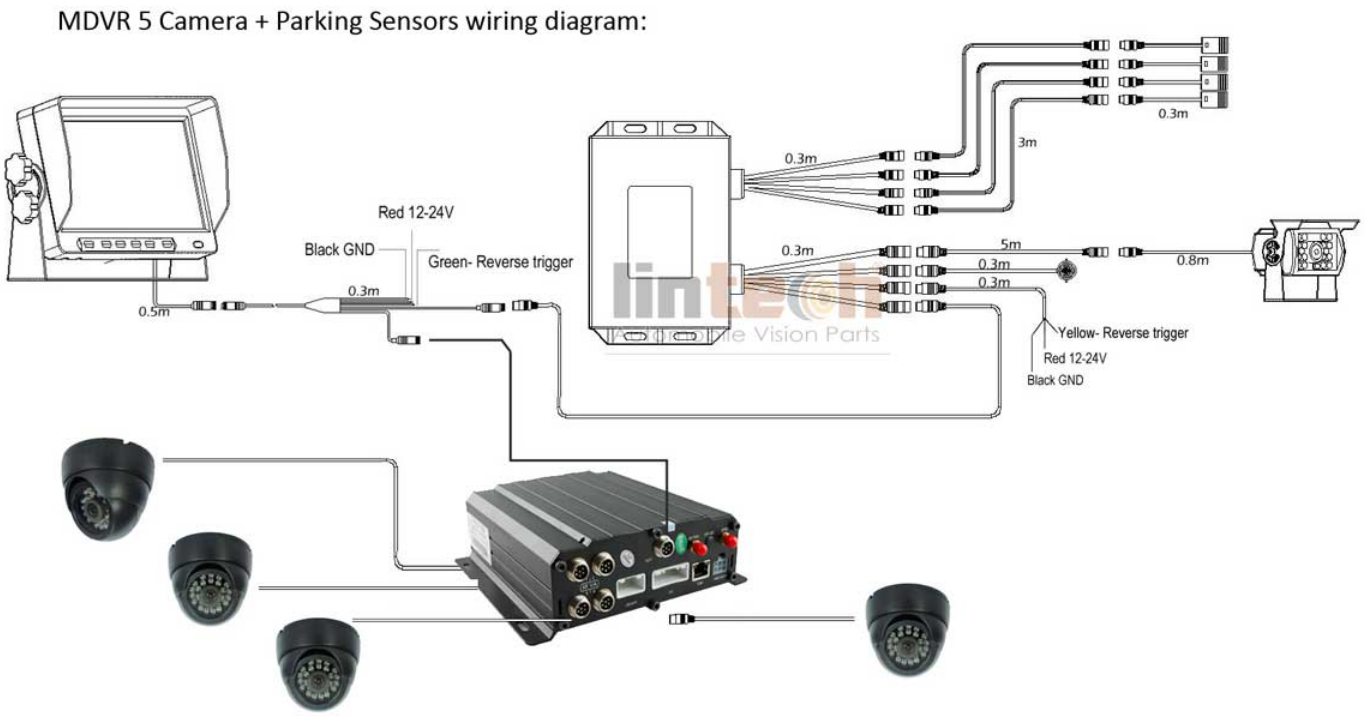
7 RADAR

A BS-9000 Brigade radar, precisely known as a Back-sense CAN Radar Object Detection System, utilises FMWC (Frequency Modulated Continuous Wave) radar system technology which is designed to detect people and objects in blind-spots, significantly reducing collisions. The radar/Backscenes can detect stationary and moving objects whilst also working effectively in harsh environments with poor visibility (darkness, smoke, fog, and dust). The internal structure of the radar comprises of a CAN interface for network connectivity, allowing the user to link up to 8 sensors and network host to a single CAN bus. Thus, enabling monitoring of multiple detection areas around the vehicle.

Note: back sense can only report and detect data, when engaged in reverse.

8 360° CAMERA

A BN360-200 Series Blackeye Select 360° system is an advanced camera monitor system that provides a simulated birds-eye-view of the vehicle, enabling drivers to see all around the vehicle in a single image. The use of the Blackeye system can significantly improve driver's blind-spot visibility and low speed manoeuvrability in comparison to conventional camera monitor systems. The system encompasses four of Brigade's ultra-wide angled cameras, an ECU, power, interface harnesses and IR remote control for interaction with the system. The ultra-wide cameras should be positioned symmetrically around the vehicle for the ECU to capture and process multiple camera images into a single Image, to have a bird's eye view of the of the vehicle and surrounding area.



9 POWER GUIDELINES

- 1 x Red wire connected permanently from the battery to the IMS-CCU. **Note:** Must be fused with a 5A fast blow fuse
- 1 x Black wire connected permanently from the battery to the IMS-CCU. **Note:** Must be fused with a 5A fast blow fuse
- Ground chassis line should be rated to a minimum of 5A fuse.
- Connect IMS-GDU, IMS-E6 and IMS-RCM to the IMS-CCU
- Should additional ISS accessories be required, the technician/installation officer is obliged to calculate the cable length and fuse values for the prescribed current load.

9.1 ABSOLUTE MAXIMUM RATINGS

This subsection accounts for the electrical tolerances of the ISS; The table below shows the electrical specifications for the ISS. The first column highlights a description of the electrical dimension; the second column shows the actual amount measured and the last column accounts for the actual unit of measurement.

Characteristic	Measurement	Unit
Supply Voltage (VDC – Directly from source)	10 to 36	V
Supply Current (no peripherals)	0.45	A
Operating current @ 13.8VDC with no peripherals & ignition on	Typical: 350	mA
Standby current @ 13.8VDC with no peripherals & ignition off	Typical: 160 Max: 170	mA
Operating Temperature	-20 to +70	°C
Operating Temperature	-20 to +65	°C

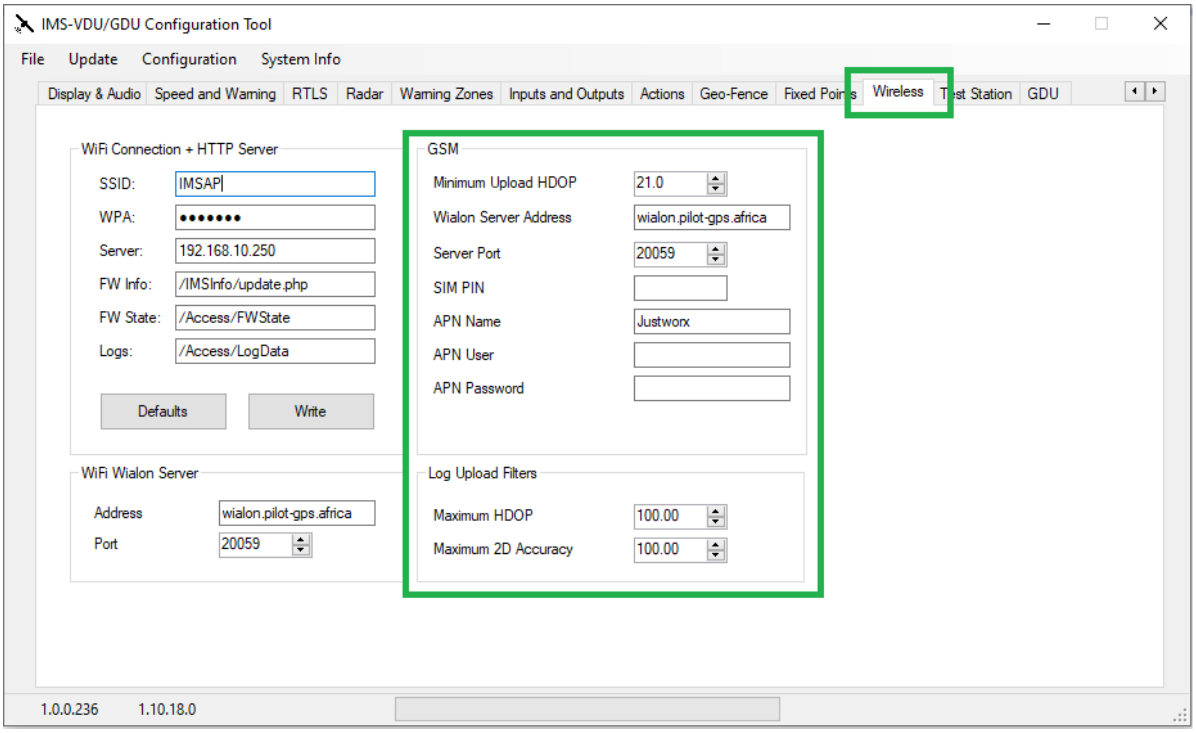
9.2 LIMITATIONS (NOT FOR INTENDED USE)

The ISS has not been designed to operate under the following conditions:

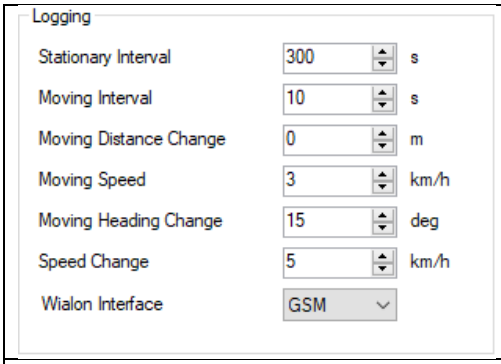
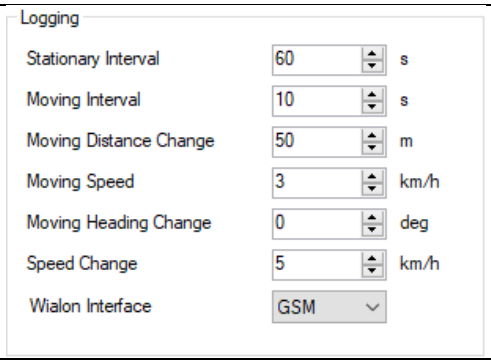
- Operating in deep, narrow, open-pit mines where both GNSS signals and radio communication signals between vehicles can be restricted.
- ISS units are not familiar with similar systems of its disposition and may only communicate with ISS products.
- Adverse weather conditions, by the likes of dust clouds and severe thunderstorms can potentially reduce signal strength for GNSS reception.i.o.t and Tracking.

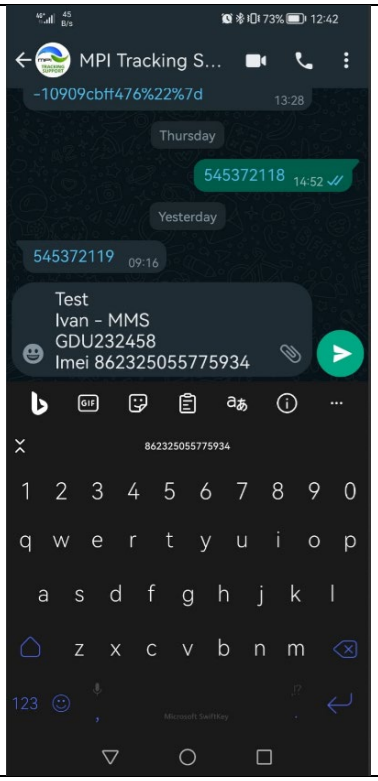
9.3 GDU SETTINGS AND ONBOARDING FOR MPI TRACKING PLATFORM

9.3.1 TEST PROCEDURE:



9.3.2 GDU LOGGING SETTINGS:

	
All vehicle settings: excl. Excavators and Loaders	Excavators and Loaders



GSM Configuration:

If the original installation Job Card was missing any details, you may be requested to provide the missing or incomplete information.

Should any issues in testing online devices arise you will be informed of the problem to fault find?

After a successful test you will be provided with a unique test reference number to prove you have successfully tested the system.

Test Ref Example: 1024-65740-IG

To complete the activation of a GDU on the Tracking Platform

The message should have the heading:

- Test,
- your name and Site,
- GDU Serial Number and
- IMEI Number

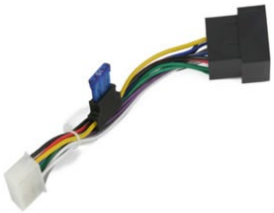
Send private message to MPI Tracking Support WhatsApp: 078 770 7470
(This number is only for WhatsApp messaging)

10 INSTALLATION INSTRUCTIONS

10.1.1 TOOLS REQUIRED FOR INSTALLATION

 Test Lighter (for testing and finding voltage outputs)	 Side Cutter, Deutsch Crimper (Original)	 Terminal Crimper for Copper Terminals	 Deutsch crimping tool
 Multi-meter	 Screwdriver Set	 Male and Female Spline Set	 Laptop
 Mini USB Cable	 Sleeving, Cable Ties and Heat Shrink Tubing		 Spanner Set (e.g., 6-14, 17, 19, 22 mm sizes)
 Drill and Extra Batteries	 Allan Key (Hex Key) set (e.g., 1.5 - 2 - 2.5 - 4 - 4.5 - 5 - 5.5 - 6 - 7 - 8 - 9 - 10 mm sizes)		

10.1.2 CONSUMABLES (EXPENDABLES) REQUIRED FOR INSTALLATION

 Wire for harness	 Excess Terminals	 Deutsch Plug kit	 Extra 5 A fuses and fuse holders (2 extra)

- Wire for harness: Red (2.5 mm), Black (2.5 mm), Yellow/Black (1 mm), Blue (1 mm) and Brown (1 mm). **Note:** Keep a minimum of 25 m per colour on large mining vehicles and 4 m per LDV
- Excess Terminals: Isolated Terminals (5 extra), Copper Terminal (30 extra)
- Deutsch Plug kit (supplied)
- 2 Extra 5 A fuses and fuse holders

10.1.3 INSTALLATION REQUIREMENTS

- Supply line MUST be protected by a 5 A fuse with a proximity to the positive terminal of the battery.
- DO NOT obstruct ventilation slots on display.
- DO NOT mount near moisture stimulating equipment.
- Follow wiring diagrams provided in the appendix below.
- For optimum results, the antenna module (RCM) must be mounted no less than 1.2 m from surrounding RF antennas and RF devices.
- The mounting point must be elevated 0.5 m above any obstructing surfaces on the vehicle.
- All cables must be channelled through glands in the vehicle and not cut to fit.
- Spare input wires are included on the IMS-GDU I/O connector. If these are not used, they must be insulated and strapped out of harm's way for future use.
- Take note of the antenna orientation in the diagram below
- All ISS installers must have an approved training certificate from MPI and/or official partners in addition to industry approved qualifications and experience as Auto-Electricians
- The radar is to be installed with a bracket, four screws and four magnets.

10.1.4 PREVENTATIVE INSTALLATION REQUIREMENTS

1. Installation of the ISS must be completed by a qualified installer.
2. All site safety measures must be adhered during installation.
3. Ensure all wiring has been correctly installed and that no damage has been incurred to the products and cables before applying power.
4. Conduct a Harness Test, as described in section 5.1, to ensure all harnesses are operational.
5. Ensure all harnesses and wires are insulated with breaded sleaves.
6. Never attempt to secure or trace a harness on a machine/vehicle's hydraulic lines (harnesses)
7. Never secure or tighten a harness on moving components/parts of a machine/vehicle.
8. Never secure harnesses next to or close to a co-axial cable; two radio cables or any radioactive cables
9. Never secure a harness next to or close to a high voltage wire/line
10. Never secure a harness next to or close to a heat source (Neither should it be strapped to a heat source)
11. Ensure there are grommets when holes are made during installation.
12. Never drill through a fire wall; HOPS (Hole Over Protection); ROP (Roll Over Protection) certified equipment
13. Ensure all cables are not installed in the vicinity of non-compliant EMC equipment or cables.
14. The ISS unit must be wired to a fuse as illustrated in the diagrams in the appendix.
15. Always ensure both the positive and negative terminal of a battery is fused.
16. Always ensure both battery terminals are clean before attaching the relay.
17. Always remove all fuses secured to the ISS before jump starting or welding on the respective vehicle/machine.
18. Always utilise dedicated Deutsch plug crimper to crimp Deutsch plugs configured to the required gauge wire.

19. Ensure cable ties are used to secure the individual components of the ISS and its accessories (E.g Tracker) especially in the vicinity of the CCU.
20. Never mount the RCM bracket Infront of the emergency escape.

10.1.5 INSTALLATION PROCEDURE

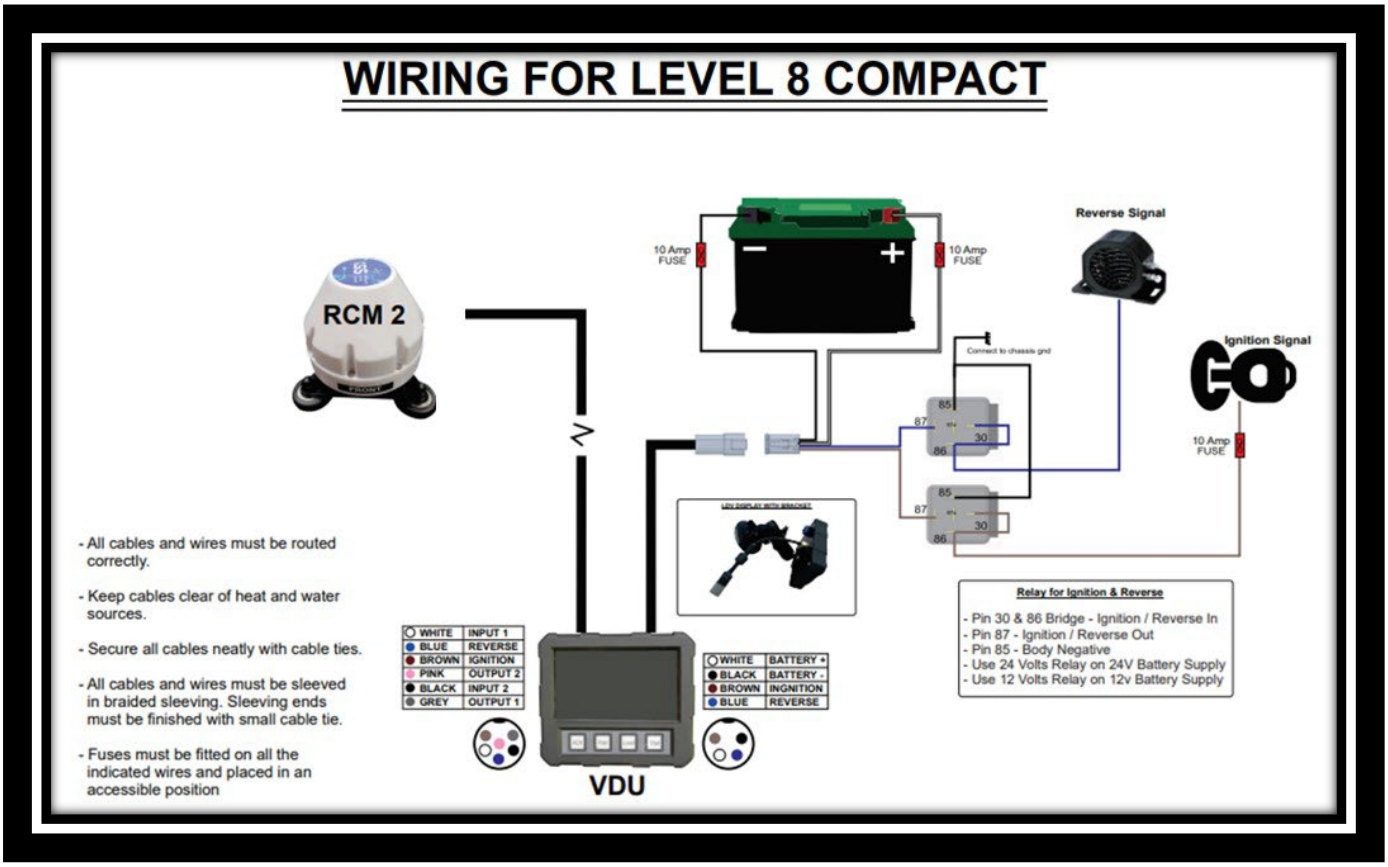
Prior to installations taking place the bucket if applicable will be lifted, the area where installations take place will be barricade off and scaffolding will be erected if necessary.

Vehicles must always be locked out while installations of the ISS system and 360 cameras take place.

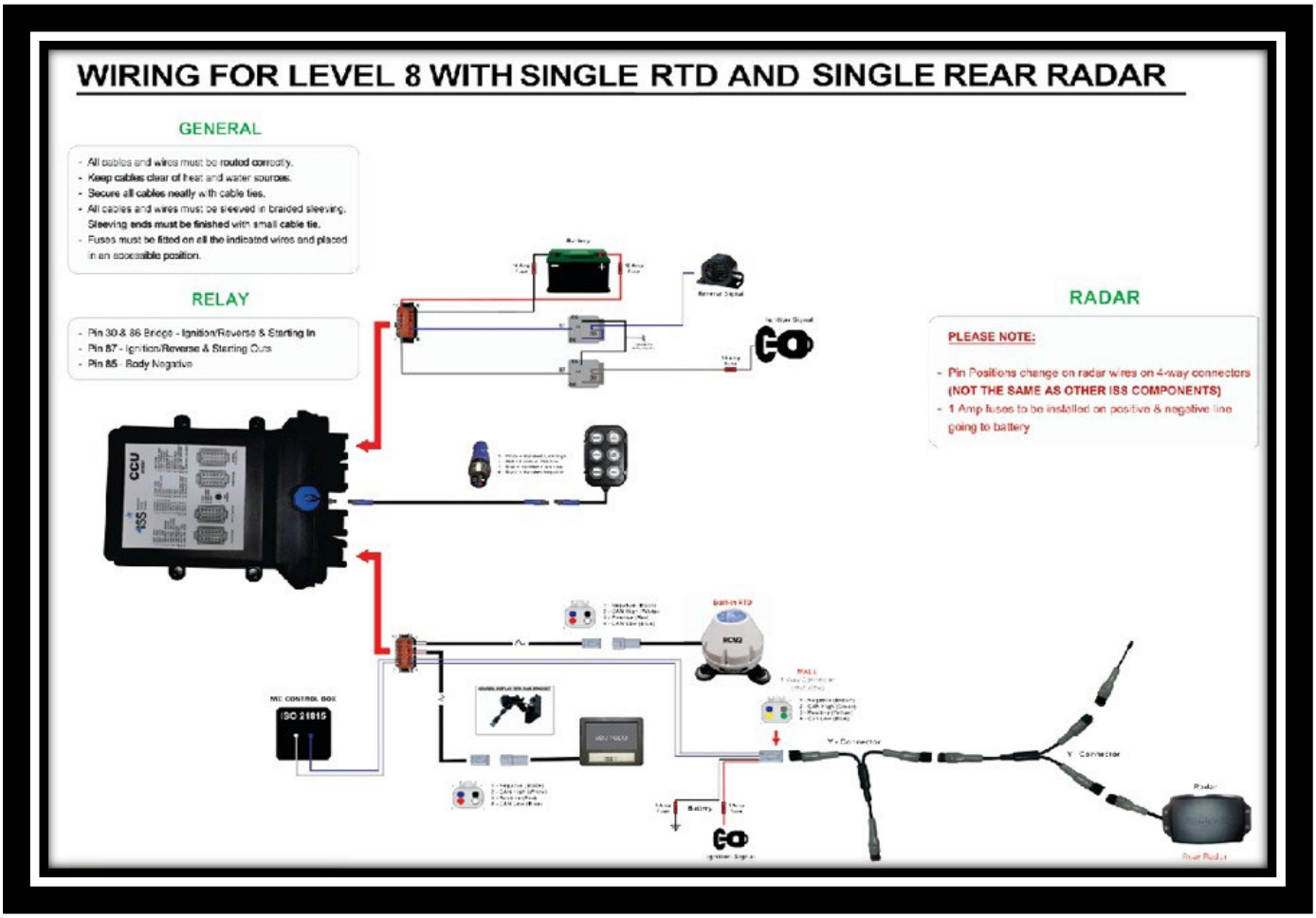
Correct and full PPE to be always worn.

11 WIRING DIAGRAMS

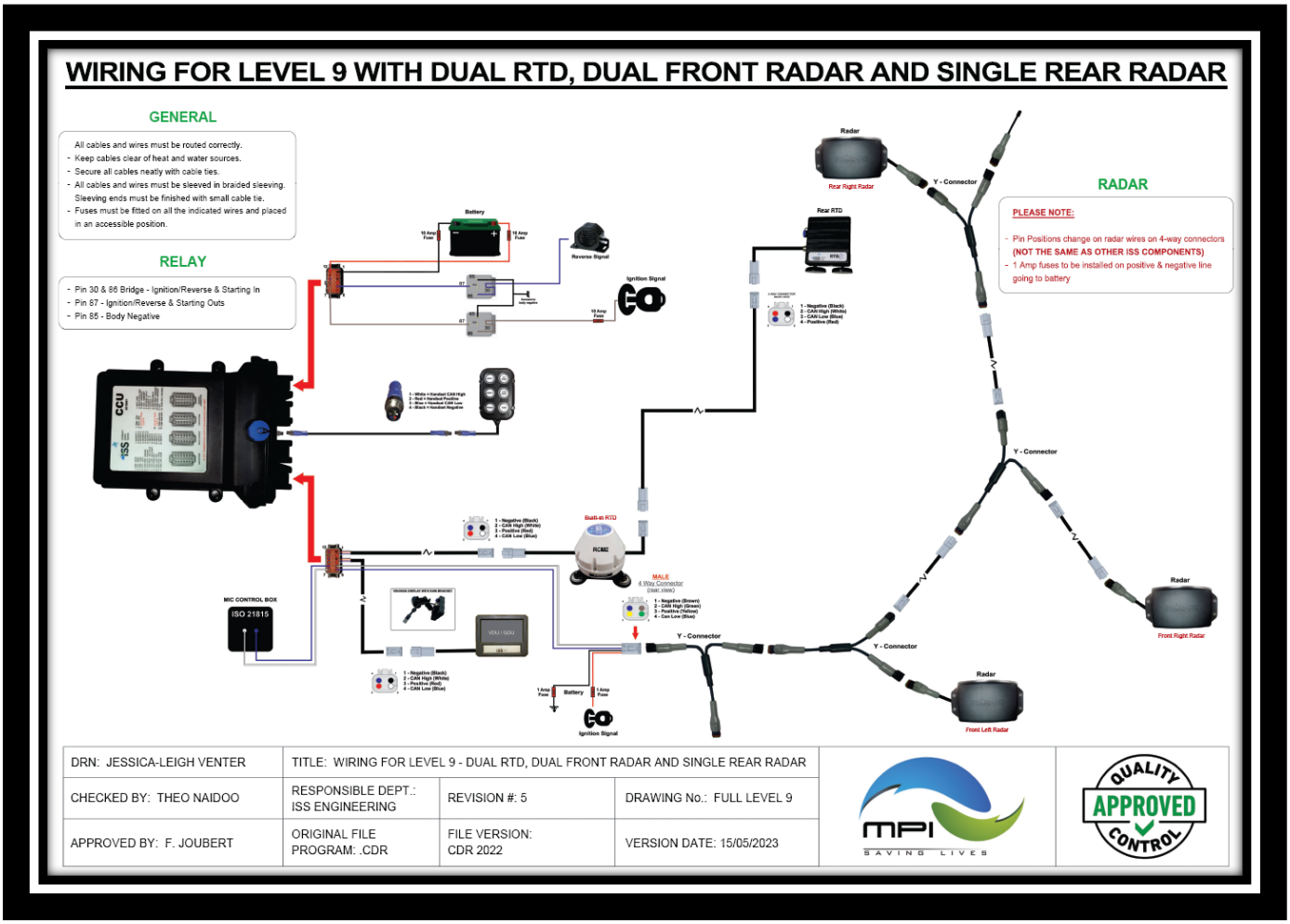
Wiring Diagram for Level 8 Compact:

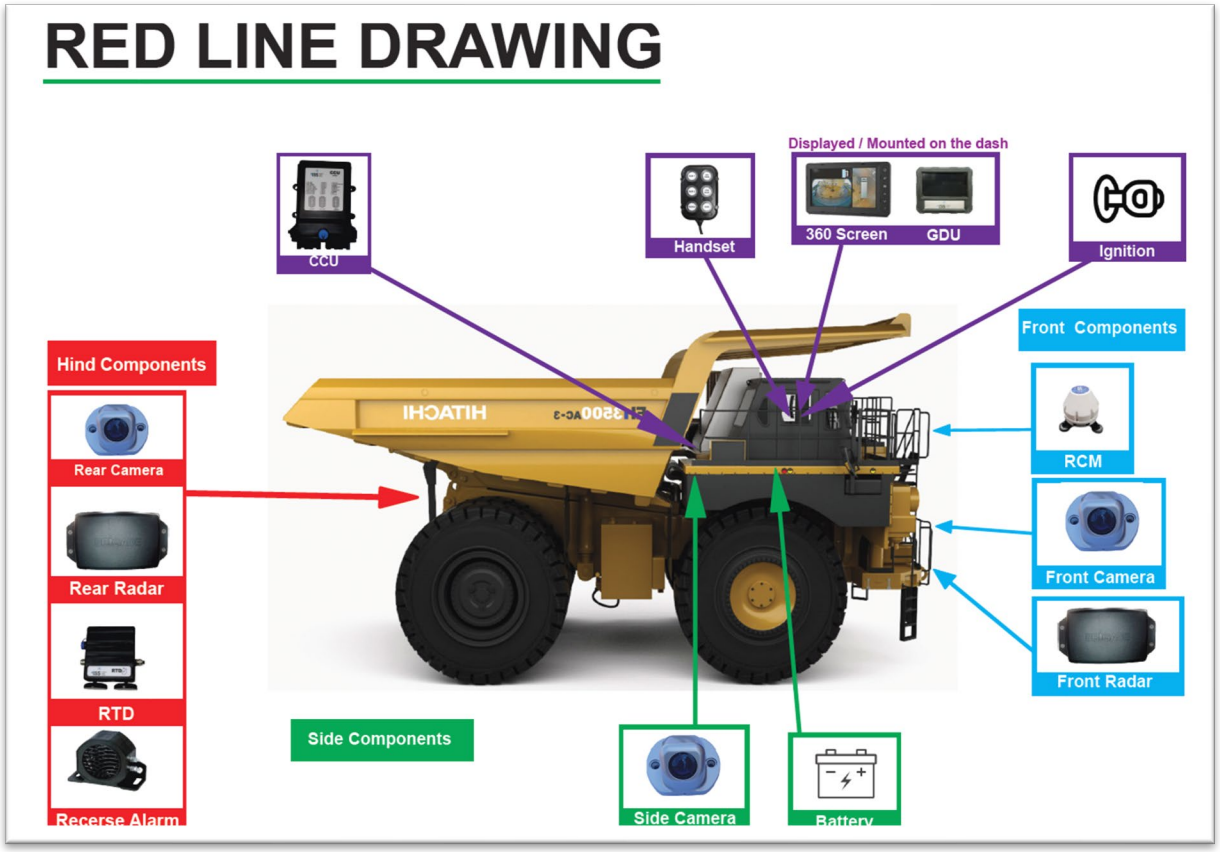


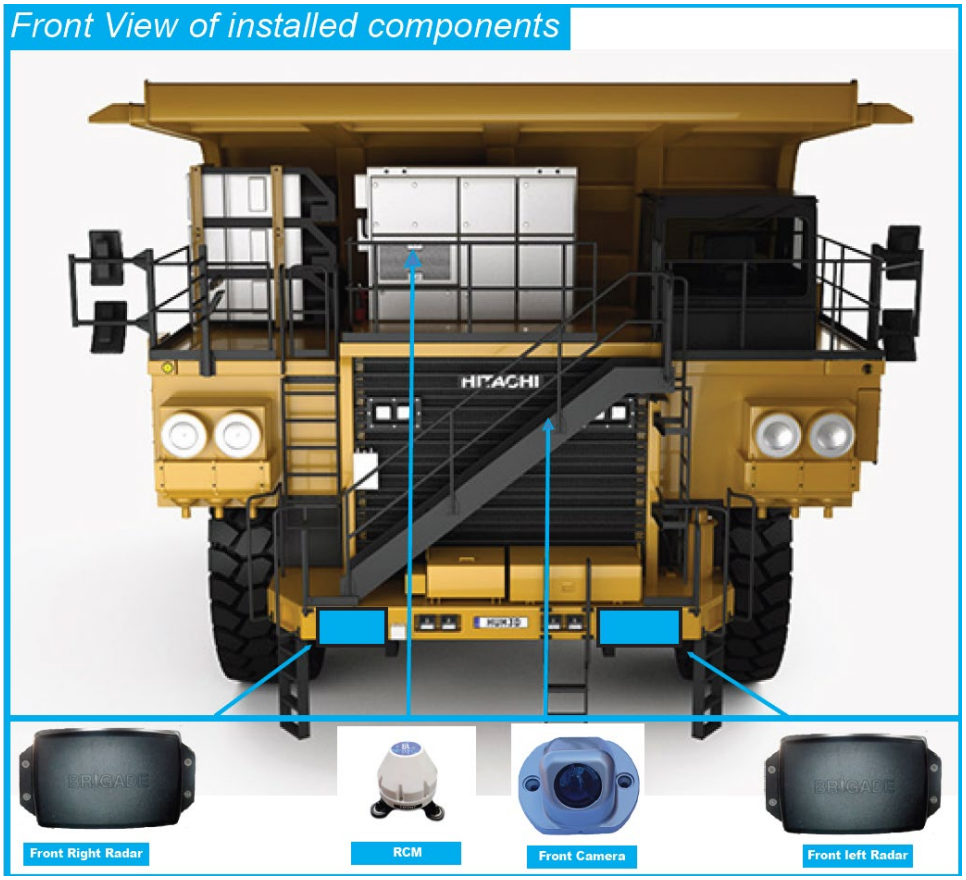
Wiring Diagram for Level 8 Advanced:



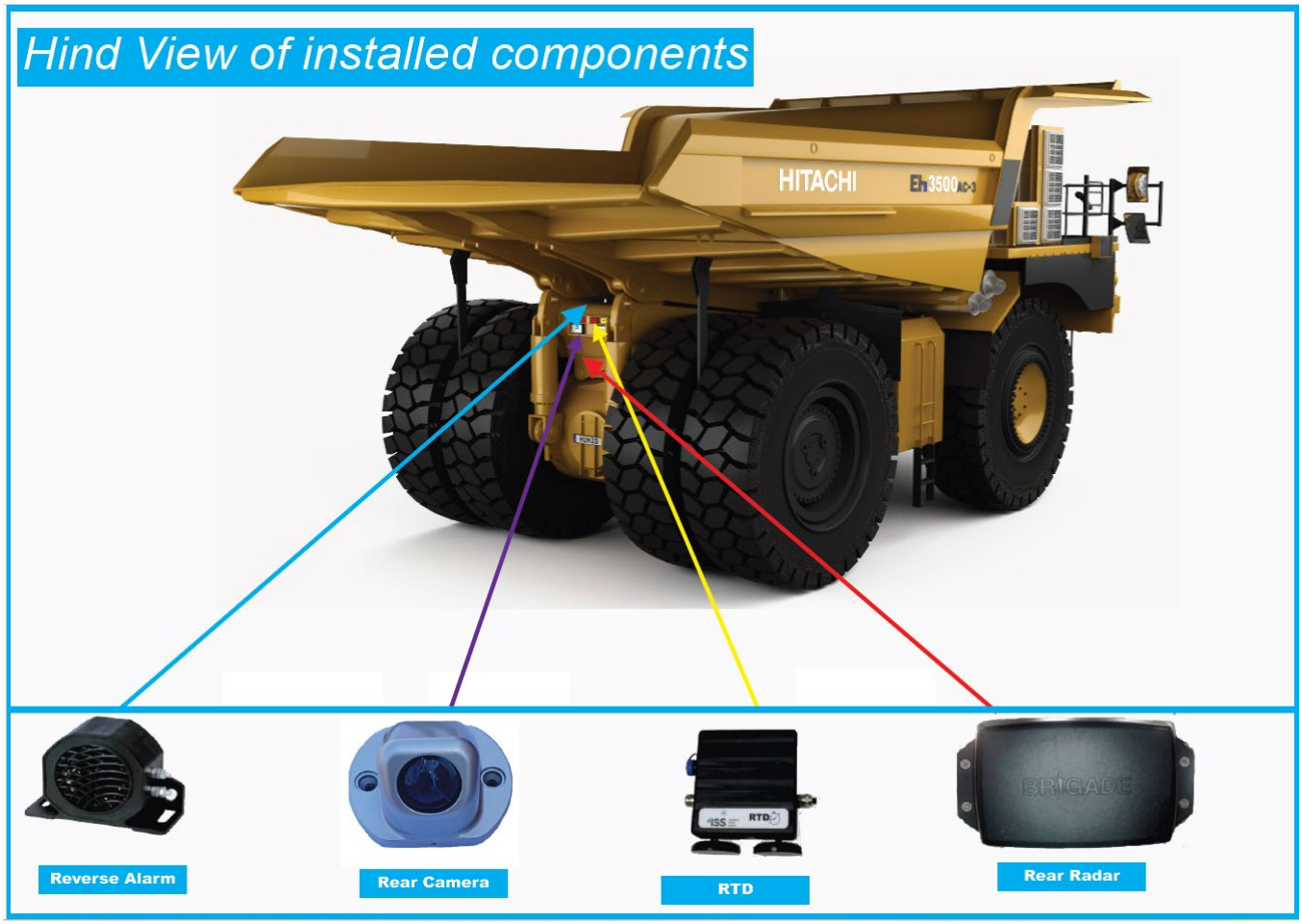
Wiring Diagram for Level 9:




RED LINE DRAWING
CCU
Handset
Displayed / Mounted on the dash
360 Screen
GDU
Ignition
Hind Components
Rear Camera
Rear Radar
RTD
Recerse Alarm
Front Components
RCM
Front Camera
Front Radar
Side Components
Side Camera
Battery

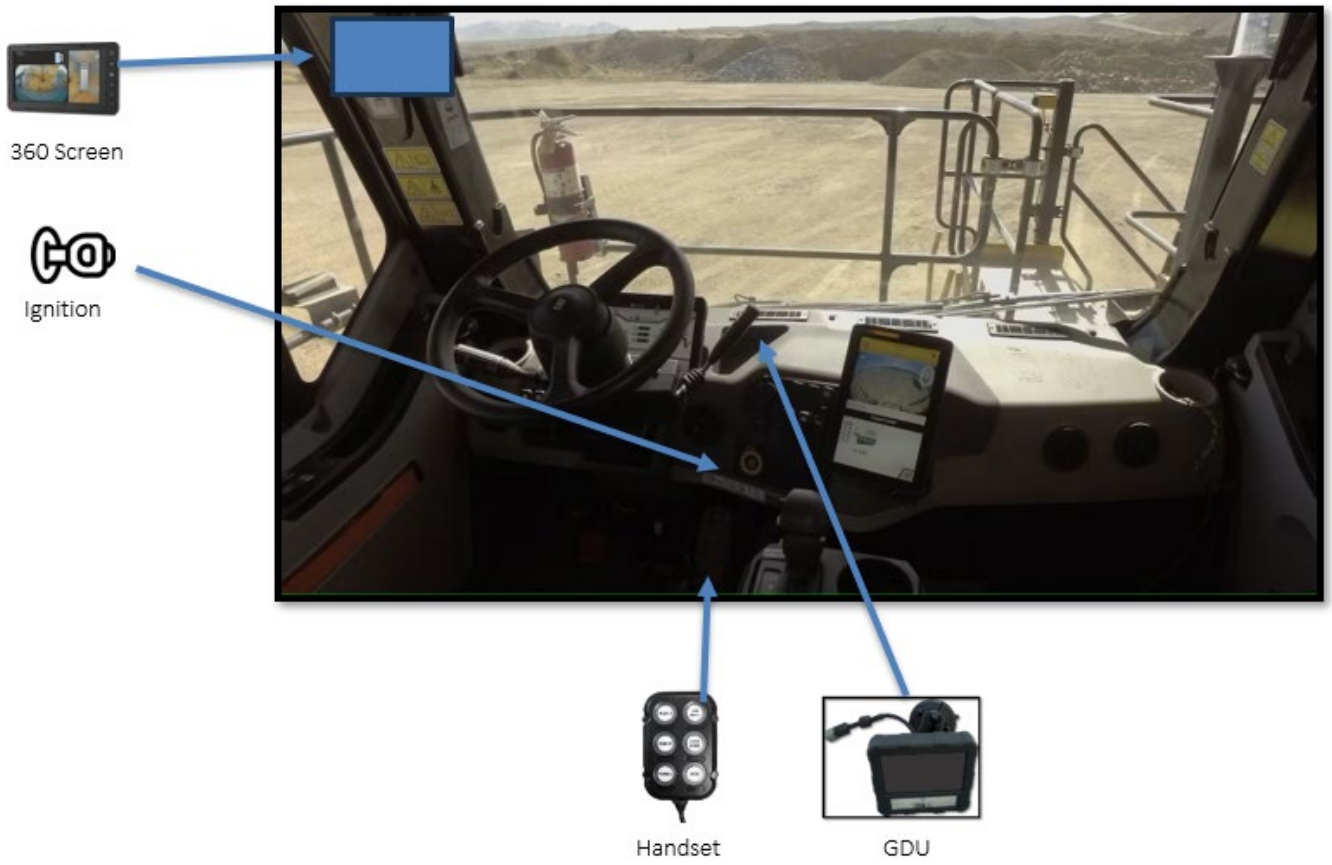

Front View of installed components
HITACHI
BRIGADE
BRIGADE
Front Right Radar
RCM
Front Camera
Front left Radar


607


Hind View of installed components
HITACHI
Reverse Alarm
Rear Camera
RTD
Rear Radar


Hitachi
DDT607

Cab View of installed components



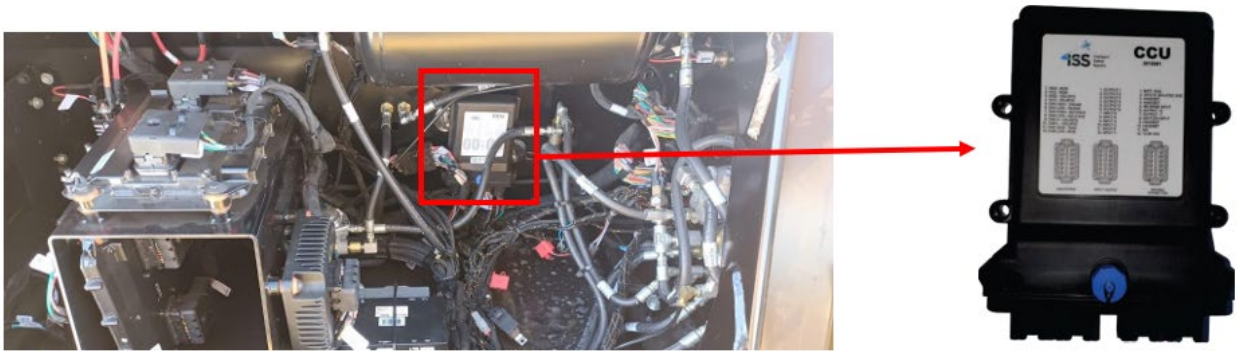
12 COMPONENT FITMENTS

12.1 CREATING THE POWER HARNESS:

- Use a 2.5 mm Black (Negative) and red wire (Positive) whose length will be subject to the application. This ranges from 1.5 m in LDVs to 22 m in larger vehicles
- Red wire needs to have an in-line fuse holder with a 10 A fuse (Fit fuses after installation)
- Red wire needs to be connected directly to the Positive terminal of the battery using an eye terminal (not lock-out switch)
- Similarly, Black wire needs to be connected directly connected to the Negative terminal, via an in-line fuse, using an eye terminal.
- Make use of the harness supplied. And attached extensions for power, ignition and reverse.

12.2 CCU FITMENT:

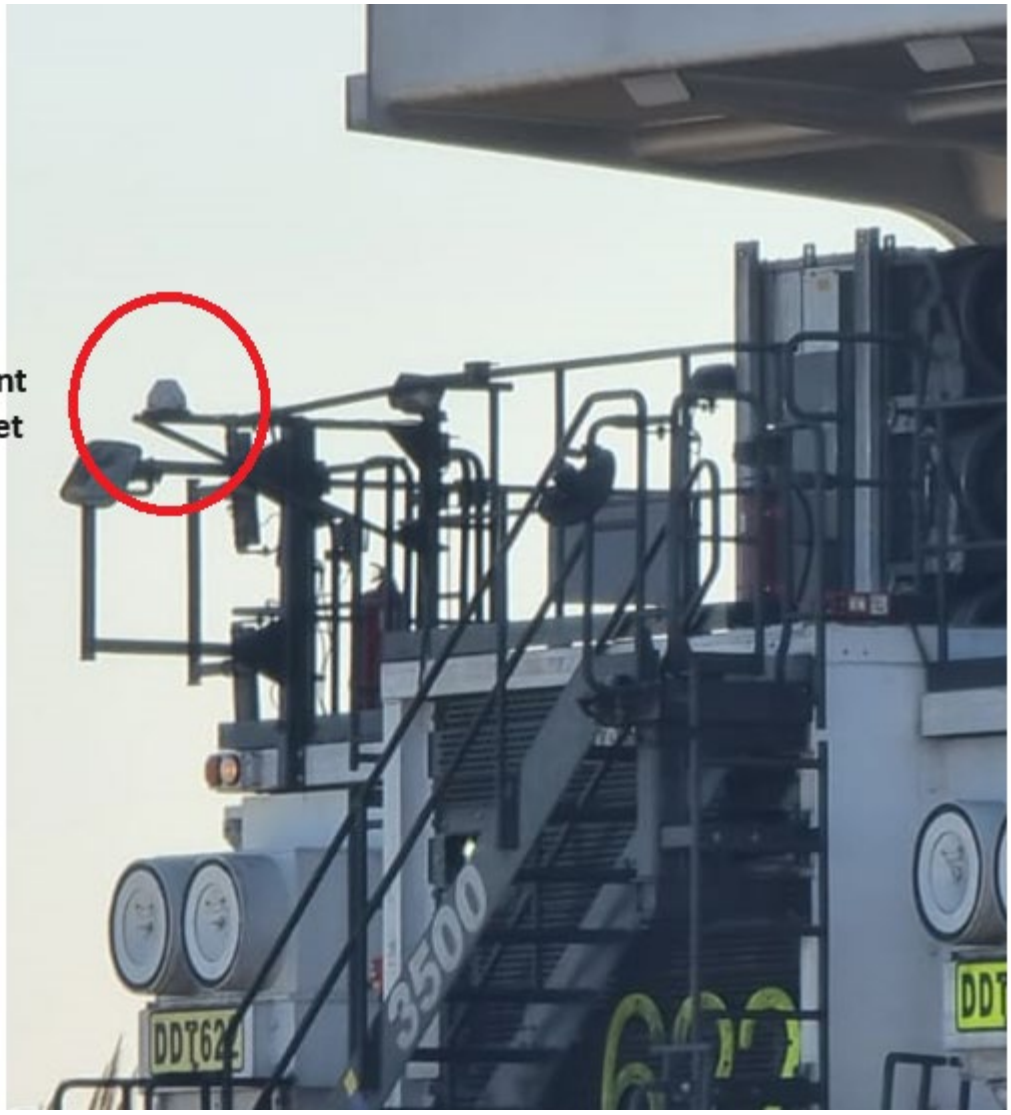
- Find a secure position inside the cab to mount the CCU. General places to position the CCU are under or behind the driver or passenger's seat. Either use adhesive, cable ties, or attach magnets to the CCU.



CCU placed behind the cab

12.3 RCM FITMENT:

- Position the RCM in a centralize position of the vehicle at the highest point of the roof should there be no overhead obstruction. If there is an overhead obstruction, use a bracket. RCM antenna Orientation as per image below.
- Run RCM wires into the cab through a grommet to the CCU.
- Any exposed wires must be insulated with breaded sleeving.
- Add heat shrink to Deutsch plug for protection against dust and water.
- ENSURE RCM is not grounded in any way.
- ENSURE RCM rubber mounts are not torn and are properly secured.
- ENSURE RCM is at least 1.2 m away from strobe lights and two-way radio antennas to prevent interference.
- All surrounding electrical equipment must be tested for RF emission. Hence guaranteeing there is no interference with the RCM.



In this instance the RCM is positioned in the middle of the machine on a bracket.

12.4 GDU FITMENT

- Mount the unit in a position that does not impair the operator's vision and can be clearly seen.
- The GDU mounting bracket is supplied in the kit. The mounting bracket includes a large suction cup that allows the unit to be mounted to a window. The suction cup can be removed from the bracket which will allow for a more permanent mount this is dependent on the customers' requirements.
- Ensure that the Deutsch plug is attached to the GDU is covered with heat shrink and cable ties. Tightly wrapped the heat shrink around the heat shrink to prevent tampering.
- **Note:** Tape, cable ties.

General location for GDU placement

General location for GDU placement

General Acceptable examples of GDU Fitments with multiple screens in-cab:

12.5 HANDSET FITMENT-E6

- The Handset must be placed within the proximity of the operator.
- The selected mounting location should not obstruct the operator's view.
- Ensure all wires are not damaged from CCU to Handset
- The bracket of the Handset must not be grounded in anyway; The supplied plastic clip must be used to ensure this.
- **Note:** All wires must be insulated with breaded sleeves

Handset Placement examples (must be in reach of the operator/driver):

12.6 RADAR FITMENT

Ensure the radars are mounted to the supplied brackets and is fixed to the bumper of the vehicle with the 4 magnets supplied with screws.

All wires are neatly routed to the CCU. As per wiring diagram.

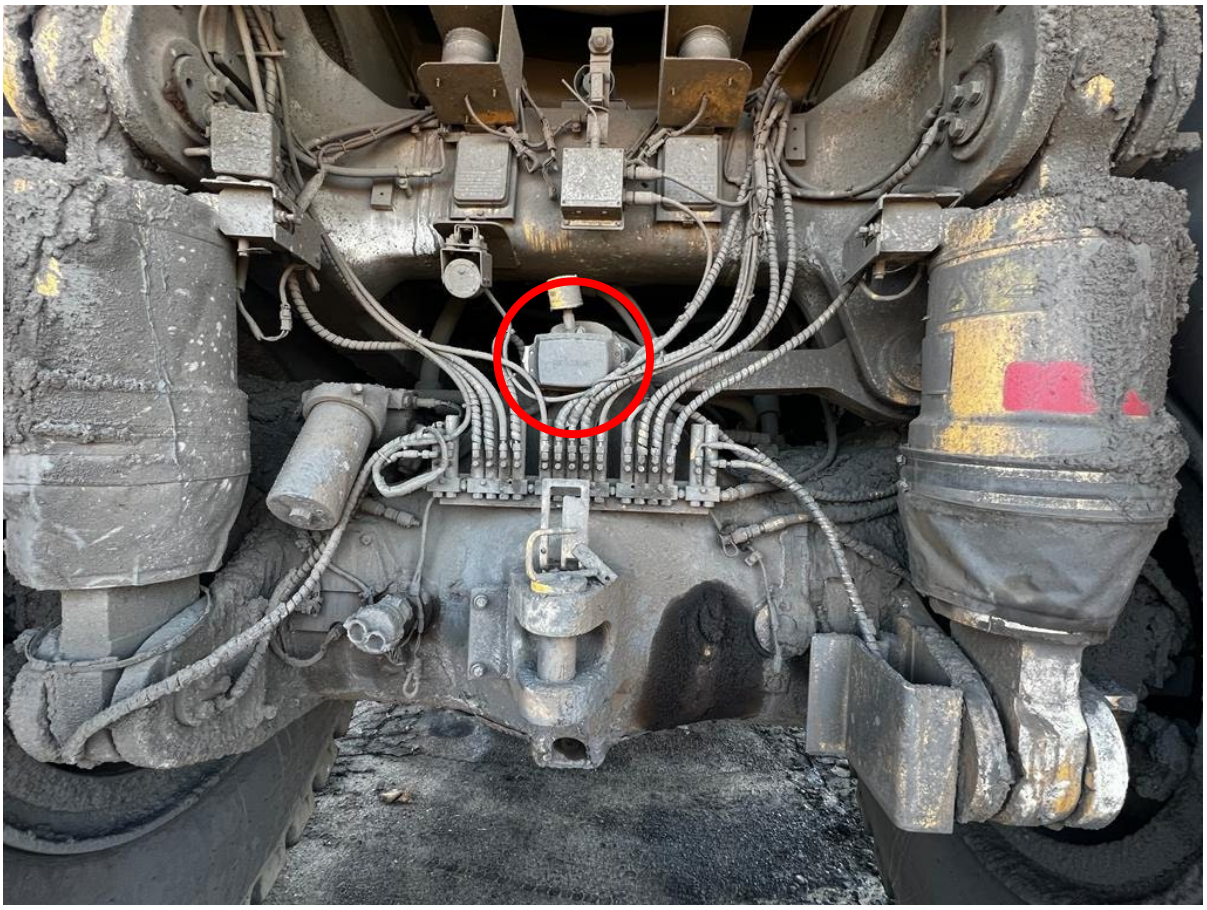
Ensure all radars are function without any obstructions. The rear Radar should only be activated when in reverse.

Radar placements at front for Hitachi 3500:

Radar placements at front for CAT 773 (with unobstructed access):

Radar placements at front for CAT 773 (with obstructed access and/or stop block):

Radar placement at rear:



13 SECURITY

- Ensure all wires are neatly placed and cable tied.
- Ensure connections on all Deutsch plugs are secure.

14 TEST

- Fit a 5 A fuse to power harness.
- Power up and test
- **Configure the GDU to site specifications:** Ensure all components are updated with the latest firmware. **Note:** The procedure may be subject to modifications depending on the type of Machine/Vehicle where the ISS is installed

15 BACKEYE®360 SELECT BN360-200 INSTALLATION

15.1 INTRODUCTION:

This method statement outlines the procedures for the installation of the Backeye®360 Select BN360-200 system. The purpose of this document is to ensure a safe and accurate installation process in compliance with the manufacturer's guidelines and industry standards.

15.1.1 INTRODUCTION TO BN360-200 BACKEYE SELECT 360

Brigade's BN360-200 Series Backeye® Select 360° system is an advanced camera monitor system that provides a simulated birds-eye-view of the vehicle, giving drivers the ability to see all around the vehicle in a single image. Using Backeye® 360 Select system drivers can significantly improve blind spot visibility and low speed maneuverability versus traditional camera monitor systems. The BN360-200 system comprises of four of Brigade's ultra-wide-angled cameras, an ECU, power and interface harnesses and an IR remote control for interaction with the system. By placing the ultra-wide-angled cameras symmetrically aroundthe vehicle the ECU can capture and process single camera images into a single, top-down view of the full surroundings of the vehicle.

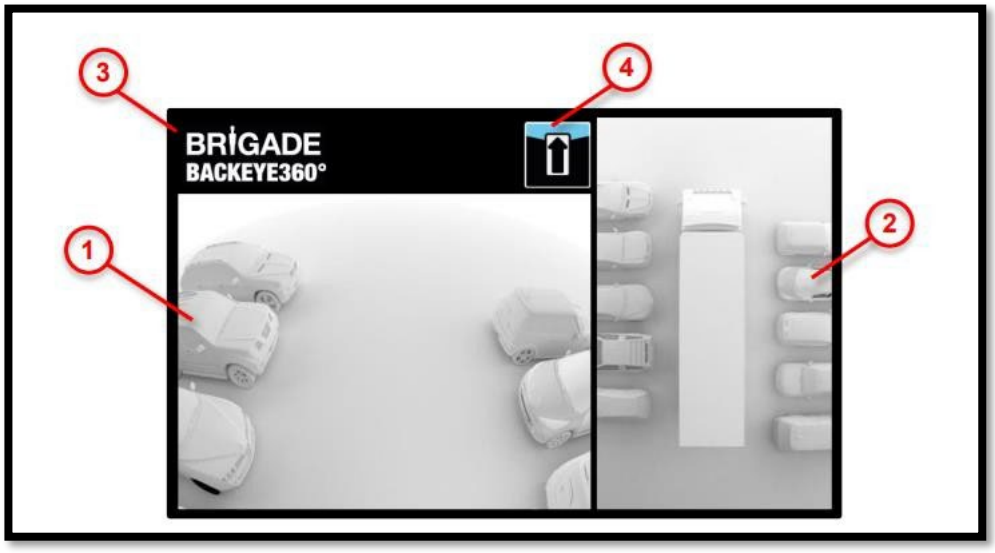
15.2 MATERIALS AND TOOLS

Ensure that all required materials and tools are available before starting the installation:

- Backeye®360 Select BN360-200 system kit.
- Mounting brackets and hardware
- Wiring harnesses and connectors
- Power supply and control unit
- Hand tools (screwdrivers, wrenches, crimping tools, etc.)
- Wiring diagram and installation manual provided by the manufacture.

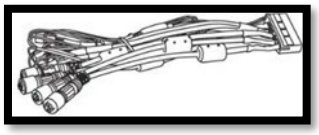
15.3 DISPLAY OVERVIEW (DEFAULT VIEW)

1. Single camera view – shows the single camera normal view (i.e., front, rear, left or right).
2. 360° surround view image – the simulated, 360° birds-eye view of the vehicle.
3. Brigade logo – not visible on portrait full screen views.
4. View information graphic – pictogram that indicates which single camera view is currently being display.



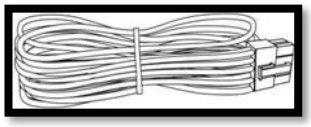
Main interface harness – BN360-200-INT

Main interface harness provides connectivity between cameras, ECU, Set-up & View Select Button.



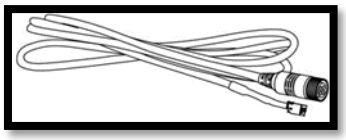
Power harness – BN360-200-PWR

The power harness provides connectivity between vehicle trigger and power sources.



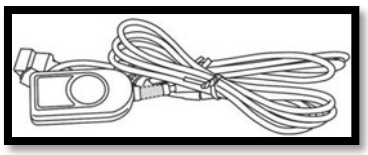
Select Video Output Cable – BN360-VBV-L4015

The Video Output Cable provides the Main Interface Harness with the ability to connect to Brigade VBV style monitors.



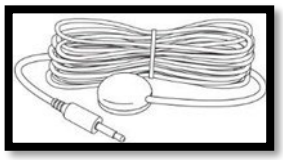
Set-Up & View Select Button – BN360-CP-01

The Set-Up & View Select button is used for calibration and changing the view. The Set-Up & View Select Button does not have to be mounted for driver to use.



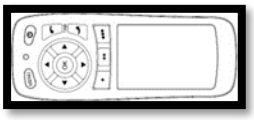
IR Receiver- BN360-200-IR

The IR Receiver provides the BN360-200-ECU with IR remote control functionality.



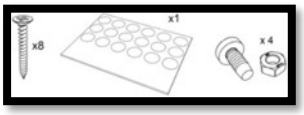
IR Control- BN360-200-RC

The remote control provides the interface between the user and the BN360-200 configuration menu.



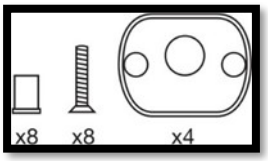
Camera Fitting Kit- BN360-100C-FIX

The fitting kit contains all the required fixing components for fitting the cameras to a vehicle. This consists of self-tapping screws, machine screws and nuts & screw caps.



Isolation Gasket Kit – BN360-100C-MK

The mounting gasket kit stops vehicle noise or interference that may disturb the camera image by insulating the camera and its body from the vehicle ground.



Calibration Tools

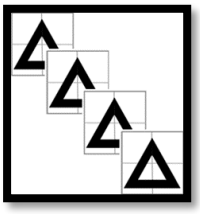
The following is a list of the components that are required to calibrate the Backeye360° products.

Calibration Tool – BN360-CT-01

Used for transferring data (e.g., calibrations, capture images, backup data etc.) between the ECU and PC from data saved on an SD card.

Calibration mats (4 off) – BN360-CAL-MAT

These mats are aligned around the vehicle to perform camera calibration for the 360° surround view image.

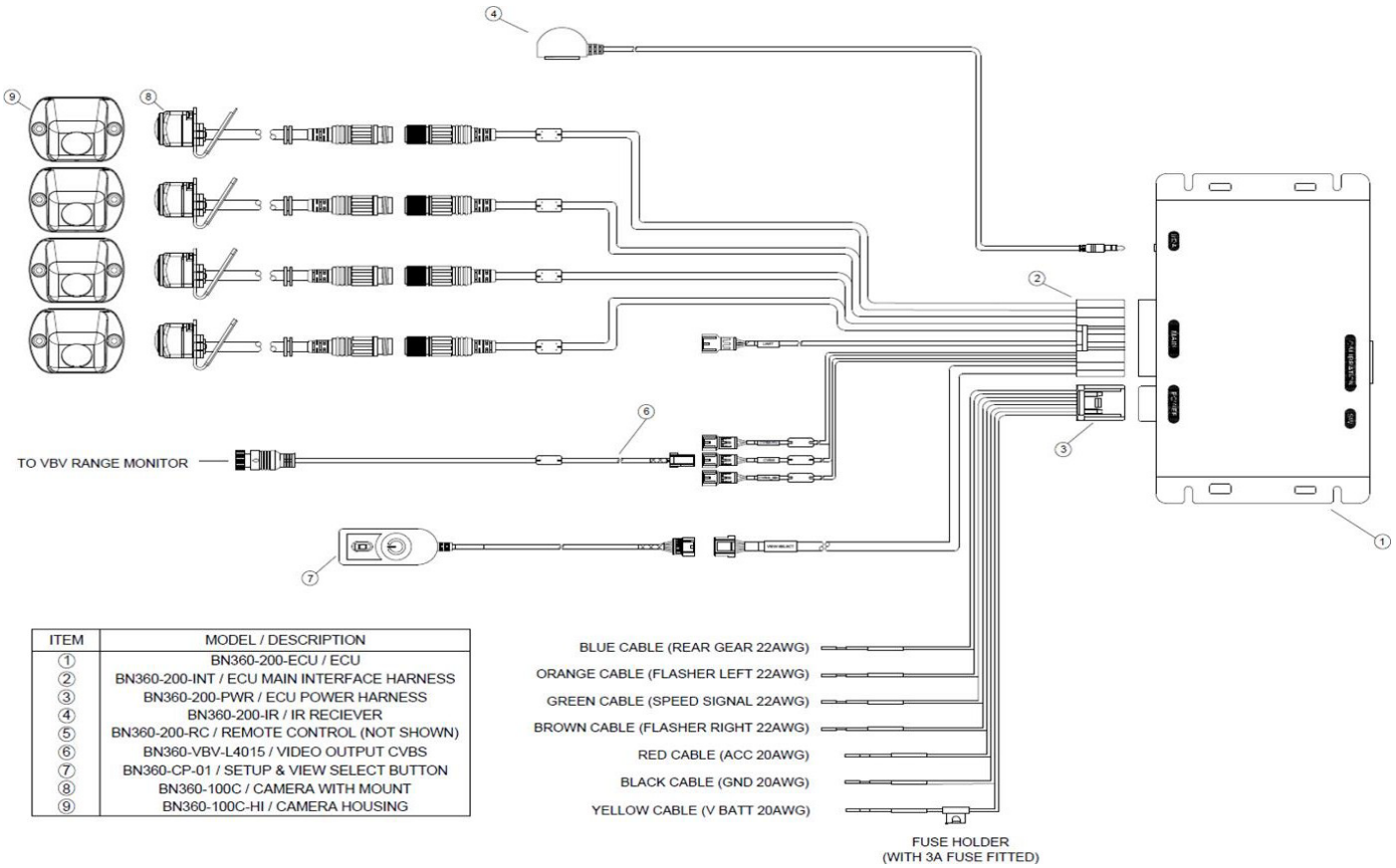


USB – BN360-200-USB

The USB contains all documentation, software and support files required to install and calibrate the BN360-200 system, including the Brigade Backeye® 360° Select Calibration Software

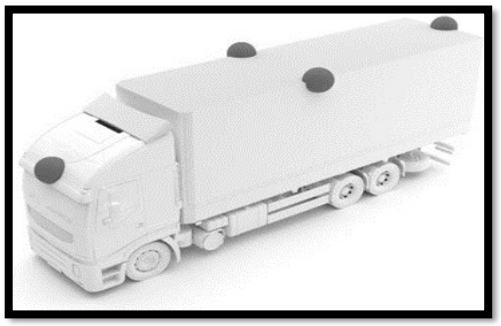
Hardware installation

Connection Diagram



ITEM	MODEL / DESCRIPTION
①	BN360-200-ECU / ECU
②	BN360-200-INT / ECU MAIN INTERFACE HARNESS
③	BN360-200-PWR / ECU POWER HARNESS
④	BN360-200-IR / IR RECIEVER
⑤	BN360-200-RC / REMOTE CONTROL (NOT SHOWN)
⑥	BN360-VBV-L4015 / VIDEO OUTPUT CVBS
⑦	BN360-CP-01 / SETUP & VIEW SELECT BUTTON
⑧	BN360-100C / CAMERA WITH MOUNT
⑨	BN360-100C-HI / CAMERA HOUSING

Camera installation



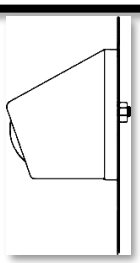
- The BN360-200 cameras should be mounted as symmetrically as possible around the vehicle, preferably centrally on each side of the vehicle. Whilst this is ideal, cameras can be positioned in differing locations on the vehicle although this will affect the overall quality of the 360° image.
- It is recommended that the cameras are mounted temporarily in the first instance to evaluate the camera positioning and perform any adjustments before installing them permanently.

Camera Mounting Angle

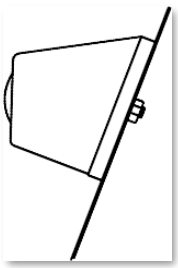
The cameras are designed to be mounted on a vertical surface to give correct alignment such that approximately 10% of the camera image is the vehicle body as shown below. In some cases, this may not be possible and may require adjustment using Brigades universal mounting brackets.

The cameras should be mounted flush to the vehicle body. Ensure the Isolation Gasket Kit is used if the cameras are mounted to metallic body parts.

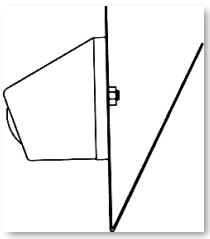
Ideal mounting, vehicle body occupies 10% of camera image.

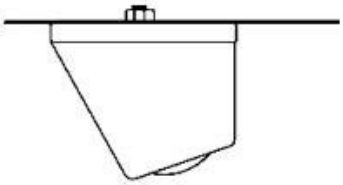


Non-ideal mounting, vehicle body does not appear in camera image.



Non-ideal mounting, vehicle body does not appear in camera image.





Additional drain holes

Camera normal position

Camera rotated 180° in mount

Camera mounting height

The mounting height of the camera is crucial to the quality of the 360° image.

Typically, cameras mounted higher on a vehicle will produce a better 360° surround view image however the minimum mounting height will be dependent on several variables i.e., the length of the vehicle, the position of the cameras etc. If each camera can see the markers the system will calibrate,
However, the overall performance may not be deemed suitable. Cameras mounted too low will affect the perspective of objects above ground level. In the image below the 1m pole appears as expected on the side cameras where the mounting height is good but appears distorted for the front camera that is mounted at 0.6m

Cable routing

Camera cables should run in conduit and along suitable cable runs throughout the machine. Avoid running cables with vehicle power cables to prevent.
interference. To prevent cable damage always allow a reasonable radius when folding excess cable and do not over tighten cable ties. Note: a 13mm hole is required to pass connectors through

ECU Mounting

The ECU should be mounted in a location free from moisture and excessive heat. Note: the ECU body may generate some heat during normal operation

System connection

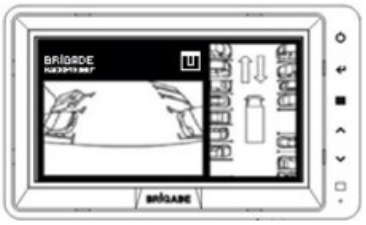
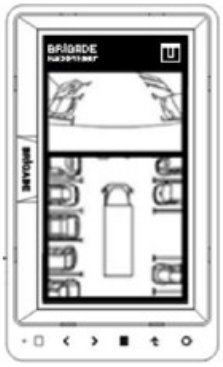
Refer to the vehicle manufacturers bodybuilder guidelines for installation procedures and connectivity in all applications. Ensure the power and ignition connections are fused at source.

Monitor

The monitor should be fixed in a suitable location for the operator and in line with any current legislation/regulations. The system can be installed in landscape or portrait view orientations therefore it may be necessary to rotate the monitor by 90°.

Initial System Power Up

With the system connected as per Section 5.1, turn the vehicle ignition on and check the image output on the monitor.Note: The “WARNING” message will be displayed until a calibration has been completed for the first time.

Default System displayed on a monitor in Landscape position	Portrait configuration displayed on a monitor rotated for correct view orientation
	

Pressing the View Select Button on the Set-up & View Select Button will cycle through the single camera views. This would be a good time to check the camera positioning.

Vehicle Calibration

To create a usable and reliable 360° surround view image a full calibration needs to be performed. As every vehicle and installation is different from the next, the camera positions must be calibrated using the Backeye 360° Calibration Kit. The procedure involves the following steps:

- Camera installation on vehicle.
- Place Calibration Mats around vehicle.
- Capture vehicle images using Calibration Tool.
- Calibrate camera positions using Calibration Software.
- Upload calibration data to the Backeye 360° ECU.
- Verify Calibration result.

\

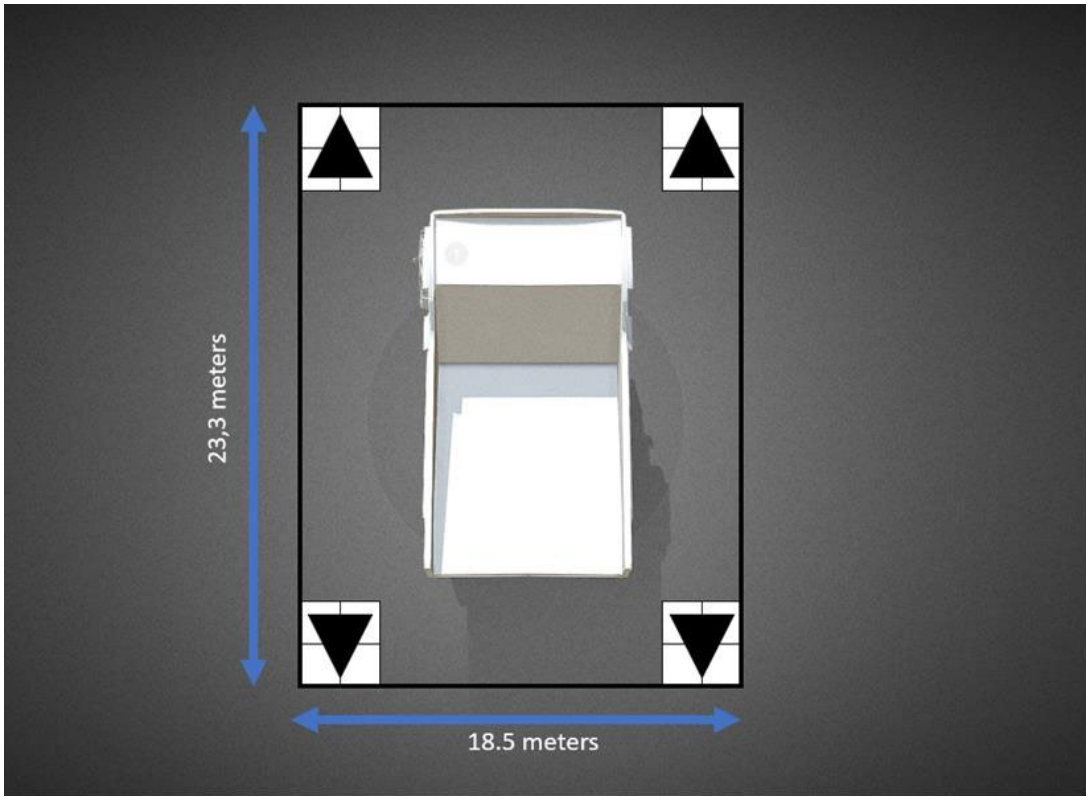
Calibration environment

Based on the CAT 789C and CAT 789D we are required to add approximately 5 meters to each side, for example, length +5 meters towards the rear and length
+5 meters towards the front, with the same applying for the sides.

For the worst-case scenario, an open area is required in the shape of a rectangle with a length of

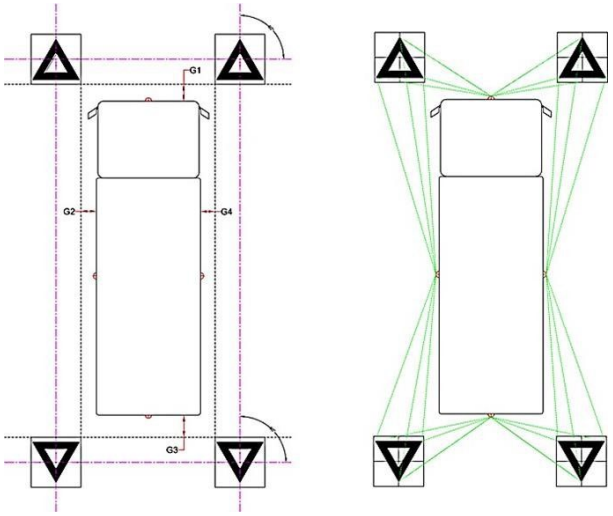
23.3 meters and a width of 18.5 meters, as illustrated below. During the 360-installation

procedure, the bucket must be raised as the technicians require access to the rear of the cab.



Calibration Pattern and Vehicle Alignment

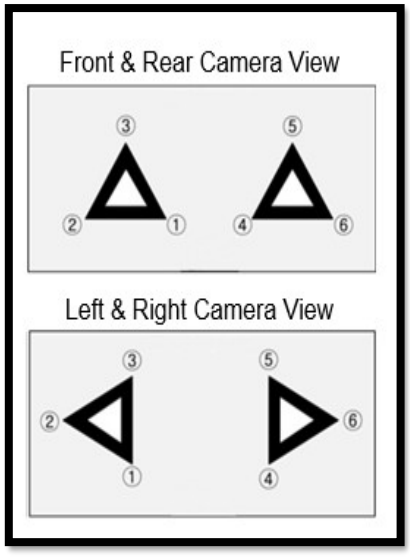
The Calibration Mats should be placed symmetrically around the vehicle as shown in the image below. The Calibration Matts should ideally be placed as close to the cameras as possible however this may vary for different vehicle and installation types, if each camera is able to see all three points of the twotriangles in the cameras field of view as shown in the image below (right) the system will calibrate. The more accurately the Calibration Matts are positionedaround the vehicle, the better the result will be. Chalk line, string or laser tools are recommended for



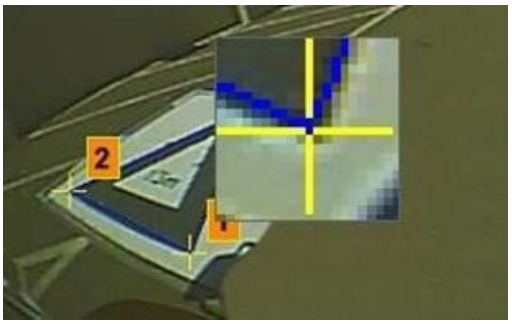
improved accuracy.
Note: it is imperative that the Calibration Mats are laid out as shown above, if the orientation of the mats is different (e.g., they are rotated through 90°) thesystem will not calibrate correctly.

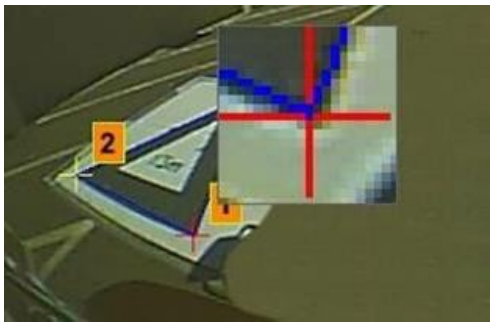
Calibration control points

The triangles in the calibration pattern are automatically detected and the control points are displayed. The software automatically detects the corners of the triangles and derives the coordinates of each image when loaded. The order of the control points starts from the triangle point closest to the vehicle and works clockwise to the other two points. Calibration is not possible if the order of the control points is not correct.

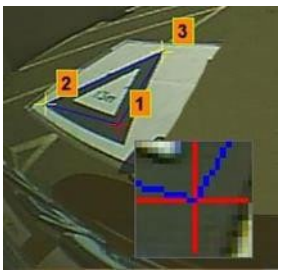


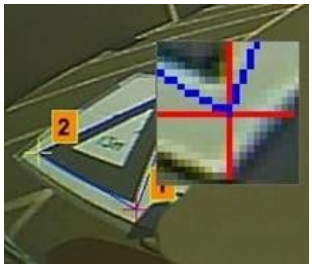
It may be necessary to adjust the control points once the images have been loaded. The control point image will enlarge when the mouse curser is moved to the control point. This enables the control points to be positioned accurately. Left click the control point that needs modifying. The selected control point crosshair will turn red. To deselect the control point, just left click anywhere else other than the selected control point.

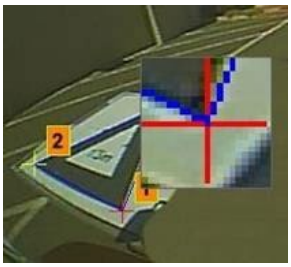




Align the control point to the outermost corner as shown below, aligning the blue lines to the triangle. The images to the right show before and after
alignment. It is recommended to move the control point outside of the triangle to leave a clear gap between it and the triangle then work the point backtowards the triangle until it meets the outer edge of the triangle. Check and modify all six control points for each camera.







CERTIFICATE OF COMPLIANCE

A valid certificate of compliance (COC) primary purpose is to act as a measure of internal control for machinery of any type or related installation. Before any COC is issued, a test report is conducted and approved by the chief inspector. It should be noted that the certificate on hand is legally binding, effective from the date of sign off and authorization.

DISCLAIMER

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POLICY OF WARRANTY

MPI provides a **One (1) year warranty** period on all components and installations. A service and maintenance evaluation are required every **six (6) months with in the one year period**, implying a coverage of two service sessions. should the client fail to meet this service inspection guideline. The warranty will be revoked. In addition, a service-call for the replacement of consumable items, such as wires, will be charged to the client. Please note: Any **tampering**, **liquid damage** and **malicious damage** invoked on the product will also result in the abrogation of this warranty.

FINAL CHECK POINTS.

Installation checklist	
Installation date:	
OEM Make & Model:	
Fleet number:	
Engine hours:	
Technician Name:	
Job card number:	

Components	Serial No:	Firmware Version
GDU		
GDU IMEI		
Sim card		
RCM		
RTD		
Handset		
CCU		
Radar		
Cameras		
DVR		

General	Tick
Ensure that the GDU is communicating to all devices and that no component faults is displayed.	
Ensure that the USB cap is closed and secure on the CCU, GDU and RTDs.	

Connections	Tick
Ensure Deutsch plugs/pins are properly connected and correctly crimped.	
Ensure that all wires and plugs exposed to vibrations or/and to the elements are sleeved.	
Ensure that there are no loose connections, pinched wires, or un-isolated wires / joints.	
Positive and Negative wires directly connected to battery.	
Positive, Negative wires fitted with inline fuse holder.	
Any signs of oxidation of terminals at the battery? (*if yes, report to workshop or responsible foreman to ensure remedial measures*)	

GDU	Tick
Check that the audio is functional and clear.	
Ensure that the GDU is ergonomically placed and ensure bracket it is tightly secured.	
Check that all site-specific configuration parameters are in accordance with the latest signed off parameters.	
Ensure that the Ignition, Reverse are all operational and triggered accordingly.	

RCM	Tick
Ensure that the RCM Bracket is straight and tightly secure. (HDV's)	
Check RCM placement and orientation as per installation guideline.	
Ensure that the RCM is placed more than 1.2m away from radio antennas or strobe lights.	
Ensure that the RCM is **not** close to radio coex cables.	
Check that the RCM firmware aligns with the latest signed off version.	
Ensure that the magnet rubbers are not torn and are properly mounted.	

Harness	Tick
Check that all wiring is secure / strapped to vehicle and sleeved.	
Check that all Deutsch plugs contain tamper-resistant heat shrink tubing and tightened with cable ties.	

Handset	Tick
Check that all buttons are functional. (Handset / GDU)	
Ensure that the T8 Handset is isolated from the vehicle using plastic brackets/ mounts.	
Ensure that the handset wiring is correctly secured.	
Ensure that the handset is mounted securely and ergonomically placed within reach of the operator.	

Radar	Tick
Has the Radar been mounted with the brackets using 4 x screws and magnets	
Does the front right Radar work	
Does the front Left Radar work	
Does the Rear right Radar work when in reverse.	
Ensure nothing is Infront of the radar.	

Camera system (Haul trucks)	Tick
Check all the cameras and ensure they are secured with brackets, check all bolts.	
Ensure that the screen is securely mounted and displaying all cameras.	
Ensure that the device key is closed.	
Ensure that the wires are not exposed and are placed correctly.	
Ensure that the power wire is connected to the ignition relay.	
Ensure all negatives are connected to the vehicle body and not to the vehicle battery.	
Inspect fuses and ensure that the correct fuse is used as per installation manual.	

Configurations and confirmation (To be done after installation)	Tick
Correct Vehicle Type set	
Correct Vehicle Name set	
Correct Vehicle Size set	
Display Brightness: Day and Night Set to **Zero**	
Sound Volume Set to **Zero**	
Power down RTLS on Ignition Off	
Power down Wi-Fi on Ignition Off	
Power down GSM on Ignition Off	
Confirmation of the latest Firmware loaded on to the units	
Confirmation of system reporting online with reference number	

Comments:

_____

_____

_____

_____

_____

Conformance Statement

I do hereby certify that the products as listed above have been duly checked, inspected, and conforms to the specifications as requested.

Technician Name, Surname, and signature:

_____

Supervisor Name, Surname, and signature:

_____

Date: Location:

_____ _____

Customer Name, Surname, and signature:

_____

Date: Location:

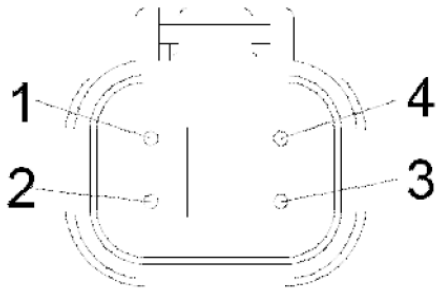
_____ _____

Disclaimer

The product sold by MPI have been subject to testing and should only be utilized for their desired applications. No liability arising out of the use or failure of our products or services can in any way be attributed to MPI. MPI reserves the right to make any changes whatsoever to this document, products, and services without notice.

APPENDIX

WIRING DIAGRAMS FOR RADAR TO ISS



Deutsch Pin	Signal Name	Brigade Wire Colour
1	Ground	Brown
2	CAN High	Green
3	Positive (+12/+24V)	Yellow
4	CAN Low	Blue

15.4 CONTACT DETAILS

HEAD OFFICE GAUTENG	Unit 10, The Stewards Industrial Park, c/o Main Reef Rd & Beryl Str, Benoni	+27 (0) 10 020 0515
WORKSHOP GAUTENG	Unit 9, The Stewards Industrial Park, c/o Main Reef Rd & Beryl Str, Benoni	+27 (0) 10 020 0515
MPUMALANGA	Unit 3, Midway Park, November Street, Middelburg, Mpumalanga	+27 (0) 13 244 1677
KWAZULU-NATAL	Unit 2 Hillmax, 31 Hillclimb Road, Westmead, Durban, KwaZulu-Natal	+27 (0) 31 700 6378
NORTHERN CAPE	Unit 3, Asbes Street, Meerkat Plaza, Industrial Area, Kathu, Northern Cape	+27 (0) 15 690 0982
WESTERN CAPE	9 Tedric Avenue, Stikland, Cape Town, Western Cape	+27 (0) 21 945 1158

16 NOTES