

GemOne®

EN

Sapphire V2SC Hardware Installation

Procedure Manual

Version 1.2 - March 2024



Please contact the GemOne support desk after the table has been filled out. This is required so modules operate and report correctly.

Gem Serial #	<i>Example</i> <i>sap_721f06a1</i>
End User	<i>GemOne</i>
End User Address	<i>16355 South Elm Rd, Olathe, Kansas 66062</i>
Equipment Make	<i>Toyota</i>
Equipment Model	<i>8FGCU18</i>
Equipment Serial #	<i>Gem4982</i>
Key Hours at Install	<i>2</i>

Has GemOne been sent the customer setup sheet?
(drivers, override codes, admin users)



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1 - Safety Precautions

Read the following safety precautions before installation or operation.



Abnormal Conditions

Should the V2SC display become hot, start to emit smoke, or a strange odor; immediately turn the power off and contact GemOne. Continued usage is dangerous and may result in fire or electrical shock.

LCD Screen

Never apply heavy pressure on the V2SC display or subject it to strong impact. Doing so may crack the screen or LCD panel glass, resulting in personal injury or major damage to the device.

Power Supply

Do not use the Sapphire V2SC with any voltage other than that specified. Avoid situations that can cause damage to the power cable.

2 - Introduction

Purpose

This document is to be used as a guide to install the Sapphire V2SC onto various types of equipment, whether they are internal combustion or electric equipment.

Scope

This document is to be used by a trained and authorized person(s) with the necessary PPE as a guide for the installation, operation, and management of the Sapphire V2SC. This document provides information on the components of the Sapphire V2SC, installation procedure, and general troubleshooting methods.

Terminology

Term	Description
V2SC	Sapphire V2SC Display
NO	Normally Open
NC	Normally Closed
COM	Common
AUX	Auxiliary
PPE	Personal Protective Equipment
LV	Low Voltage

Term	Description
HVDC	High Voltage DC Converter
HV	High Voltage
IB	Interface Box
ACC	Accessories
PWR	Power
DI	Drive Inhibit

3 - Sapphire V2SC Technical Parameters

There are three configurations with the interface box to suit different battery voltages:

1. Low Voltage (LV) - 12-24V
2. High Voltage DC (HVDC) - 36-48V
3. High voltage (HV) - 80V



There is a sticker at the back of the Sapphire V2SC display with 8-36V input. This is OK as the display will get power from the interface box.

Parameter	Minimum	Maximum	Unit
LV Interface Box			
PWR In (Nominal)	12	24	V
ACC Detection (Nominal)	7.5	48	V
Digital Input Detection (ON)	5	48	V
HV Interface Box			
PWR In (Nominal)	36	80	V
ACC Detection (Nominal)	7.5	80	V
Digital Input Detection (ON)	5	80	V
DC-DC Converter			
PWR In (Absolute)	20	90	V
Voltage Out	-	12	V
Ampere Out	-	10	A
Sapphire V2SC Outputs			
Drive Inhibit Relay (NO)	-	10	A
Auxiliary Relay (NO)	-	10	A
Auxiliary Relay (NC)	-	10	A
Sapphire V2SC Miscellaneous			
Touch Sensitive Display	-	-	Ω
RFID Reader	-	-	-
Strobe Alarm (Nominal)	12	48	V
Analog Input (Nominal)	0.5	80	V

4 - Sapphire V2SC Components

The following section shows pictorial examples of components of the Sapphire V2SC system. The final product may vary slightly from what is depicted.



Sapphire V2SC Display



Main Display Harness



Interface Box



Black Connector Harness



Grey Connector Harness



Mounting Hardware



RFID kit
(optional)



RFID extensio harness
(optional)



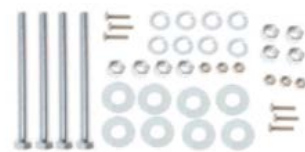
Harness connected
to interface box



Strobe alarm
(optional)





Overhead plate
(optional)



Overhead hardware
(optional)

5 - Hardware Placement

The following section shows pictorial examples of components of the Sapphire V2SC system.

Item	Example	Placement
<p>Sapphire V2SC Display with RFID Option</p>		<p>The display should be in a location where both the reader and touch screen display is easily accessible and available to the operator.</p> <p>Placement should also not impede on the operator to view the surrounding safely, i.e. mirrors.</p>
<p>Sapphire V2SC Interface Box</p>		<p>The interface box (IB) is required to be bolted to the chassis of the equipment. The surface needs to be flat or upright with minimal movement or vibrations. It cannot be at a 45 degree angle.</p> <p>Do not install onto high vibration areas such as the firewall.</p> <p>Fixings such as cable ties, double-sided tape, velcro, and silicone cannot be used to secure the interface box to the equipment.</p> <p>Consider space for cabling when selecting the location.</p>

Item	Example	Placement
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Sapphire V2SC
Strobe/Alarm Option



Strobe/Alarm should be positioned to maximise visibility to the operator and surroundings.

The V2SC display can be mounted to the same bracket or separately.

Consider **height restrictions** if the strobe is mounted outside the overhead guard.

Sapphire V2SC Cabling



Cabling must be secured and routed in a way that it is **free from excessive heat, moving components, and high electrical interference areas.**

6 - Installation Guide

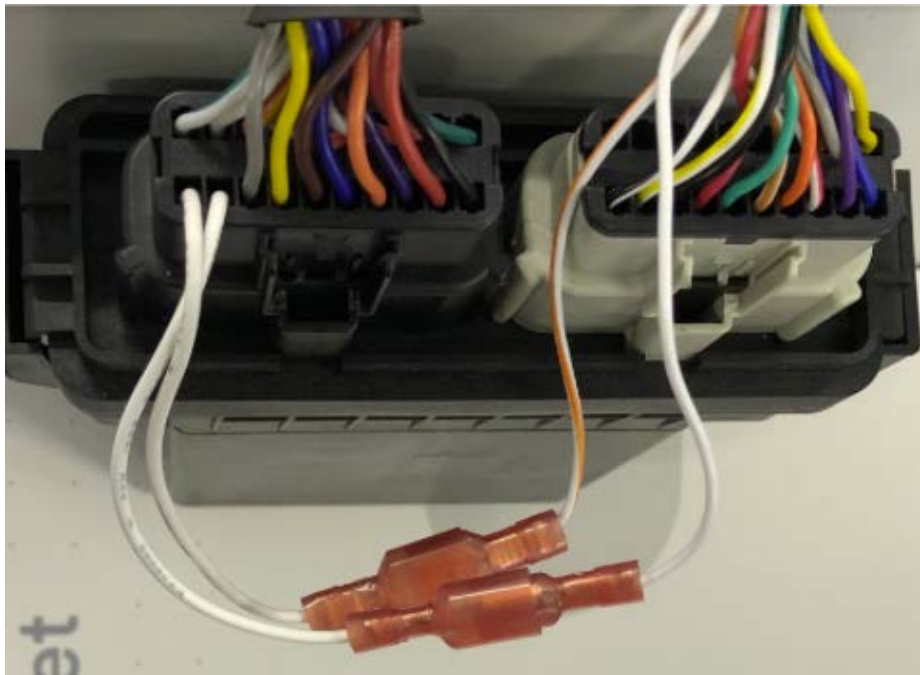
Now that suitable locations have been found to mount the hardware, wires need to be installed onto the equipment in order to get the Sapphire V2SC operational.



The type of connectors and methods used will vary from workshop to workshop. The section below will be generic guides for two main categories; internal combustion and battery electric.

Connecting V2HARNA (Black) and V2HARNB (Grey) to the Interface Box

There are two positions on the interface box for the black and grey connector. Each connector has a special notch so they can only be plugged into the correct position.



There are 4 loose wires (with spades) coming out of the black and grey connectors. Connect the two wires coming out of the black connector to the two wires coming out of the grey connector.

It does not matter where each wire is connected as long as those 4 wires are connected.

RAM Mount

The RAM mount will attach directly to the back of the display with kits using PIN access only. Please see the section below for kits using an RFID reader. The RAM mount aligns with two holes in the middle of the display.



Place the M4 spring washer onto the M4 screw.



Align the RAM mount to the holes and then secure the screws using a phillips head screwdriver.

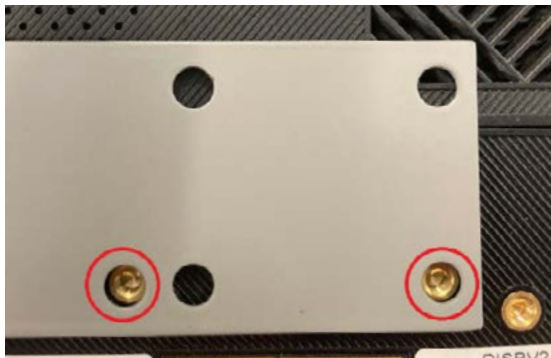


RFID BRACKET and RAM Mount

The RFID bracket attaches to the back of the display using the middle two holes. Secure the RFID reader to the bracket prior to securing the bracket to the display.



Align the RFID bracket onto the display using the holes highlighted below.



Align the RAM mount using the same holes as the RFID bracket and then secure using the M4 screw and spring washer.



General Wiring Information

The following information describes where to connect wires found on the grey connector.

Wire Color	Purpose	Connected To
<u>Black</u>	Ground	Ground / Battery Negative
<u>Red</u>	Power	Battery Positive / Constant Power Source
<u>Yellow</u>	Ignition Sense	Accessories Power / Key switch accessories position
<u>Grey</u>	Digital Input 1	Operator presence is most common for input 1. Operator Presence is measured by either the deadman or seat switch.
<u>Brown</u>	Digital Input 2	Forward motion is the most common for input 2.
<u>Orange</u>	Digital Input 3	Reverse motion is the most common for input 3.
<u>Red</u>	Analog Input	THIS IS FOUND ON THE MAIN DISPLAY HARNESS. This is the most common for scales or engine run time (Internal Combustion only). If the scale is installed, the analog input is reserved for the scale and cannot be installed as an input timer.
<u>White</u>	Drive Inhibit Relay COM	Internal Combustion & Battery Electric. White wire with male spade. Connected between the seat/dead man switch.

Wire Color	Purpose	Connected To
White/Orange - - - -	Drive Inhibit Relay NO	Internal Combustion & Battery Electric. White / Orange wire with female spade. Connected between the seat/dead man switch.
White/Black - - - -	Aux Relay #1 COM	Relay for lockouts (impact and checklist). Connected to Ground / Battery Negative
White/Yellow - - - -	Aux Relay #1 NO	Relay for lockouts (impact and checklist). Connected to Aux device Ground / Battery Negative
Purple - - - -	Aux Relay #2 COM	Relay for idle timeout or scale overweight. Connected to Ground/Earth/Negative
White/Red - - - -	Aux Relay #2 NO	Relay for idle timeout or scale overweight. Connected to Aux device Ground / Battery Negative. Only required if Aux Relay #2 NC is not connected.
Blue - - - -	Aux Relay #3 NC	Relay for idle timeout or scale overweight. Connected to Aux device Ground / Battery Negative Only required if Aux Relay #2 NO is not connected.

Internal Combustion Installation Notes

The diagram below is an overview of the installation required for internal combustion equipment. The diagram does contain the optional strobe/alarm combo and RFID Reader.

Key Notes

- Since the drive inhibit relay is connected between the seat switch, the equipment **can still be started but operators will not be able to operate** the equipment before logging into the system.
- When equipment and module information is sent across to GemOne, it is important to include the **mounting orientation** of the **interface box**. This is required to properly calibrate the impact sensor contained within the interface box.
- GemOne also needs to be notified if the equipment is gas or diesel as additional **power saving** configurations are required to complete the set up.
- Standard inputs for internal combustion equipment are below.
All inputs are dependent on equipment input availability:
 - Digital input 1 / **Gray** wire - seat switch
 - Digital input 2 / **Brown** wire - forward motion
 - Digital input 3 / **Orange** wire - reverse motion
 - Analog input / **Red wire** (from V2SC main display harness) - engine run time OR scale



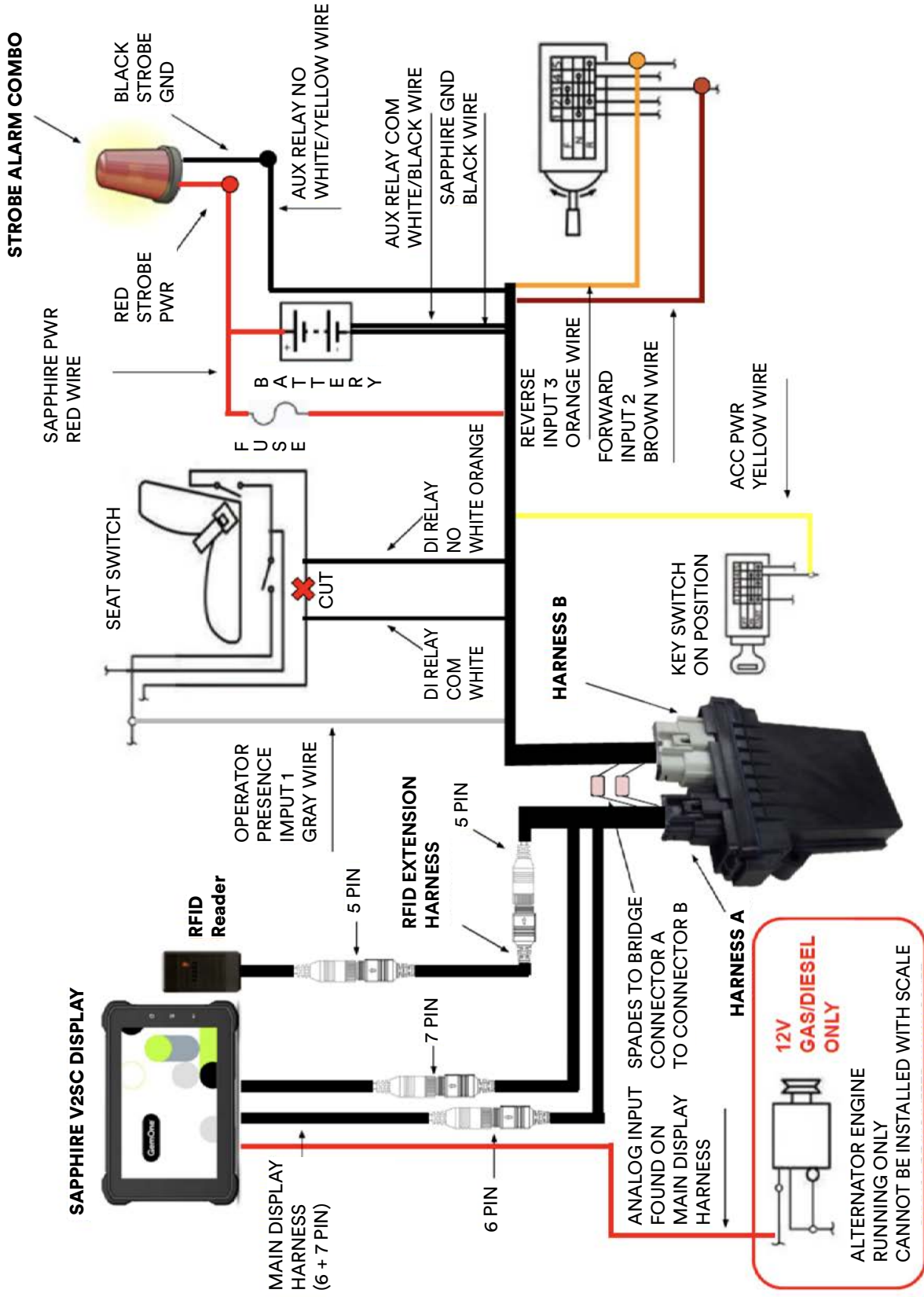
If the scale is installed, the analog input is reserved for the scale and cannot be installed as an input timer.

Inputs (grey, brown, orange, and red analog) wires do not affect the operation of the equipment. They only count the time On and time Off.

Note down how the inputs trigger (normally 0V then it changes to 5V upon active or vice versa) and inform GemOne.

If the equipment does not have a seat switch for drive inhibit, the key switch output can be used in lieu of the seat switch.

12V Internal Combustion/Diesel & 24V Battery Electric Wiring Diagram



Saphire V2SC-LV (12-24V)

36-48V Battery Electric Notes

The following diagram is an overview of the installation required for 36-48V battery electric equipment. It uses a DC-DC converter. It does contain the optional strobe/alarm combo and RFID Reader.

Key Notes

- The **DC-DC converter must be installed** onto 36-48V batteries. Failure to do so will result in damage to components of the SAP-V2SCAM-HVDC kit.
- The **maximum voltage** for the **yellow ACC wire** is **55V (Absolute)** with the Low Voltage Interface Box.
- Since the drive inhibit relay is connected between the operator presence switch, the equipment **can still be turned on but operators will not be able to operate** the equipment before logging into the system.
- When equipment and module information is sent across to GemOne, it is important to include the **mounting orientation** of the **interface box**. This is required to properly calibrate the impact sensor contained within the interface box.
- Standard inputs for 36-48V battery electric equipment are below.
All inputs are dependent on equipment input availability:
 - Digital input 1 / **Gray** wire - seat or deadman switch
 - Digital input 2 / **Brown** wire - forward motion
 - Digital input 3 / **Orange** wire - reverse motion
 - Analog input / **Red** wire (from V2SC main display harness) - scale



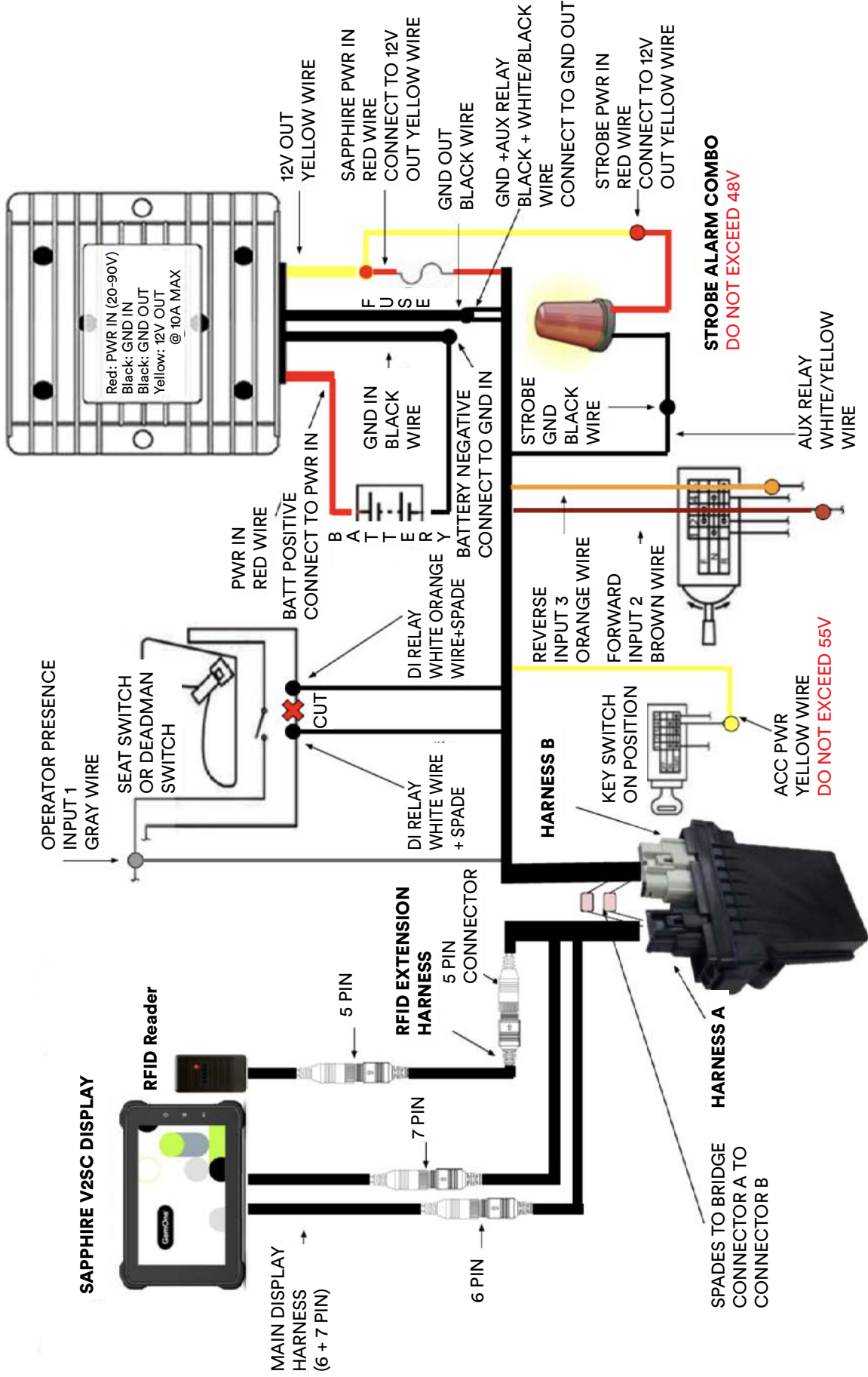
If the scale is installed, the analog input is reserved for the scale and cannot be installed as an input timer.

Inputs (grey, brown, orange, and red analog) wires do not affect the operation of the equipment. They only count the time On and time Off.

Note down how the inputs trigger (normally 0V then it changes to 5V upon active or vice versa) and inform GemOne.

If the equipment does not have a seat switch for drive inhibit or if error codes related to the operator presence appear, the key switch output can be used in lieu of the seat switch.

36-48V Battery Electric Wiring Diagram



Sapphire V2SC-HVDC (36-48V)

80V Battery Electric Installation Notes

The following diagram is an overview of the installation required for battery electric equipment. It does contain the optional strobe/alarm combo and RFID Reader.

Key Notes

- The SAP-V2SCAM-HV kit uses a dedicated high voltage (HV) interface box built specifically to handle voltage spikes.
- Voltage spikes can occur on 80V batteries during degeneration charging and the HV interface box can handle these spike.
- Since the drive inhibit relay is connected between the operator presence switch, the equipment **can still be turned on but operators will not be able to operate** the equipment before logging into the system.
- When equipment and module information is sent across to GemOne, it is important to include the **mounting orientation** of the **interface box**. This is required to properly calibrate the impact sensor contained within the interface box.
- Standard inputs for 80V battery electric equipment are below.
All inputs are dependent on equipment input availability:
 - Digital input 1 / **Gray** wire - seat or deadman switch
 - Digital input 2 / **Brown** wire - forward motion
 - Digital input 3 / **Orange** wire - reverse motion
 - Analog input / **Red** wire (from V2SC main display harness) - scale
- The **maximum voltage** input for the **strobe alarm** is **48V**. Contact GemOne if installing onto an 80V battery and if a voltage source less than 48V is not available.



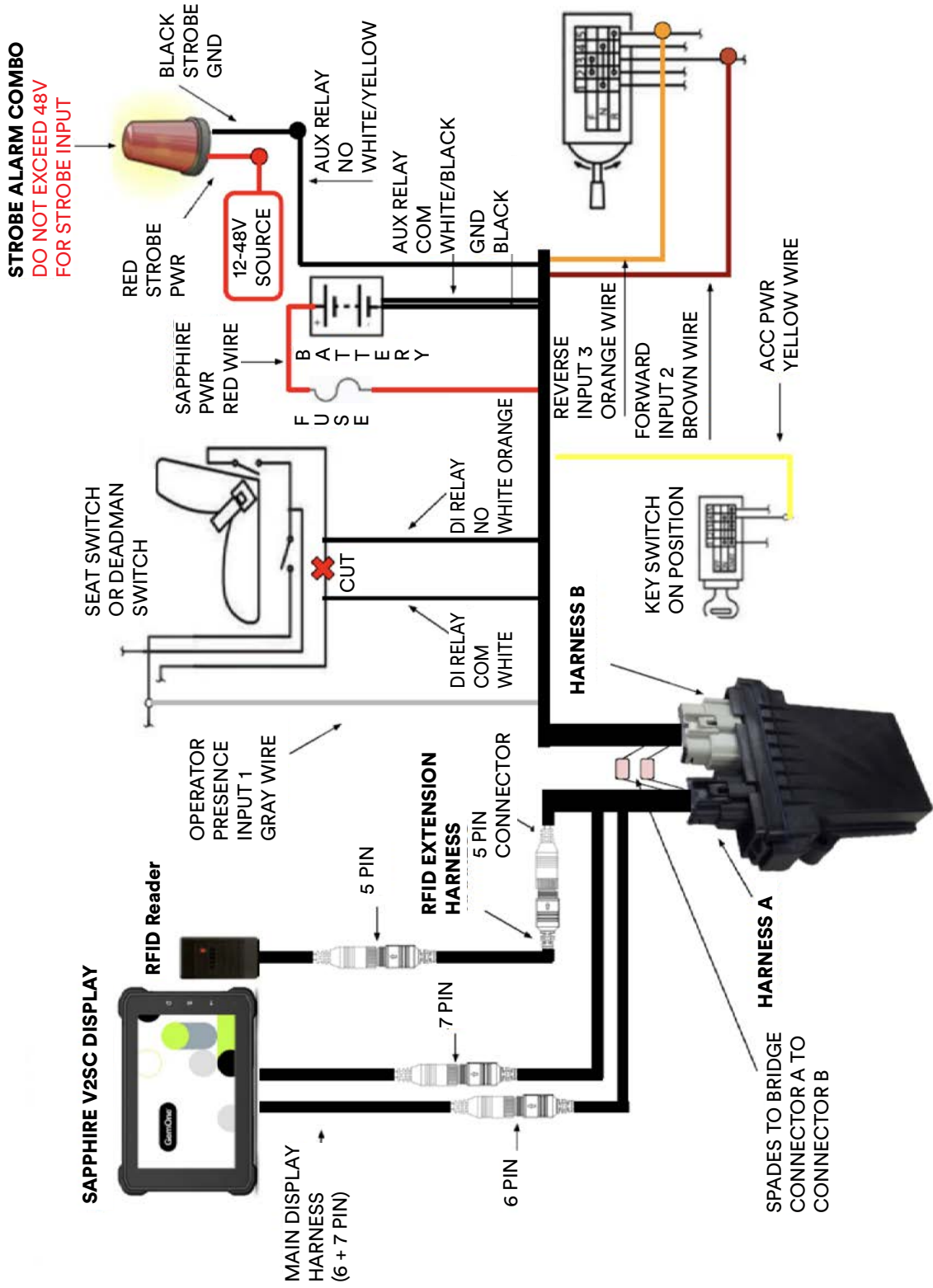
If the scale is installed, the analog input is reserved for the scale and cannot be installed as an input timer.

Inputs (grey, brown, orange, and red analog) wires do not affect the operation of the equipment. They only count the time On and time Off.

Note down how the inputs trigger (normally 0V then it changes to 5V upon active or vice versa) and inform GemOne.

If the equipment does not have a seat switch for drive inhibit or if error codes related to the operator presence appear, the key switch output can be used in lieu of the seat switch.

80V Battery Electric Wiring Diagram



Sapphire V2SC-HC (80V)

7 - Sapphire V2SC Operation

Powering Device

Turn the key to accessories (internal combustion) or On (battery electric) and the sapphire system will boot up. It will take ~25 seconds for the display to boot up completely before it is ready for an operator to log in.



If the sapphire does not turn on when the key is turned, check where the yellow wire is installed to. The yellow wire needs to see at least 7.5V in order for the sapphire to start up.

If a DC-DC converter is installed with the sapphire, ensure the GND IN is the same as the GND OUT. The GND needs to be common in order for the sapphire to function properly.



Turn key to Accessories or ON



Logging In

Now that the sapphire is booted up, the screen will say “touch screen to start” and touching the screen will bring up the keypad.



The default PIN is **6061** and this can be entered as a Driver or Supervisor:

- 6061 as a **Driver** - this will **prompt** the **checklist** questions. The drive inhibit relay will **close after** completing the checklist questions.
- 6061 as a **Supervisor** - this will **bypass** the **checklist** questions. The drive inhibit relay will **close immediately** after logging in.



Answering Checklist Questions

If a checklist is required, select from the YES and NO responses to the checklist questions. Once complete, the drive inhibit relay will close and the sapphire will return to the driver home screen.



All sapphire units have default checklist questions and a 6AM checklist prompt loaded onto the display. These can be customized for the customer during the setup process.

Unlocking the Sapphire

If the sapphire is locked out by impact or checklist question, log in as **6061** under a **Supervisor**, select **Unlock**, and then turn the key to OFF to log out.



After a module has been unlocked, the sapphire will prompt the checklist questions for the next operator that logs in. This will occur regardless of whether or not the operator completed the questions earlier.

Logging Out

If a checklist is required, select from the YES and NO responses to the checklist questions. Once complete, the drive inhibit relay will close and the sapphire will return to the driver home screen.



If the sapphire is turning off immediately at key Off, check to ensure the red wire is receiving a constant power feed. The red wire will need to see voltage at all times in order for the system to function properly.

If the sapphire is not logging out, check to ensure the yellow wire is not sensing a voltage when the key is turned OFF. This voltage change will trigger the sapphire to log the operator out.

8 - Sapphire V2SC Configuration and Information

Powering Saving Mode

There are two timers on the display and one on the interface box for power saving:

1. Display: 1 minute dim timer.

The display will automatically dim after 1 minute with the key being turned OFF. Turning the key to ON will wake up the sapphire and the display will appear.

2. Display: 15 minute shutdown timer.

If there is no activity on the display and the key remains at the OFF position, the sapphire will shut down completely after 15 minutes.

3. Interface box: shutdown mode.

This setting must be set by GemOne staff in order to activate the interface box shutdown. Refer to sections below for more information on how this is set up. Shutdown mode will turn off the interface box after ~3 seconds of the key being turned OFF.



Contact GemOne if an extended shutdown is required. This will keep the display On for a period of time after the key is turned to Off and no one is logged in.

Relay Information & Operation

Drive Inhibit Relay

A Normally Open (NO) relay is used to inhibit the operation of equipment. This is mandatory for access control and it will be installed between the operator presence switch.

Operators must log into the sapphire using their PIN or RFID card, which will prompt a checklist (if applicable), and then the relay will close. The equipment can only be operational once the relay is closed.



Since the drive inhibit wires are installed between the operator presence, the equipment can be turned on but will not be operational until the relay is closed.

When the key is turned to Off, the operator is logged out of the session, the relay will open back up, and the equipment cannot be operated until another operator logs into the sapphire.

Auxiliary Relays

Lockout (NO) Relay

A Normally Open (NO) relay is available for the lockout relay.

This relay will activate during lockout events such as:

- Impacts above set threshold
- Critical checklist question failures
- Scale overweight (optional - if fitted)

When the sapphire locks out, this auxiliary relay will close the contacts and will activate the device attached to the relay. For example, the most common item that is connected to this relay would be the strobe/alarm combo.

Other items apart from the strobe/alarm can be connected to the lockout relay.



Contact GemOne if additional information is required on what can be fitted to the lockout relay.

Changes to the impact lockout threshold can be changed remotely via the portal.

Changes to critical questions can be changed using the portal.

Auxiliary (NC) Relay

A Normally Closed (NC) relay is available for items such as:

- Idle timeout
- Scale overweight

When the event is triggered, the auxiliary relay will open the contacts and will typically deactivate the item attached to it.



Contact GemOne for more information around idle timeout. This requires an input within the detection range of the sapphire system and additional settings.

Inputs

There are 3 x digital inputs and 1 x analog input available on the sapphire V2SC. These can be connected to various areas of the equipment to detect time ON or time OFF.

Input timers are subject to availability of the equipment and the trigger voltage needs to be within the specified range of the sapphire system.

The input detection ranges are:

1. 0-5V = OFF
2. 5-80V = ON (interface box dependent)



Inputs do not affect the operation of the equipment. They are only a counter to determine the time ON or time OFF.

Checking Inputs on Sapphire

Installation of inputs can be verified using the diagnostics screen on the sapphire. Since inputs work by detecting a change in voltage, the diagnostics screen will also display a change when an input is activated or deactivated.

For example, if the grey wire, input 1, is connected to a 5V seat switch.

When no one is on the seat, the voltage reading is 5, the sapphire will show input 1 as ON.

When someone is on the seat and the voltage drops to 0V, the sapphire will show input 1 as OFF.



Since there is a change from ON to OFF, jumping off the seat will trigger the change from OFF to ON. GemOne will need to be notified of the direction of the switch (5V to 0V or 0V to 5V) so the correct configuration can be made on the portal.

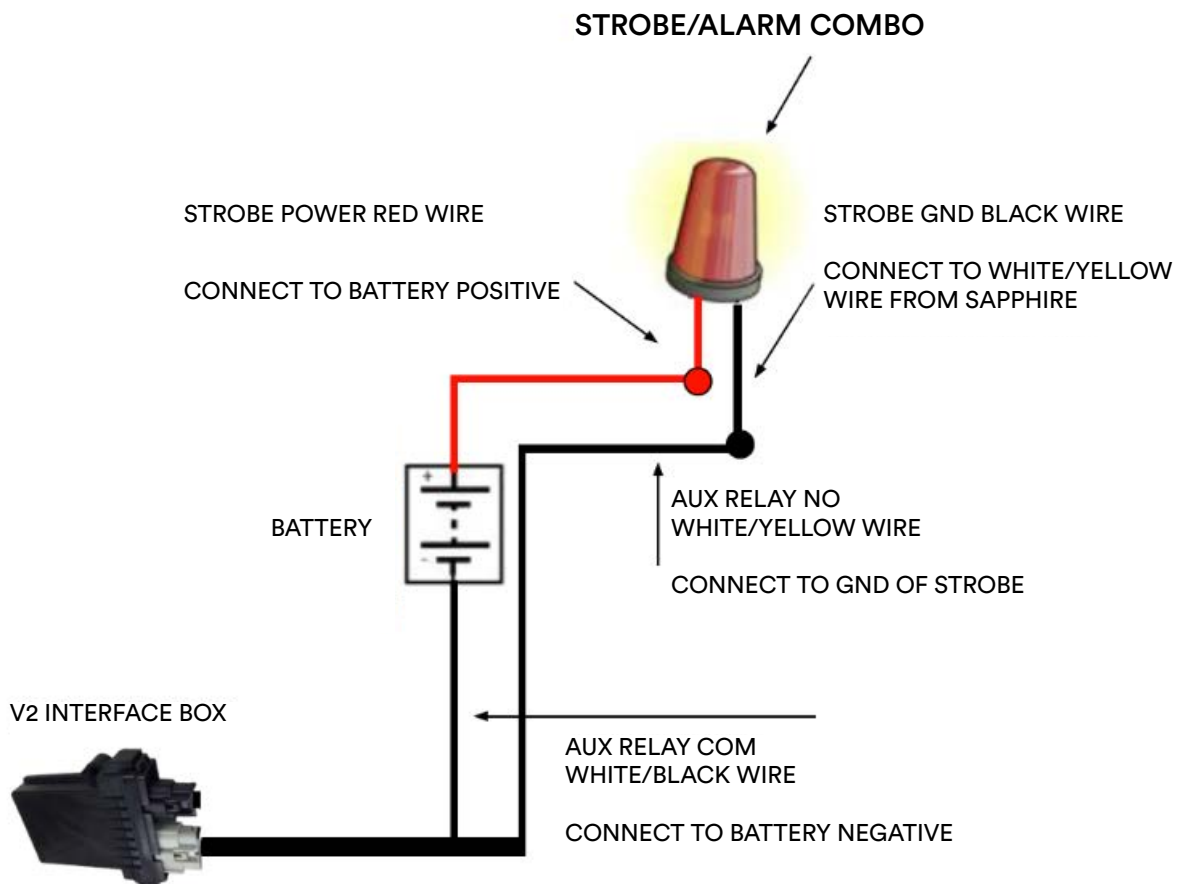
9 - Installing Aux Device for Lockout

If the impact lockout threshold is set on the sapphire, an auxiliary device such as the optional strobe/alarm can be fitted with the sapphire. This strobe/alarm will activate when the sapphire unit locks out via impact or critical checklist failure.

Refer to the section below on how to install the strobe/alarm to work with the auxiliary relay.

Installation Diagram

– *Strobe/Alarm on 12-48V equipment*



Activating the Aux Device

The auxiliary device should be tested to ensure the installation is correct. This can be done by activating the lockout relay.

This can be done by:

Answering a **critical checklist** question unexpectedly.

This will lockout the module after completing the pre-start or post-start section.

This will activate the lockout relay and trigger the auxiliary device.

10 - Installation of Overhead Mounting Bracket (optional)

The following components will be required to install the mounting bracket kit:

- 2 x Overhead Guard Plates (optional)
- 1 x Overhead Hardware (optional)
- 1 x Strobe and Alarm (optional)



The mounting bracket kit and strobe/alarm combo reflected in the picture below are optional accessories. These options are not standard in the Sapphire V2SC kits.

Procedure

Authorized and trained person/s must ensure correct use of appropriate PPE and safety precautions are in place before installing to ensure person/s and equipment are free from damage/injury.

See image below for finished product. Two plates are clamped on the overhead guard with the strobe mounted on the top and the Sapphire V2SC mounted underneath. The standard RAM mount is used to secure the V2SC to the overhead guard. The end of the bolt will be facing up but they will be lower than the strobe.



- Select a location to mount the two plates that will not interfere with the operation of the equipment and will meet overall height requirements.
- Line up the holes on both plates and secure using the nuts and bolt and select suitable holes on the top plate to mount the strobe.
- Select a suitable location to mount the Sapphire V2SC & RAM mount to the bottom plate.
- Route cables and tighten all the fixings and clamps.



The image above should be used as an example only. A site evaluation may be needed to verify that the placement meets site overall height and safety requirements.

11 - Items to send to GemOne

The following information is required to be sent to GemOne so the sapphire can be set up on the portal. This can be emailed across or communicated over the phone to GemOne staff.

Customer Details

- Customer Name:
- Customer Address:

Equipment Details

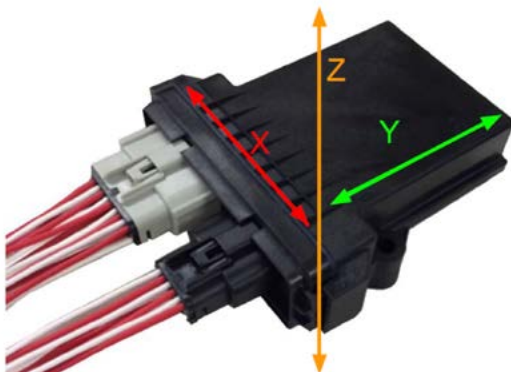
- Equipment Fleet Number:
- Equipment Make:
- Equipment Model:
- Equipment Serial Number:
- Hours at installation:
- Battery type & voltage:

GemOne Details

- GemOne serial number (sticker at the back of the display):
- Orientation of interface box when mounted to equipment:



The interface box has a 3-axis accelerometer. The orientation is important as configuration settings can be made to configure the correct axis.



GemOne staff will use this information to set up the sapphire system on the relevant customer portal.

Additional configurations will be sent across from the portal to finalize the setup.

12 - Checklist of Items

Item	Action	Expected Outcome
1	Turn key to ON	Sapphire display turns ON It will take ~25 seconds for the sapphire to boot up completely.
2	Start and attempt to operate the equipment	The equipment cannot be operated.
3	Log in using 6061 as a driver	A checklist will appear if one was not completed earlier. The drive inhibit relay will close after the pre-start and then the drive inhibit relay will close.
4	Attempt to operate the equipment	The equipment is now operational .
5	Check input timers on the diagnostics screen	Inputs on the diagnostics screen should change status (ON to OFF and vice versa) depending on the trigger.
6	Check connectivity of the sapphire	Look at the Network field under diagnostics. A carrier name will be populated here if there is an active connection.
7	Turn key to OFF	The session will end , the operator is logged out of the sapphire, and the drive inhibit relay opens up .
8	Gas/Diesel with RFID & pin code access ONLY	If the RFID reader is installed, turning the key to OFF will also power off the RFID reader after 5 seconds at key OFF.
	Check power saving mode	If the RFID reader does not turn off, contact GemOne.
9	Gas/Diesel with PIN code access ONLY	The 5 pin connector will need to be measured to determine if the power saving mode is active.
	Check power saving mode	Measure the top right pin. With power saving activated, it will measure 0V. It is the pin to the right of the aligning notch on the 5 pin connector.



Measure this PIN
It should be 0V with
power saving activated.

13 - Support

In case of issues, questions or feedback, feel free to contact our support team.

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