



Sapphire v3 Installation guide

Hardware installation guide of the Sapphire v3

Safety Precautions



Abnormal Conditions

Should any of the Sapphire v3 components become hot, start to emit smoke, or a strange odor; immediately turn the power off and contact GEM One. Continued usage is dangerous and may result in fire or electrical shock.

LCD Screen

Never apply heavy pressure on the Sapphire v3 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

Never use any of the Sapphire v3 components with a voltage other than that specified. Use the included DC/DC converter for machines with a voltage above 12V. Avoid situations that can cause damage to the power cable.

Introduction



Purpose

This document is to be used as a guide to install the Sapphire v3 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 v3. It provides information on the components of the Sapphire v3, installation procedure, and general troubleshooting methods.

Components



Main components

The Sapphire v3 contains multiple components, depending on the features used. The main components can be found below.

- Sapphire v3 interface box
- Sapphire v3 display
- DC/DC converter
- RFID keypad
- Strobe alarm
- Weight sensor (transducer)
- Various wiring and antennas
- Various mounting kits

A picture of each item can be found on the following pages.

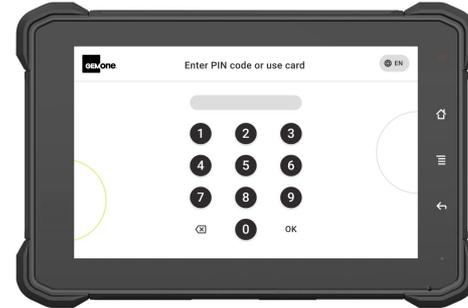
Components



Sapphire v3
Interface box



RFID keypad



Sapphire v3 Display



DC/DC converter



Strobe alarm

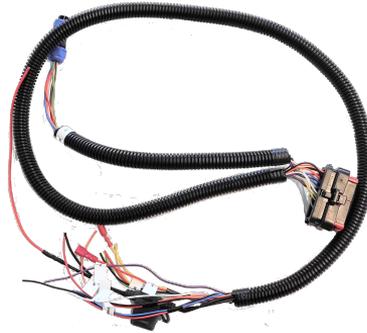


Weight sensor
(transducer)

Components



GPS and data antenna



Wiring harness (X1)



Display data connector



Overhead plate mounting kit



Display mount

Wiring harness



Main wiring harness X1

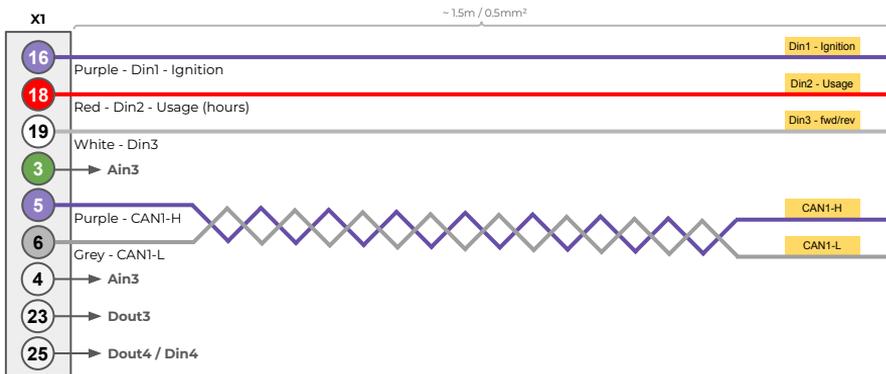
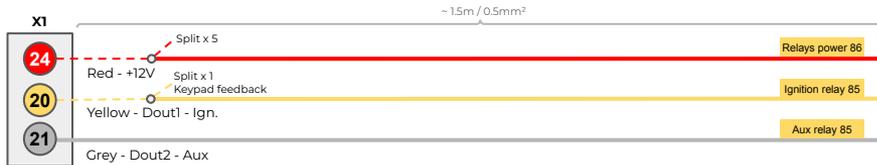
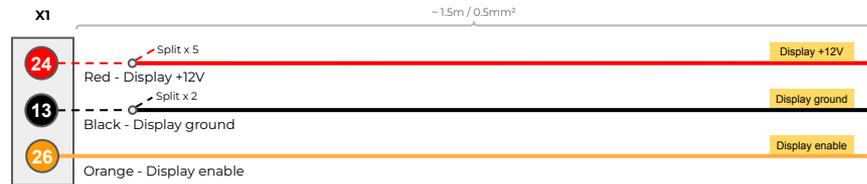
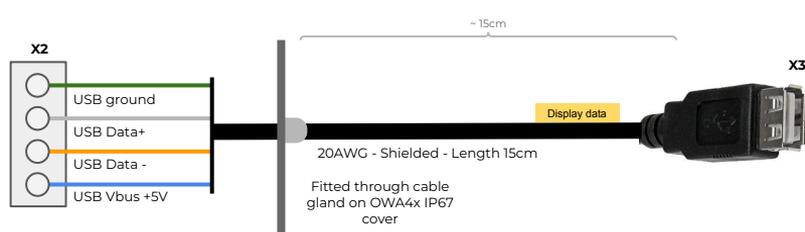
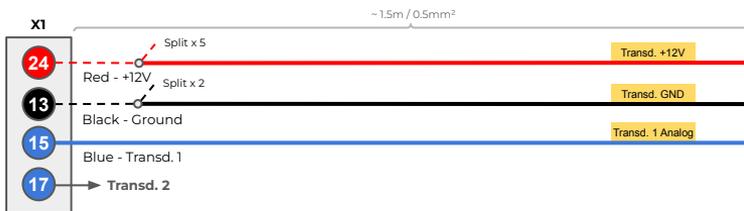
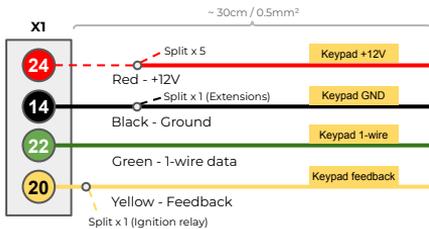
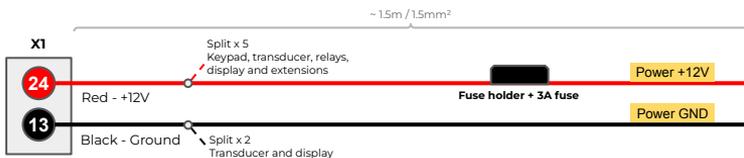
The main wiring harness of the Sapphire v3 has two bundles. Each bundle has its own flexible tube protecting the wires from heat and vibrations.

Extensions bundle

The 7-pin Weipu extensions connector is reserved for future use and should not be connected.

Machine bundle

The machine wire bundle on the main wiring harness contains all wires and splits required for installation on an asset. This includes ignition, usage and extra inputs, power to the display and all necessary connections to the RFID keypad, relays and weight sensor. A complete overview and pinout can be found on the next page.



Electrical diagrams



Schematics

The

next few pages describe the necessary electrical connections component by component.

- DC/DC converter
- Asset inputs
- Display
- RFID keypad
- Drive Inhibit Relay
- Aux relay: Strobe light / Buzzer
- Load sensor

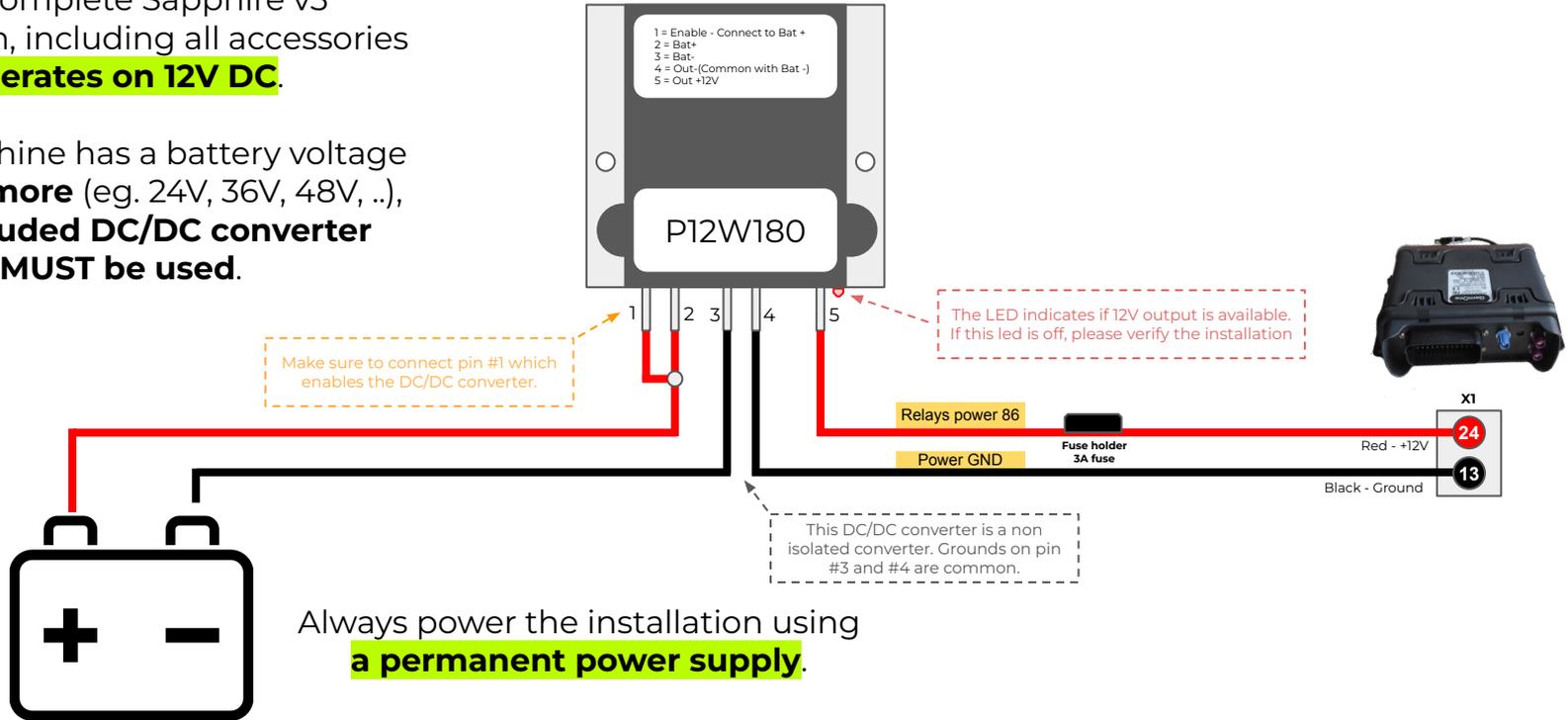
General guidelines

Please note that every machine is different. This document contains general guidelines that apply to most machines. Always consult your vehicle's technical manual in case of doubt.

DC/DC converter

The complete Sapphire v3 installation, including all accessories **operates on 12V DC.**

If the machine has a battery voltage of **15V or more** (eg. 24V, 36V, 48V, ..), **the included DC/DC converter MUST be used.**



Always power the installation using **a permanent power supply.**

Do not install behind the ignition key switch, emergency button or any other supply that might cut of power.

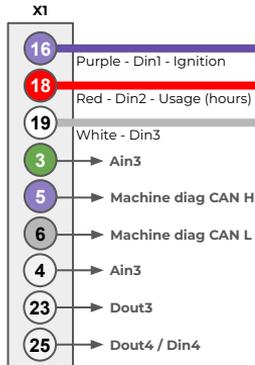
Asset inputs

All inputs have a **absolute maximum input rating of 50V**.

Use measurement points in the machine which will never exceed this voltage (eg. during charging, regenerative braking, ...)

Ignition input Din1 is mandatory and should always be connected.

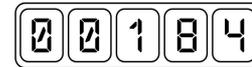
- Must be **low (<6V)** when machine is off
- Must be **high** when machine switched on - before engine is on
- Must **stay high when the engine is running**
- Must go back **low** when machine is turned off



Solder these connections and cover with heat shrink to isolate.



Key switch



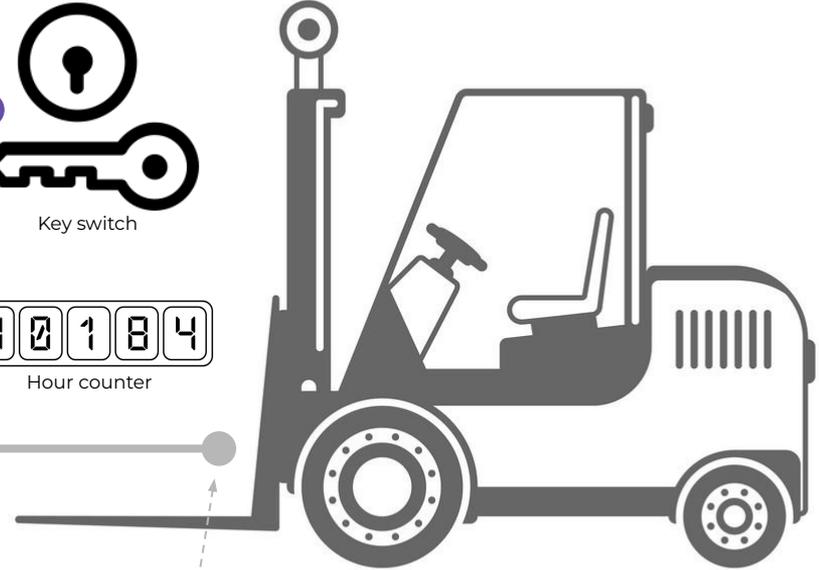
Hour counter

Connecting the **Usage input Din2 is optional** but recommended.

Must be **low (<2V)** when machine is not in use actively used. Free to connect to any point in the machine which you refer to as 'usage'.

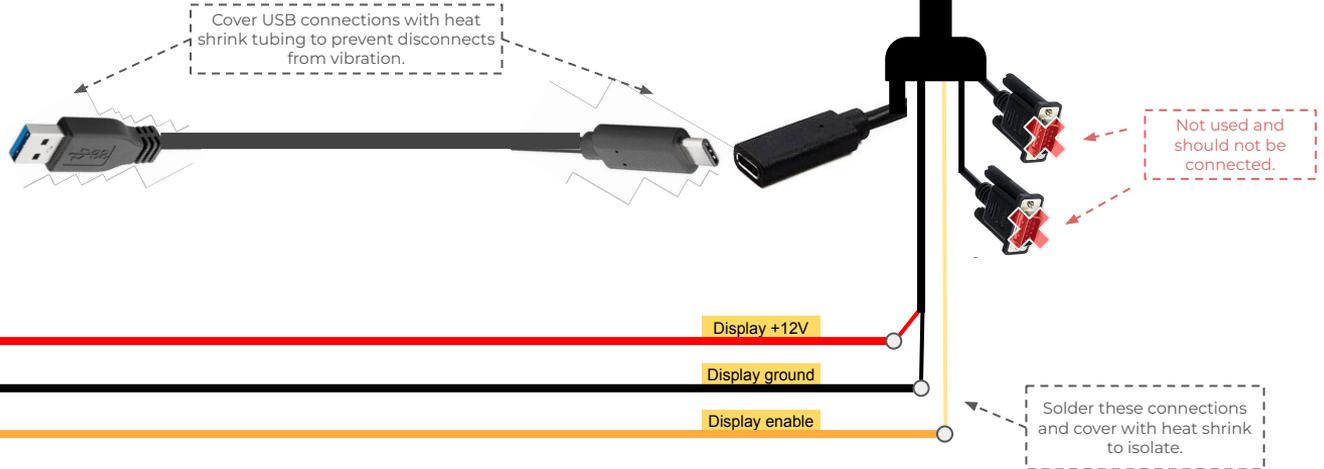
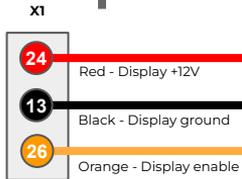
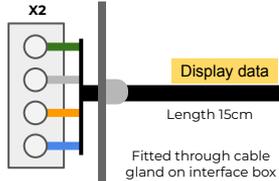
- **Physical hour counter** with on/off input
- Signal indicating **engine running**
- **Pneumatics or hydraulics** pumps on/off
- **Seat switch** - driver present?
- **Foot pedal** - operator using machine?

Digital input 3 is optional and free to use. Common use cases are forward/reverse signal, seat switch, seat belt switch, ... Voltages **below 2V** are detected as **low**.



Display

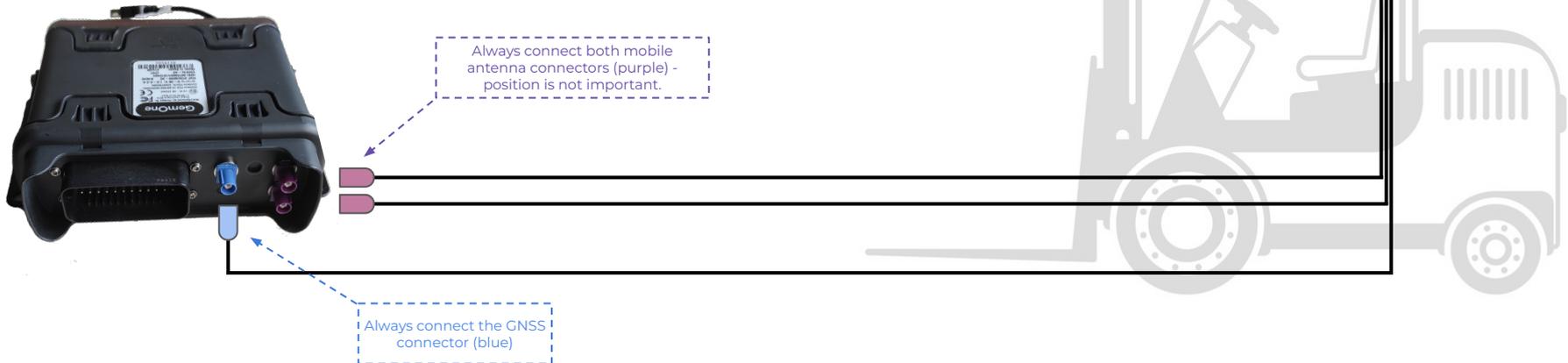
Once started, the display **shows the application splash screen**. Other functionality is triggered if the **ignition signal** on the interface box is turned on.



Antenna

The Sapphire v3 has an **external 4G LTE antenna combined with GNSS** to get the vehicle location.

The antenna should have an **unobstructed view of the sky**. This is especially important to receive the GPS signal. Please make sure that the antenna is **not shielded by a metal object** or other impenetrable material. The best mounting position is **on top of the machine**.



RFID keypad

Mount the RFID keypad on a location **easy accessible for operators** to enter a pin or swipe an RFID card.



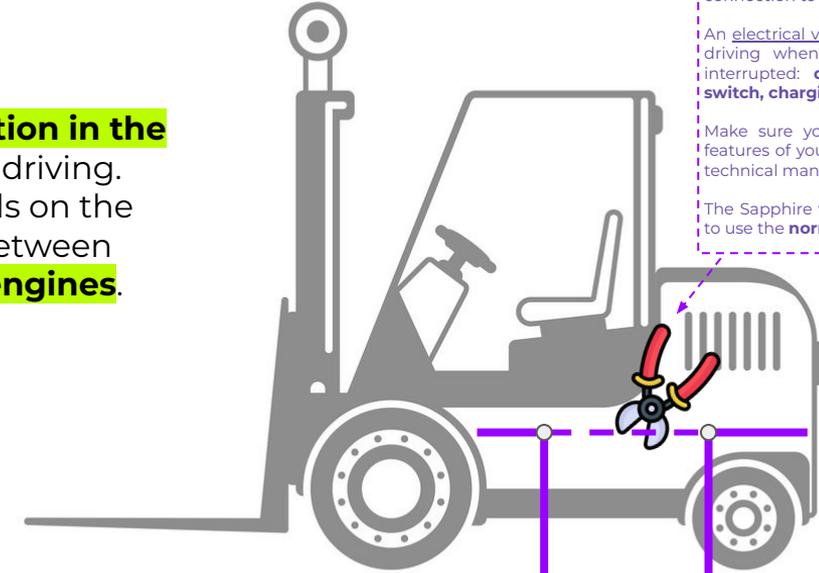
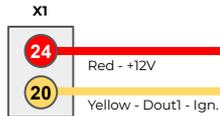
This led indicates if the machine is actively being blocked (red) or not (green). Ignition blocking only triggers when the ignition input on the interface box is high.



Solder these connections and cover with heat shrink to isolate.

Drive Inhibit Relay

The Sapphire v3 can **interrupt a connection in the machine** to prevent an operator from driving. Which connection to interrupt depends on the machine type. This will be different between **electrical vehicles** and **combustion engines**.

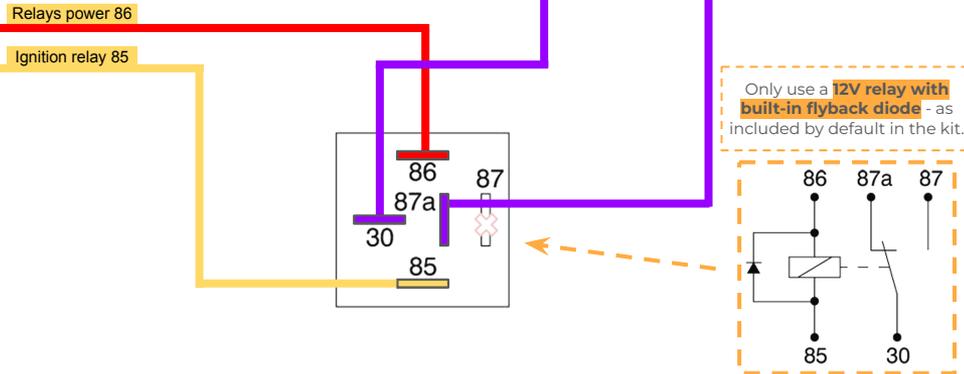


In a vehicle with a combustion engine, the easiest connection to interrupt is the **starter relay coil**.

An electrical vehicle usually prevents an operator from driving when one of the following connections is interrupted: **driver seat switch, driver seat belt switch, charging switch/input, ...**

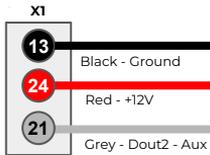
Make sure you never circumvent any of the safety features of your machine; always consult your vehicle's technical manual.

The Sapphire v3 will use active blocking, so make sure to use the **normally closed contact** of the relay.



Aux relay: Strobe light / Buzzer

The optional **strobe light and buzzer** can **warn a supervisor** of an incident such as an impact lockout, critical checklist failure or a manual lockout.

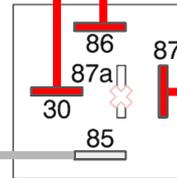


Solder these connections and cover with heat shrink to isolate.

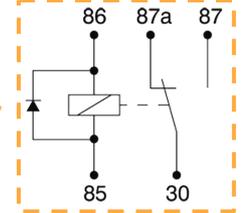


The Sapphire v3 will use active warning, so make sure to use the **normally open contact** of the relay to connect the strobe light.

Power GND
Relays power 86
Aux relay 85



Only use a **12V relay with built-in flyback diode** - as included by default in the kit.



Load sensor

The optional **load sensor** translates the pressure in a hydraulic line to a corresponding voltage. The **pressure will go up and down together with the load** on the forks of the machine.

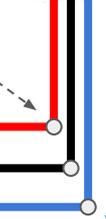
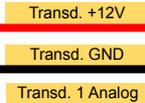
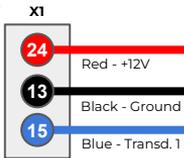
Pressure port uses a **1/4-18 MNPT** connection. Maximum pressure is **3000 PSI**

Solder these connections and cover with heat shrink to isolate.

The load sensor will **output a voltage between 0 and 5V** on 'Transd. 1 Analog', using the ground as a reference. This output voltage is linear with the pressure in the hydraulic system.

- 0 PSI will output 0V
- 3000 PSI will output 5V

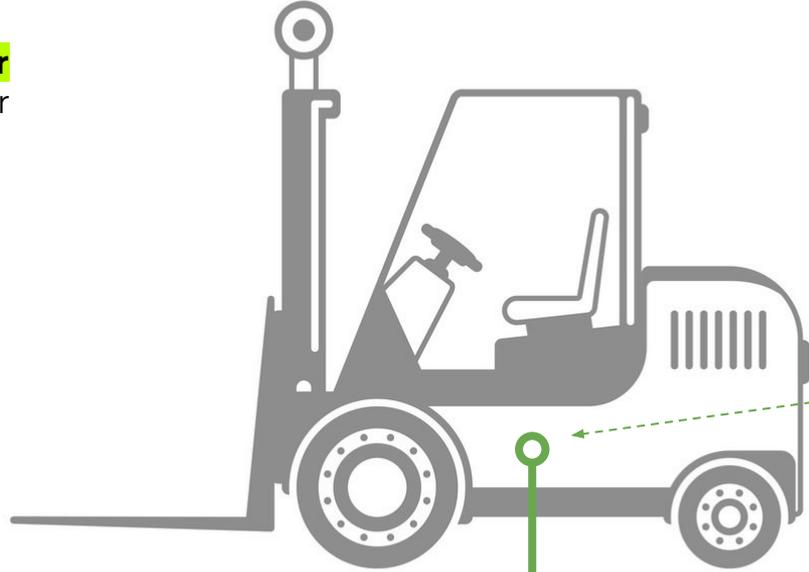
Correct installation can be verified by measuring the voltage without load and with load. The value with load should be significantly higher than the value without load and still between 0 and 5V.



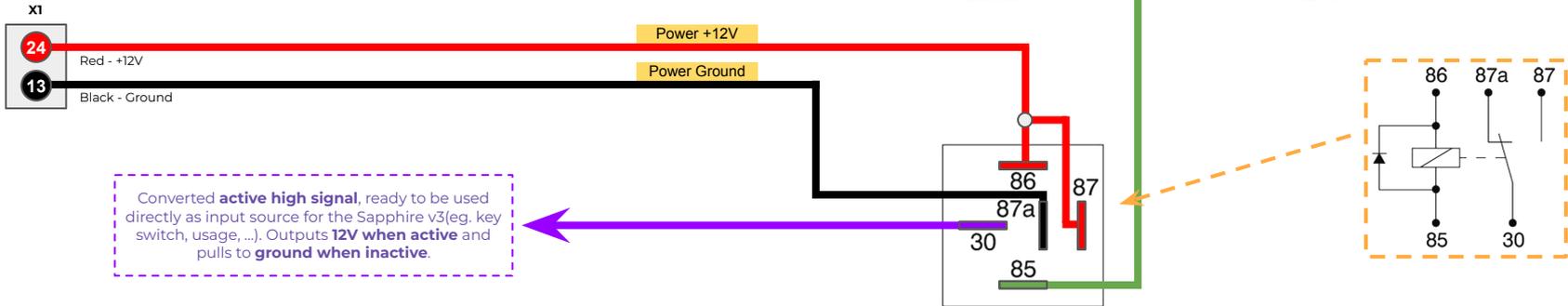
Converting ground signal to +12V

Some machines use a **pull-to-ground for internal signals** such as the key switch or hour counter. The Sapphire v3 needs a logic high voltage on the inputs to be detected.

The following circuit can be used **to convert a pull-to-ground signal to an active high signal.**



Active low signal from machine (pull-to-ground) that needs to be converted to active high. (eg. key switch, usage, ...)



Converting floating signal to 12V with a common ground

Some machines have isolated **internal DC/DC converters for some circuits**. To detect a signal, the signal must use the same ground as the Sapphire v3. Measurements and detection will be unreliable - since **there is no common reference point**.

The following circuit can be used **to convert a signal from an isolated floating supply to a signal with a common ground**.



Signal from machine without common ground

The grey wire in this example is a **floating ground**, not shared with the Sapphire v3. The orange wire is a **positive signal** you want to measure, based on the grey ground. Make sure to use a suitable relay for this machine signal (coil voltage and current).

