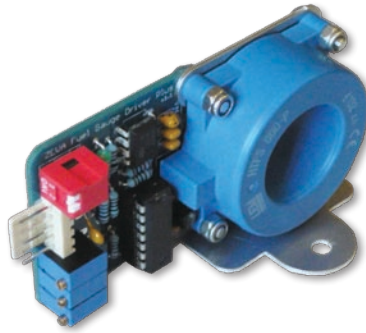




## Fuel Gauge Driver Plus v1.1



### Mini Manual

#### 1. Introduction

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The ZEVA Fuel Gauge Driver Plus (FGD+) provides an intuitive solution for monitoring three important aspects of your Electric Vehicle (EV):

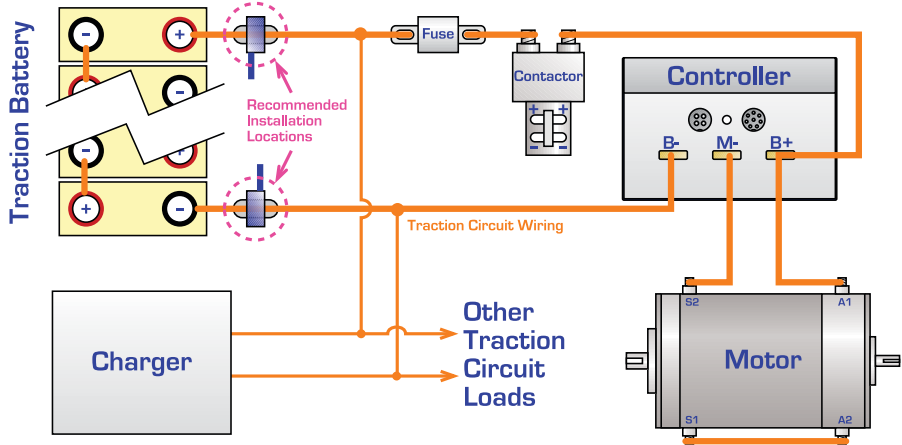
- Battery State of Charge (SoC), displayed on the vehicle's factory fuel gauge.
- Instantaneous current flow, displayed on the vehicle's factory tachometer.
- Low battery warning light, using a standard LED installed on the dash.

As well as simplifying installation, reusing factory gauges offers drivers the most intuitive feedback, particularly those unfamiliar with EV technology.

## 2. Installation

The device should be rigidly fastened to the vehicle using the integrated mounting bracket. It should be installed where it is protected from the elements. It is usually most convenient to mount close to either the positive or negative battery terminal.

Route the power cable from the battery through the blue toroidal current sensor. Ensure that all loads in your traction circuit (including charger, DC/DC converter) are connected to the traction circuit *after* the FGD+ or they will not be monitored. The diagram below shows recommended installation locations in a typical EV circuit:

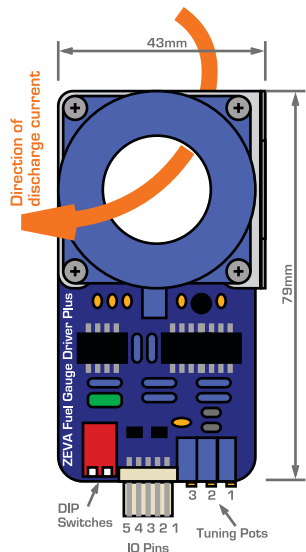


The flow of conventional current should go from the back to the front through the blue toroidal current sensor – that is, the side with the mounting bracket attached should be oriented towards the positive terminal.

## 3. Wiring

The FGD has five I/O pins as shown on the diagram right. All wiring should be referenced to the vehicle's 12V electrical system, not the traction circuit.

- Pin 1: Permanent 12V supply. The device must be powered at all times (not ignition switched) to ensure current flow is monitored even when the key is off.
- Pin 2: Ground, or vehicle body.
- Pin 3: To fuel gauge, replacing the wire originally going back to the sensor in your fuel tank.
- Pin 4: Low SoC LED. This provides a 5V 5mA output which may be used to drive a standard LED installed in the dash.
- Pin 5: To the tachometer, replacing the original wire coming from the vehicle's engine tach sensor.



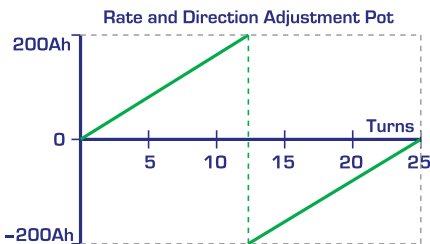
The FGD+ calibrates the zero point of its current sensor during the first 2 seconds after being powered up. It is important to ensure that there is zero current flow through the traction circuit during this period to ensure accurate calibration. (If you have a master switch in your traction circuit, turn it off before powering up the FGD+.)

If the device loses power, it will reset to 100% SoC. The rationale behind this is to offer a simple method for resynchronizing the state of charge at the end of a charge cycle if you experience any SoC drift. As above, ensure there is zero current flowing in the traction circuit when resetting to ensure accurate zero point calibration on startup.

## 4. Calibration

The FGD+ is calibrated using three 25-turn adjustment pots and a pair of DIP switches. The pots are adjusted with a small flat-blade screwdriver. The limits of travel at each end are indicated by a gentle clicking as you turn the pot.

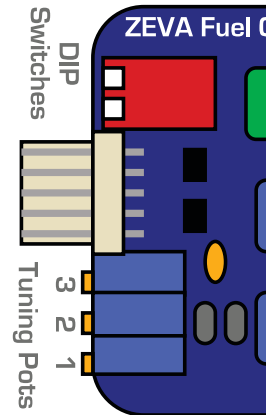
- **Pot 1, full position adjustment:** Turn this pot to change the fuel gauge needle position when Full (100% SoC). This calibration is best performed when the device first powers up. (Note: you may need your ignition key on for the factory gauge itself to activate.)
- **Pot 2, rate and direction:** This pot allows you to tune the device for your battery pack, with an approximate calibration range of 200Ah to -200Ah (i.e for gauges with reversed operation). Minimum capacity settings are found at each end, and the sensor polarity swaps in the middle as shown in the diagram, below.



Capacity calibration is best performed during one full-depth discharge cycle. After a full charge simply drive the vehicle to its maximum range (3.2V/cell for LiFePO4 or 12V/batt for PbA is a good reference point) then adjust the tuning pot until the needle sits on empty. Some older vehicles have very slow-moving fuel gauge needles so some patience may be required!

- **Pot 3, position for low SoC warning light:** Adjusting this pot will change the SoC at which the low battery warning LED output switches on. It is automatically polarised relative to the direction set with Pot 2.
- **DIP switches:** Use these two switches to adjust the scaling of the tachometer drive. For a typical tachometer, expected pulses per rev will be *half* the number of cylinders the original engine had, e.g for an ex-4 cylinder vehicle, set 2 pulses per rev for correct scaling on the tachometer. Units displayed will be in hundreds of amps, instead of thousands of RPM. Switch positions as follows:

**0:** 1p/rev (2cyl)    **1:** 2 p/rev (4cyl)    **2:** 3p/rev (6cyl)    **1&2:** 4p/rev (8cyl)



## 5. Tech note on SoC synchronization

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The FGD+ uses 100% SoC as its synchronization point. Once it hits 100% SoC, it will ignore any further charge current. Lithium batteries have approx 1% charge inefficiency, which means your charger will usually put 1% more energy in to the cells than you can get back out. This 1% is useful to give the FGD+ a brief synchronisation window at the top-of-charge, to compensate for any SoC drift from measurement inaccuracy. In most cases, it will allow the FGD+ to maintain synchronization with your pack's SoC transparently.

The device does *not* stop counting current flow when it hits 0% SoC, so you can recalibrate your low point anytime without truncating the SoC counter.

## 6. Accuracy and SoC drift

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This device uses a Hall Effect sensor to measure current flow. Whilst offering good accuracy and linearity, they can suffer from a small amount of zero-point drift and inaccuracy when measuring very low levels of current. If a vehicle is not driven or charged for a period of weeks or longer, the FGD may have accumulated SoC error due to quiescent current flow. In such cases simply recharge your pack, then reset the FGD (via power cycle) to allow it to resynchronize.

This device should only be used to give an indication of the battery's SoC, and can not replace a battery management system (BMS) for protecting your cells from overcharging or over-discharging.

## 7. Advice for use in modern vehicles, or with digital gauges

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Some digital and aftermarket fuel gauges are more particular about the input signal they receive, and some modern vehicles perform error checking on the input. If the FGD doesn't seem to be working with your gauge, you can try putting a resistor between the FGD+ and gauge, usually in the order of 10-30 ohms (depending on your gauge).

If using a programmable aftermarket gauge, for best performance select an input resistance range with a small value for Full and a large value for Empty, then add an inline resistor equal to the Full resistance.

## 8. Specifications in brief

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- Power supply input voltage: 9-30VDC
- Power consumption: Approx 35mA.
- Current range:  $\pm 1200A$
- Capacity range: Approx 10-200Ah (some variation depending on OEM gauge behaviour)
- Traction circuit voltage range: Limited by power cable insulation rating
- Reverse voltage protected and fuse protected

*The ZEVA Fuel Gauge Driver is proudly designed and manufactured in Australia.*

