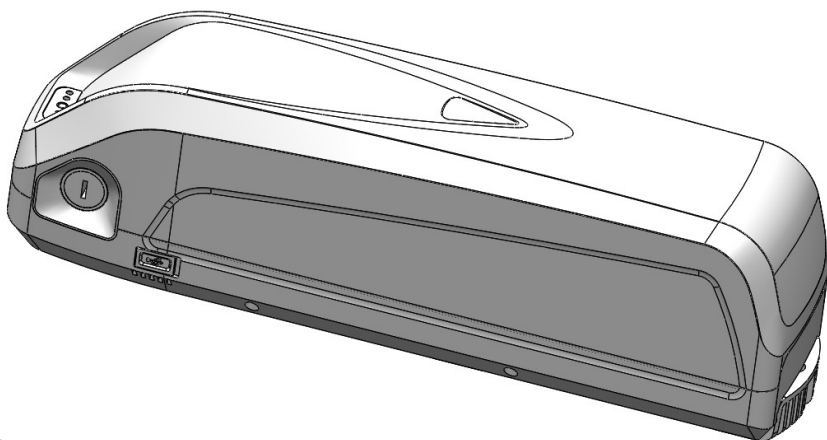


# ***The Downtube Battery***

## **Generic User Manual - Rev0**

(covers all 36V-52V models)



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## Introduction

Modern Battery Management System (BMS) protected lithium batteries using top grade cells from Panasonic or Samsung have wonderfully long lifespans, high reliability and require much less babying than earlier rechargeable battery types. Here are key things to know.

### *First Thing - Don't Lose the Keys!*

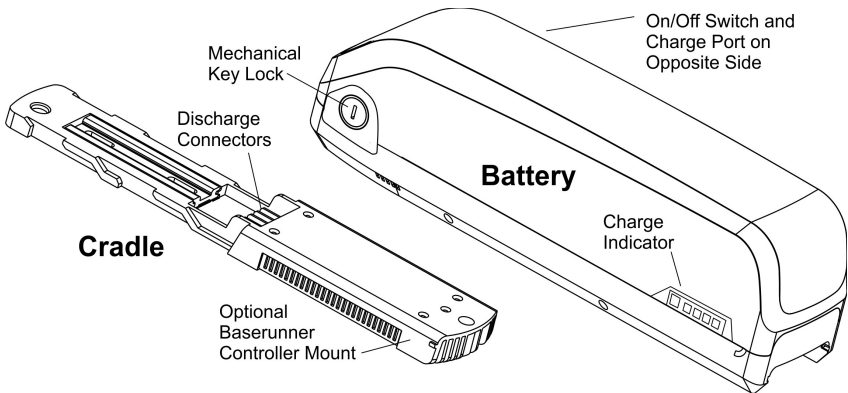


Your battery is supplied with two keys to lock the battery to the mounting rail. Grin does NOT have replacement keys on hand for the thousand possible key numbers. Please be sure to separate the keys onto different key rings keeping one in a safe place, and consider having additional spare keys made by a locksmith if you are prone to losing things.

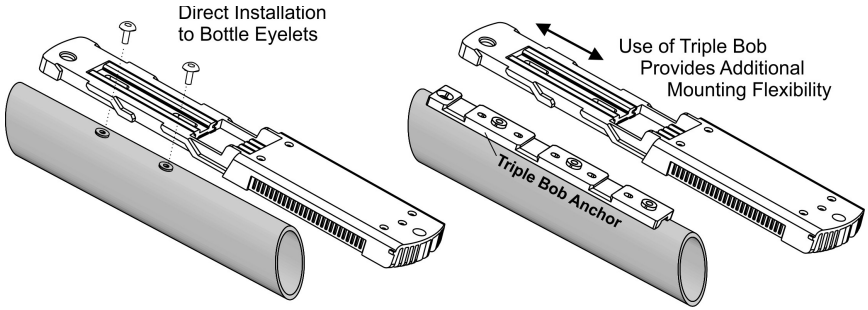
If the keys are lost with the battery locked onto the rail, removing the pack can be a somewhat destructive process. Do your best to avoid this scenario.

## Basic Functionality

The downtube battery has a 3 pin charging port, an on/off switch, a key lock, a charge level indicator and spade connectors to a battery cradle.

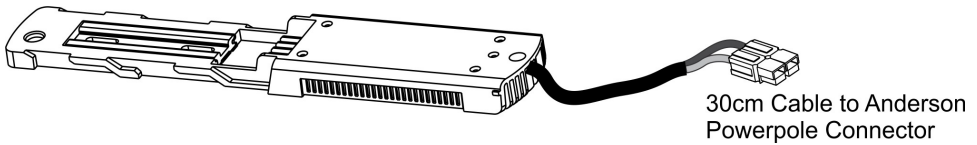


The cradle is designed for mounting to waterbottle eyelets on the bike frame using M5 screws, but can be installed more securely and with greater versatility using Grin's [Triple Bob](#) battery anchor. The pack slides in and out of the cradle for easy removal to charge indoors, with a key and barrel lock to hold it secure.



If your ebike system has its own On/Off switch on the handlebar, we recommend always leaving the battery switch ON and relying on the motor controllers power control.

If you have a system with a Baserunner motor controller mounted into the battery cradle, then the battery hookup is already present. If you do not have a Baserunner, then the battery leads are terminated with a pair of Anderson Powerpole connectors for hook-up to your external motor controller.



The battery should be mounted upright for the casing to shed water and be supported by the rails. If the battery is hung upside down, there is a risk of water seeping into the enclosure and causing internal corrosion.

## Fire Safety

Be aware that even properly handled lithium batteries have been known to catch fire unexpectedly, especially while charging. This is exceedingly rare with brand-name cylindrical cells as used in packs from Grin, but it is always a finite possibility.

The energy output of a lithium battery fire in large pack can be destructive and dangerous. As much as possible, don't leave the battery charging unattended in an area where a fire would cause significant harm. Also, be very careful around lithium batteries that have suffered mechanical impact damage as those can cause shorts internal and external to the cells.

If for some reason the battery is not accepting charge via the charging port, do NOT try and force charging via the discharge leads. An experienced battery

technician will have to open up the pack and assess the state of all cell groups before any repair can be considered.

## Getting the Most from the Pack

There is a lot of incorrect information about the best care practices for lithium batteries. In actual reality the battery requires little special care beyond charging it whenever it is running flat. Here are the details that actually do matter:

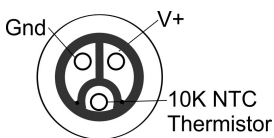
### *Avoid Storage Death*

The single most common reason for lithium battery failure is when they are stored for a long period of time in a discharged state and the slow trickle current from the BMS circuit drains the cells to unsafe levels. The BMS will usually go into a full shutdown once the cells are below 2.5V each, at which point the pack can no longer be charged or discharged. To prevent this situation, always charge the battery to at least 50% before any long term (>2 month) storage, and have the battery physically disconnected from the motor controller and/or other electronics to ensure there are no parasitic loads that will drain it.

### *Don't Charge If Frozen!*

Harmful and dangerous plating can take place when lithium batteries are charged at high rates below 0C (32F). It is no problem to use the battery in cold weather, even down to -20C (-4F), but you must always warm the battery up by bringing it indoors before a continuous charge process.

### *Charge Through Charge Port*



These batteries use dual port BMS circuits, which means that separate protection circuitry is present on the charging leads and discharging leads. If you charge the battery up through the discharge leads instead of the charging port, it will not have any overcharge

protection from the BMS, and nothing will prevent the cells from getting overcharged if the wrong charger settings are used or if there is an internal cell defect. There are scenarios where charging through the discharge port is required, but those should be approached with caution and only with supervision.

### *Have Battery Switch ON for Fast Charge*

When the battery on/off switch is off, there is an extra diode voltage drop in the charge port circuitry while charging is active that can heat the BMS circuit. Any time you are charging with 5A or higher current levels, it is important to have the on/off switch ON to prevent excessive heat on the circuitboard and potential BMS damage.

## ***Regen is OK***

Regenerative braking puts charge current through the discharge port, and often at a much faster rate than most wall chargers. Even though this appears to violate some of the recommended practices, the short burst duration of regen current interspersed with all the discharge current does not harm the cells or produce a risk of overcharging the pack. We recommend allowing at least 20 amps of regen battery current via your motor controller settings for the regenerative braking to have full effect.

## ***Partial Charge can be Useful***

If you have Grin's [Programmable Satiator Charger](#), you have the option of charging the battery to less than 100%. Many studies have demonstrated that partial charging to 80 or 90% can increase the cycle life of the lithium cell by a significant degree. This option also provides more headroom for doing regenerative braking on long hills even with a battery that is hot off the charger.

All that said, with modern cells you will still get a massively impressive calendar life from the pack even if you charge the battery to 100% all the time, so don't sweat too much about this detail.

## ***Lower Currents and Larger Packs are Better***

Where we have seen a noticeable reductions in battery longevity is from people who drain the packs at relatively high currents. We say relatively, because it depends on the capacity of the battery. As a rule of thumb, if your typical discharge current in use is 1C or less (i.e. 15 amperes for a 15Ah battery, 10 amperes for a 10Ah battery etc.) then the cells should give you many years of regular use. If your discharge current is on the order of 2C much of the time (ie 30 amps for a 15Ah pack, 20 amps for a 10Ah pack), then the expected life can decrease to just a couple years of regular use.

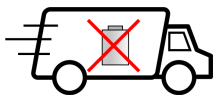
For these reasons we recommend always erring towards a larger battery. It will last longer, give you better range and still be useful as the capacity eventually degrades.

## ***Don't Worry about Full Discharge***

There is a misconception that fully draining the battery to empty is bad for the cells or will harm the pack. This is not actually true, and it is fine to drain the battery right to the point that the BMS circuit completely shuts off the output. That will normally happen at about 2.7 volts/cell which is well above any risk of cell degradation. However, when you have drained it this low, you want to charge it up *within a few days* to avoid the "storage death" situation discussed previously.

## Other Details

### Shipping / Transport



Large Lithium batteries must be shipped as Class 9 Dangerous Goods (DG) cargo, which requires specially trained technicians, documentation and packing materials. You cannot simply mail the battery to other destinations without first finding a specialized DG shipping firm willing to offer this service. Similarly, you cannot take this battery on any passenger aircraft when traveling.

### Vermiculite Packing

To comply with DG shipping guidelines, your battery may come from Grin surrounded with vermiculite padding. Vermiculite is a natural form of expanded mica that is absorbent, entirely flame resistant and not toxic. You can use it around the garden or dispose of it in any waste bin. The dust can be a little messy but is not harmful.

### Disposal

Large lithium batteries should never be disposed in the garbage and must be taken to a battery recycling facility. Most municipalities have battery drop-off locations. In North America please use the following links to find the one nearest you:

Canada: <https://recycleyourbatteries.ca/>

USA: <https://www.call2recycle.org/locator/>



**call2recycle®**  
Leading the charge for recycling™

## Specifications

<b>BMS Max Discharge Current</b>	40A (Typical Trip at 60A)
<b>Max Charge Current through ST3 Plug</b>	8A (Battery ON) / 5A (Battery OFF)
<b>BMS Max Cell Cutoff Voltage</b>	4.2 V/cell
<b>BMS Min Cell Cutoff Voltage</b>	2.7 V/cell
<b>BMS Style</b>	Dual Port
<b>BMS Cell Balancing Mode</b>	Bleed Balance at Full Charge
<b>Charge Port Connector</b>	ST3
<b>Temperature Range for Discharging</b>	-20C to 55C (-4F to 130F)
<b>Temperature Range for Charging</b>	0C to 45C (32F to 113F)
<b>Cell Model* (18650 Packs)</b>	Samsung 35E or Panasonic NCR18650GA
<b>Cell Model* (21700 Packs)</b>	Samsung 50G or Panasonic NCR21700A

\*Cell choice will vary from batch to batch depending on availability