Battery Stuff – Things to Know

HOW DO I KNOW HOW MUCH "JUICE" I HAVE?

It is easy to see how much battery power (charge voltage) you have at any given time by looking at your LCD Speedometer dashboard display. Read below for more information about these display readings.

RCR Display Shown

(1) LCD Dashboard Display – Battery Voltage Reading

The LCD Display shows the current real-time battery "juice" (voltage) in the upper right corner of the screen when the bike is turned on. *This is your key battery indicator!* The battery's instantaneous voltage reading actively changes while riding based on the battery's output power demand, power output available (at rest), and power input from regenerative braking.

As stated in the RCR User Manual, you always want the voltage to show more than ***60 volts when riding an RCR Model or 42 volts when riding a CTY Model*** so you don't get stuck somewhere…!!!

RCR Model Voltmeter Battery Level Reference

84.0 Volts* - 100%
78.0 Volts - 75%
72.0 Volts - 50%
66.0 Volts - 25%
60.0 Volts - 0%

* - 84.0 Volts Max. +/- 2%

(2) LCD Dashboard Display – 10-tick Battery "Gas" Gauge Charge Level Indicator

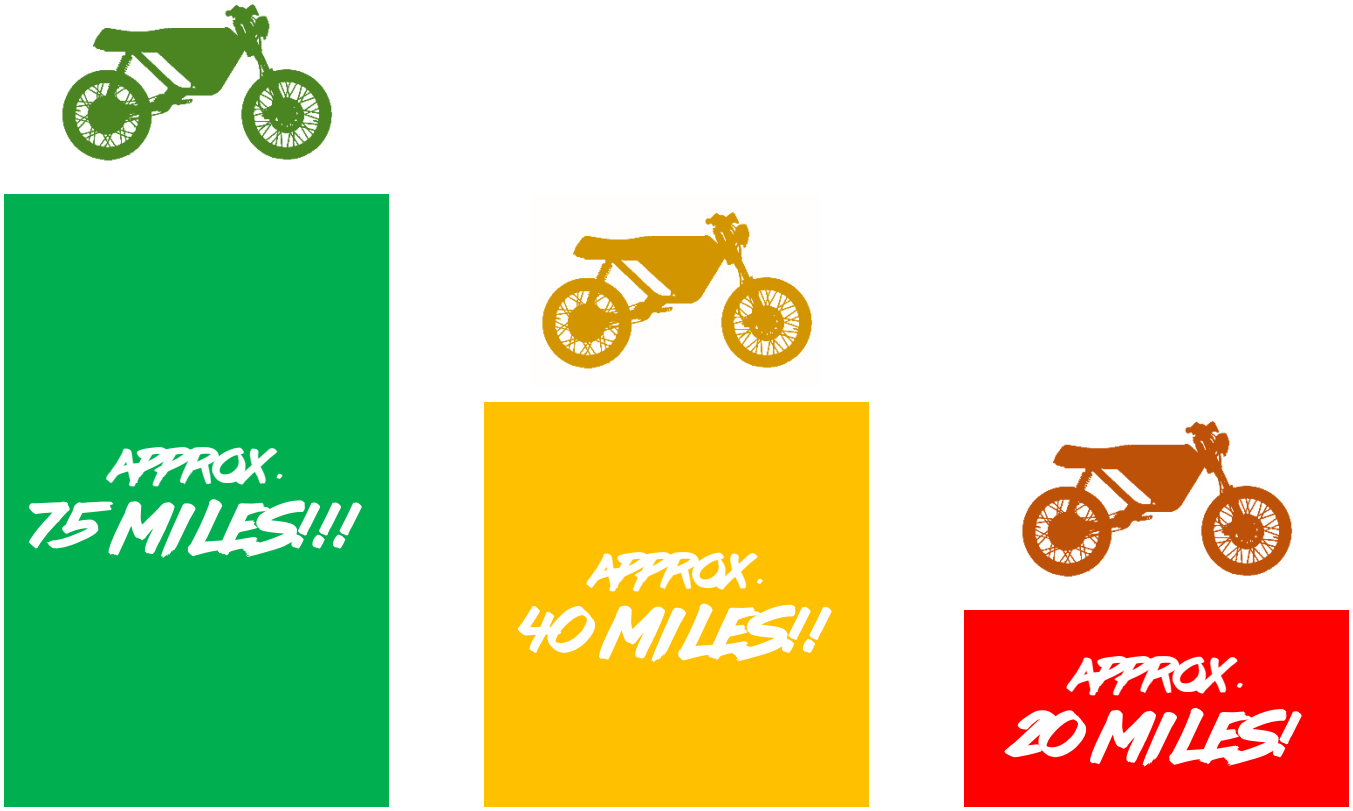
The LCD Display shows a 10-tick (roughly 10% increments) visual representation of the battery charge level in the lower right corner of the screen when the bike is turned on. Use this as an indicator to know generally how much charge you have left.

At lower states of charge, the bike may limit power output to prevent damage to the battery. When the battery is close to being fully depleted, the last bar will begin to flash, warning the user to charge the battery as soon as possible. If possible, let the battery rest about an hour, and then charge the battery as soon as possible when only one tick is left on the battery gauge.

HOW FAR CAN I GO ON A FULL CHARGE?

The battery gives the bikes an expected range of between 20-75 miles on a single charge for the ONYX RCR Model (15-40 miles for the CTY Model) depending on the mode you use, the amount of pedaling you do, the terrain, and your size/weight. All of these things affect your overall range. For example, only using the throttle consumes the most battery power, but you can help increase your range by pedaling whenever possible to conserve battery power.

As a basic reference, take a look at the graphic below to get an idea about how far you can go on a single charge with the 72 Volt RCR Model:



Economy (ECO) Mode
(Max. Speed = 20 mph)

Normal (NRM) Mode
(Max. Speed = ~38 mph)

Sport (SPT) Mode
(Max. Speed = ~60 mph)

NOTE: The throttle-only estimates above are based on a 170 pound rider riding a standard RCR model on flat paved roads with nominal stops and starts with no pedaling assistance.

HOW LONG SHOULD IT TAKE TO CHARGE MY BATTERY?

When properly maintained, the smart battery charger that ONYX provides will quickly and efficiently charge your lithium ion battery in the best manner possible to maintain the life and performance of the battery. There is a simple equation using the battery capacity (amp-hours) and the output current (amps) of the battery charger that can be used to quickly calculate how long a given battery charger will charge a particular battery from fully discharged to fully charged. Here is the basic equation:

$$\frac{\textbf{Battery Amp-Hours Rating (Ah)}}{\textbf{Battery Charger Output Current (Amps)}} = \textbf{Total Charge Time (hours)}$$

ONYX RCR Battery Example: 23Ah / 5A = 4.6 hours

(where RCR Battery Amp-hours = 23 Amp-hours, and Standard Charger Output Current = 5 Amps)

Below is a table that provides a basic idea of typical charge times that can be expected to fully charge a battery from fully discharged to full:

ONYX Motorbikes Lithium Ion Battery	ONYX Motorbikes Battery Charger	Typical Full Charge Voltage	ONYX Motorbikes Battery Charger	Estimated Time For A Full Charge
 **RCR 72 Volt / 23Ah Battery**		84.0 Volts	Standard 5 Amp Charger	4-5 hours
			Rapid 10 Amp Charger*	2-3 hours
 **CTY 48 Volt / 16Ah Battery**		54.2 Volts	Standard 2 Amp Charger	6-8 hours
			Rapid 8 Amp Charger*	2-3 hours

** - Optional accessory sold separately. Do not use any other battery charger without approval from ONYX Motorbikes. Contact ONYX Motorbikes for availability and more information.*

However, while the equation gives a good general idea of how long it can take, actual battery charging times may vary depending on various factors related to your battery including the battery's age, battery's SoC, battery's internal temperature, ambient temperature, etc.

WHAT IS THE BEST WAY TO CHARGE MY BATTERY?

It is really easy to charge your ONYX Motorbike battery. The battery pack in your ONYX Motorbike is removable, which allows to you remove and take the battery with you to charge or store the battery to prevent theft. However, you *can* charge the battery with it installed in the bike if that is more convenient. If charging the battery IN the bike, you can leave the battery switch (RCR only) in the ON position, but make sure that your e-bike is system is turned completely off before beginning charging using the kill switch button in the OFF position and/or by disconnecting the battery.

Follow the following steps for consistent trouble-free charging of your battery:

1. Making sure that the charge cord connector will reach the battery, place the charger on an open (uncovered), flat, and secure surface so that it will not be disturbed while charging the battery.
2. If your battery has an accessible on/off switch (RCR model only), turn it to the OFF position. If it does not have an ON/OFF switch, such as for the 48V/16Ah ONYX CTY battery, or you cannot easily access the ON/OFF switch, don't worry! It is still safe to charge it as-is!
3. Plug the charger input plug into a suitable power outlet (before plugging the charger into the battery). The indicator light on the charger should be green with nothing connected to it. The charger works on 110/220 V 50/60 Hz standard home AC power outlets.
4. Connect the charger XLR-style battery charge cable to the battery's XLR-style charge cable. After the battery is connected, the charger light will change from GREEN to RED to indicate that it is charging
5. Charging status is indicated by the LED light on the charger:
   - RED – Battery is charging,
   - GREEN – Battery is fully charged.

   If the indicator light is not lit at all, it is possible that the charger's replaceable fuse may be blown and needs to be changed. Do NOT open the charger case for any reason! Fuses are easily replaceable without removing the charger case/cover!

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RCR 72 Volt / 23Ah Battery	Standard 5 Amp Charger	84.0 Volts	4-5 hours
CTY 48 Volt / 16Ah Battery	Standard 2 Amp Charger	54.2 Volts	6-8 hours

NOTES:
- Do not leave the battery and charger unattended while charging! Stay nearby or where you can monitor the battery and charger while charging is taking place.
- Keep the bike OFF while charging the battery in the bike. You can briefly turn the bike ON to check the battery charging progress, but do not leave the bike power ON.
- Charging times will vary depending on the battery age, battery state (level) of charge, charger being used, temperature, and other factors.

6. When the battery is fully charged (GREEN indicator is lit on charger), unplug the charger from the power outlet first, then disconnect the battery charger plug from the battery charging cord.

HOW SHOULD I MAINTAIN BY BATTERY CHARGER?

Battery chargers generally require little to no maintenance. They pretty much either work or they don't... However, below are some basic common-sense items that should be heeded that will help ensure that your battery charger will look and operate at its best.

- Do not just toss your battery charger around or store it haphazardly. It deserves respect!
- Keep water and other liquids away from the battery charger at all times.
- Keep the cooling fan open and clear so that the charger is able to properly keep itself cool.
- Periodically wipe the case of the battery charger with a soft cloth to remove dirt/debris.
- Store the battery charger indoors in a safe and secure place where it will be protected from falls and external damage.
- Always keep a spare battery charger fuse handy in case it the fuse blows.

WHAT ELSE CAN I LEARN ABOUT CHARGING MY BATTERY?

A great thing about lithium-ion batteries compared to other older style batteries (e.g., lead-acid, nickel-metal hydride (NiMH), etc.) is that lithium-ion batteries have little to no "memory effect." This means that you can generally charge your battery after each ride, regardless of its charge level, with little effect on its long term health. Each battery has a built-in smart Battery Management System (BMS) that monitors and maintains the health of the cells, and our optimized battery chargers automatically monitor and turn off when the battery is fully charged.

Below are some additional battery charging tips, advisories, and notes that can be handy to know and keep in mind...

- COOL DOWN - After riding your ONYX, do not charge the battery yet, let it cool down for an hour or more if possible. It is best to provide your battery a cooling period of about 1 hour AFTER a ride before starting to charge it, and then let the battery rest for about 1 hour after charging it before going on a ride.
- Please allow an ample amount of time to fully charge your battery.
- Never leave your battery on the charger after it is done charging. Even though the battery charger does have a cut off this is good practice to keep your battery safe.
- Only use a battery charger provided or approved by ONYX. Using an aftermarket high current rapid-charge or quick-charge battery chargers can damage your battery and will void your warranty.
- Avoid constant exposure to extreme temperatures for a long battery life.
- Always charge your battery before use if it has been sitting unused for a few days.
- Avoid frequently fully discharging your battery (dead all the way down to cell protection cutoff) in order to prolong the life of the cells.
- Keep the bike power OFF while charging the battery in the bike. You can turn the bike on briefly to check the battery charging progress but do not leave the power on.
- Do not charge or use a damaged battery.

- The charger works on 110/220 V 50/60 Hz standard home AC power outlets.
- Do NOT open the charger case for any reason! Fuses are replaceable without removing the charger case/cover!
- Do not cover the charger while charging. The charger should be used in a dry location (preferably inside at room temperature (~50-77 degrees Fahrenheit) with good ventilation away from direct sunlight and debris.
- DO NOT try to charge your battery when it is frozen (below 32 degrees Fahrenheit). This can lead to permanent damage. Let your battery rest indoors and warm up to about 50 degrees Fahrenheit before beginning charging.
- Lithium ion batteries charge differently from traditional technology lead acid batteries. Using smart chargers that ONYX provides, they charge quickly up to 80%, and then they taper off until the final few volts trickle in. This is normal and safest for your battery. However, this also means that the last 20% will seem like it is going to take forever to finish… Be patient!
- It is best to always use the smart battery charger provided by ONYX. However, occasionally you can quick charge your battery using a higher charge current (amps) charger approved and offered by ONYX only. However, keep in mind that it is not ideal to quick charge for your battery EVERY time. Patience is a virtue, and it can save the life of your battery…
- After charging the battery, let the battery rest for an hour or two if possible so that the battery can cool down and to let the cell charges can even out. This is known as cell balancing. When new, battery cell balancing can take a couple or more 100% charge cycles to completely balance out for consistent and even charges every time.
- Charge the battery in a safe well-ventilated place, and don't leave the charger unattended. Unplug the charger when done as soon as possible.
- It may not always be practical, but charging the battery to 80% and discharging it to 20% are actually best for a long life. However, it's of course more than OK to charge it to 100%. Just try not to let the battery sit at 100% on the charger any longer than necessary.
- Keep in mind that the 100% RCR battery maximum charge voltage is 84.0 Volts +/- 2% on the 72V battery for the RCR. Yours may charge fully to a little more or a little less. This normal, so don't worry if it is not exactly 84.0V. The chargers that ONYX provides are smart, but they are not calibrated power supplies where the output is digitally monitored and adjusted. So you can patiently to charge the battery to 84.0V (for the RCR), but DO NOT expect it to perfectly fill each and all cells and show 84.0V once unplugged. The high-quality cells are matched, but each and all of the cells in the pack are not perfect can have some variance. So the BMS manages it to make sure it is optimized based on the cells and their condition in the pack.
  Also note that the bike draws a certain amount of voltage when it is on. For example, a standard RCR will normally draw approximately 0.6 volts when it is turned on. Therefore, it is normal for the display show 83.8 V (in the upper right corner) when fully charged.
- There will be times when YOU JUST HAVE TO RIDE ASAP and want to recharge your battery as fast as possible. Again, you need to use the ONYX-provided charger for best results, however, if you just can't wait and you decide to forego your warranty anyway, you can occasionally charge the 72V battery with an 84V charger that has an output higher than 5A so that the battery will charge faster. However again…, the higher amperage charging rate crams more into the cells quicker, which will heat up the cells and make the battery warmer. Doing this occasionally is not a big deal, but if you only charge it every time with a higher amperage charger, you run the risk of shortening the life of the battery. Remember, the cooler the battery is, the better… So it is nice to give the battery a break and just charge it normally with the standard charger from time to time…

HOW LONG WILL MY BATTERY LIVE?

This depends on several factors, including the age of the battery, how frequently an owner discharges and recharges the battery, temperatures, and general storage techniques. Your ONYX batteries will typically give most riders an average of 5 years of awesome riding adventures or approximately 800 full discharge/charge cycles (where a full charge cycle is from **completely empty** to **completely full**)! Here are some general riding style considerations that will give you a good idea of what to expect regarding the long-term health and life of your battery:

	**Daily Riders and Regular Speed Racers** A rider who rides out the full charge every time or hammers it all the time with full throttle drag runs that fully drains and recharges it back to full every day, seven days a week, may see about 3-4 years of life from their battery.
	**Casual or Weekend Warrior Riders** A casual rider who rides maybe once every few days or only on weekends for a couple of hours at a time and charges the battery only just before each use may see around 5-6 years of life from their battery.

Continue reading this article for even more helpful information about your battery, charger, and general use.

HOW DO TEMPERATURES AND STORAGE AFFECT MY BATTERY?

Using and storing your battery in extreme heat and extreme cold are not ideal for your lithium ion battery. Below are some lists of notable considerations with respect to the Lithium Ion battery pack that is used in your ONYX Motorbike.

COLD TEMPERATURE NOTABLES

Here are some points that are good to know and keep in mind about your battery in and around low temperatures:

- If possible, make sure that the battery is kept above 50 deg. F and below 105
- deg. F to avoid performance issues. If it is colder than 50 deg. F, it would be best to bring the battery inside with you. If that is not a reasonable option, it would be good to cover it with a blanket or something. Basically, too much cold will result in more voltage sag, which you will feel as a lack of power until the battery and motor heat up a bit while riding.
- Never leave the pack fully discharged in the freezing weather for a long time. Always keep a minimum 30-50% state of charge, and bring the battery inside if possible.
- Never charge the battery if the battery pack itself is below 40 deg. F.

- Never try to heat up a frozen battery pack too rapidly (like putting in an oven or near a fire place). Let the battery come up to proper temperature slowly and naturally.
- When you ride in the cold.., you could lose range, sometimes as much as 20% or more..., depending on how you ride... Cold (above -4 deg. F) doesn't lessen the battery capacity necessarily. You should generally get the same Ah out of your pack (or close), IF you go easy on the battery when it is cold!
- Cold raises the internal resistance (IR) of your battery. That means that the increased IR may cause more "sag" more under load, thus producing less power (Watts), which can result in early voltage cutoff if some cells aren't warm enough. This will not cause permanent long term damage unless the battery is always used hard in extreme cold conditions all the time...
- While Ah (amp-hour) remains about the same the Watt-hour (Wh) will drop because Wh are a result of the amp-hours X voltage. So when the voltage "sag" drops low due to the internal resistance, the overall Wh drops too...
- As you use a cold battery, the internals get hotter so it will gain power as you use it... This still doesn't mean that you should get on your frozen bike and hammer it, but using too little power won't let the cells get hot enough to get a decent output either, and you will have massive sag and early cutoffs. So use power, but don't overdo it or under-do it. Be reasonable, and think about what it takes you to get your body going on a really cold morning...!!!

HOT TEMPERATURE NOTABLES

Here are some points that are good to know and keep in mind about your battery in and around high temperatures:

- Lithium-ion batteries perform well at elevated temperatures, but prolonged exposure to heat reduces longevity. However, capacity loss at elevated temperature is in direct relationship with the battery's state-of-charge (SoC). So what that means is that a fully charged battery pack in very hot weather is bad in the long run... It won't catch fire, but don't expect as much cycle life out of it long term!
- Don't charge the battery if it is above 113 deg. F (45 deg. C).
- If possible, don't charge the battery right after riding it really hard since cell in the pack can be well above 113 deg. F (45 deg. C).
- If possible, don't charge the battery in direct sunlight if the ambient temperature is over 85 deg. F (29 deg. C). Charge in a cool place away from direct sunlight
- Let your battery pack cool down when it's hot outside. If you are hot, chances are your battery is too.

LONG TERM BATTERY STORAGE NOTABLES

For those who don't have the chance of having nice weather all year long to ride and must store your ONYX Motorbike for the winter, or if you just can't ride for a while (say longer than a week), here are some things to note to help best preserve your battery:

- Don't store the pack fully charged!!! Store your pack at around a 40-50% charge level as indicated on the battery level gauge.
- Store your battery in a dry place. It is best to store the battery at room temperature (approximately 72° F).

- Do not store your battery in temperature extremes of hot or cold. If you only have a choice or one or the other, colder is better than hotter. For example, a refrigerator (not a freezer though) would be better than an oven or a hot shed…
- If storing the battery IN the bike, make sure that you unplug your battery from the controller by disconnecting the large red battery connector.
- Do not leave the battery and charger connected together and plugged to the wall outlet to keep the battery charged. Remember that it is best to store it with a charge of around 40-50% of capacity as indicated on the battery level gauge… If possible, check the state of battery every month or so if possible to keep it at around 50%.
- If you let the battery go too low for too long, the battery could potentially suffer permanent damage, and that is not covered under your warranty.
- ONYX does not currently offer battery upgrades, but you may purchase an extra battery (great for extending your range on long trips!) or a replacement battery HERE.
- Failure to follow proper charging and storage procedures may result in a non-functional battery, and replacement will not be covered under warranty. Always ensure battery is charged before use. Before each ride, inspect the battery to ensure there is no damage to battery and that it is securely locked to the frame. Charge and store bike and battery in a dry location, between 50 °F - 77 °F (10 °C - 25 °C). Failure to properly charge, store, or use your battery may void the warranty and may cause a hazardous situation.

ANYTHING ELSE I CAN LEARN ABOUT GENERAL BATTERY USE AND TIPS

All of ONYX's ebike batteries are lithium-ion batteries. Lithium ion batteries are great and in many respects better than old-school lead acid, but they do have some quirks that should be noted in order to ensure good, safe, and reliable operation. Make sure that you read the "BATTERY CARE / MAINTENANCE / SAFETY TIPS" section in your RCR User Manual. It actually contains a lot of good information about charging, storing, and using your ONYX Motorbikes Lithium-Ion Battery… You should read it…!

Also, follow the advice below to help maximize performance and extend the life of your battery:

- Keep in mind that charging and general performance results will vary on your ONYX Motorbike depending on the SoC (state of charge), the # of charge cycles on your pack, the ambient temperature, the (internal) temperature of your battery, the motor, and your riding style.
- Do not immerse or submerge the battery in water or any other liquids, and prevent it from getting wet.
- Do not drop the battery.
- Do not use or charge the battery under high temperatures.
- Do not place or allow the battery to be near a fire or a heating device.
- Do not disassemble the battery.
- Do not touch/short circuit the positive (red) and negative (black) terminals of the battery connector.
- Store the battery inside in a dry, safe environment.
- Always unplug the battery when cleaning or working on the bike, especially when any covers are removed!
- When storing your battery, make sure to always store the battery unplugged from the charger, disconnected from your bike, and if applicable in the OFF position. When storing the battery long term, keep the battery at around a 50% charged level. If necessary, check on the battery once a month, and charge the battery back to approximately 50% partial charge state every month or two while not using your battery.

- Do NOT touch the "+" and "-" terminal contacts on or in the battery connectors when the battery is removed from the bike.
- Avoid damaging the exposed connector pins and sockets, and keep them clear of debris. If they get dirty, carefully clean them using compressed air or a soft bristle nylon brush if available.
- Be careful not to drop or damage the battery when separated from the bike. It is always best to carry any battery carefully with two hands.