

# Phoenix, RoadRunner, and Sparrow Power System Owner's Manual

© 2006 EV Depot, a Priority Fulfillment and Distribution, LLC Company

Welcome to the growing family of people who have discovered electric transportation! We care about you. When enjoying your vehicle powered by our Phoenix, RoadRunner, or Sparrow power systems, be sure to ride safely, defensively, and within the limits of the law. Always wear a helmet and eye protection, clothing and other safety gear as appropriate for the ride. Never ride while under the influence of alcohol or other medication. Know your bike, and know your personal limits.

Phoenix owners: High-speed biking is similar to motorcycling. For your safety and enjoyment, we suggest you take a motorcycle safety course, either online or in a classroom. A web search will reveal a number of good choices of free material if you want a self-paced course.

Your electric power system is designed and manufactured to be the best value in its class. We believe quality improvement is an ongoing process, so we continue to make investments in new and better technologies to broaden the appeal of electric alternatives. This also means that the specifications in this manual may be changed without notice.

This manual is designed to acquaint you with the operation, care, and maintenance of your power system, and to provide you with important safety information. Follow these instructions carefully for maximum performance and for your personal cycling safety and pleasure.

## **CUSTOMER SERVICE**

Most sales or service issues should be resolved by the dealer from whom you purchased your system. If your problem is not resolved, call our service center at 785-749-0949.

# Table of Contents

The History of Phoenix.....	3
How it Works.....	4
Kit Components.....	4
Hub Motor.....	4
Controller.....	5
Forward/Reverse Switch (Phoenix only).....	5
Power Switch.....	5
Throttle.....	6
Cruise Control with Brake Inhibit.....	6
Wire Set with Charger Port and Key Switch.....	7
Batteries.....	8
Power Bag.....	8
Rack.....	8
Charger.....	8
Connections.....	9
General.....	9
Battery pack.....	9
Motor.....	9
Controller.....	9
Tips.....	10
Tires.....	10
Fork Width.....	10
Torque.....	10
Batteries.....	10
Controller Placement / Battery Portability.....	10
Using other types of batteries.....	10
Troubleshooting.....	11
Safety Checklist.....	12
Periodic Electrical Checks.....	13
Etcetera.....	13
Disclaimers.....	13
Warranty.....	13
Upgrades, Parts, and Accessories.....	14

# The History of Phoenix

In 2002, I was vacationing in Idaho and wanted to ride the new rails to trails paths and the Hiawatha trail in Montana. I didn't have a bike, and didn't have much interest in pedaling. Most of the people I saw on the trail were wearing special clothes, armed with water bottles and a variety of specialized bicycling equipment. Being more engineer than athlete, I decided there must be a way to see the sights without having to dawn a new set of clothes and depend on perspiration for survival. I decided to build an electric bike. To my surprise, when I started researching candidate parts, I discovered electric bikes already existed. I chose a Currie e-ride mountain bike and the fun began. In jeans and without any special equipment (except a basket for my dog), I was able to enjoy the views of Idaho and Montana without breaking a sweat.

After riding the trails – a lot – I discovered that a run to the grocery or restaurant could be made on my e-bike more easily than in my car. I wanted to share my discovery with as many people as I could, so I became an e-bike dealer and started an online retail operation. As time passed, I found my electric bike more and more useful and enjoyable, but as my reach extended into more populous towns, I discovered the displeasure of having cars whiz by my left shoulder as I rode along the right-hand edge of the road at bicycle speed. I could have bought a motorcycle and been done with it, but that's not what engineers do.. I decided again to build an electric bike. This time I borrowed from a marvelous machine I rode that blew me away – the Jackal, designed and built by Thunderstruck EV. I used a LashOut bike frame and spent 2 months designing, welding, breaking things – finding the weak spots the hard way and strengthening them. The resulting bike did 53 MPH in about 7 seconds, and appropriately became known as the Insane-a-cycle. With this electric bike – the only one of its kind in the world – I could traverse the entire town at the highest speed limits. I could ride with traffic at last.

I began trying to find a way to share this newfound freedom from the pump. After several false starts with a number of US importers of light electric vehicles, I gave up on US companies and began contacting Chinese manufacturers. Most were interested only in selling a product they already made – typically 180-250 watt hub motors on flimsy plastic bodies that look like small motorscooters. I finally found Crystalyte. They had designed a motor that would do the job, but our testing resulted in controller failures. We finally arrived at dependable, powerful 36 volt 40 amp and 48 volt 40 amp controllers. We call the systems the Phoenix 3640 and Phoenix 4840, and they are available today. The system is unmatched in the industry, but we are not stopping there. We are working with battery manufacturers to produce batteries with greater range and less weight. We are working with frame designers and builders to produce the coolest, fastest, safest electric bike ever built for the consumer market. The Phoenix system you buy today will be able to take advantage of upgrades as they become available. We want you to be sold on electric power as a regular means of transportation.

Dave

## How it Works

The major components of the system consist of a battery pack, a controller, a throttle, and a hub motor. The battery pack can be any type of battery that can supply the correct voltage and current required by your system. All major components are connected to the controller, the “brain” of the system. The controller’s basic operation is similar to an electric light dimmer. It adjusts the amount of power going to the motor based on the throttle setting. Phoenix and RoadRunner motors are brushless. *Brushless* hub motors are very efficient. Inside, there are three separate windings. Each winding is responsible for turning the wheel one-third of the way around. Sensors tell the controller which winding to apply power to. This allows the energy to be more focused, and changing windings is all electronic – done by the controller. There is no physical connection between the stationary part of the motor and the moving part of the motor, so there is no theoretical limit to their life. The Sparrow is a traditional *brushed* motor. Power is transferred to the motor by brushes making contact with the moving part of the motor.

## Kit Components

### Hub Motor

Your Phoenix wheel is one of three types: Racer (5303), Cruiser (5304), or Brute (5305). The decal on the motor indicates the model. RoadRunner and Sparrow motors have only one type. Our motors can be powered from 24 volts to 72 volts. In Light Electric Vehicle (LEV) applications, motor wattage is not of great concern since the motor is not running under continuous load at continuous RPM. If you choose to experiment with other controller technologies, you must assure the motor does not overheat. A 4840 controller with 12AH SLA batteries barely tasks the Phoenix motor under heavy load until the battery pack is dead.



Phoenix motor on a 26” rim

Phoenix and RoadRunner are three-phase brushless motors with Hall-effect sensors, and must be powered by a controller designed for this type of motor. Sparrow is a brushed motor and can be powered by a simple controller. The controllers we offer have proven themselves to be the best performers and the most reliable.

## Controller

You have a choice of two controllers to power the **Phoenix** motor. They are the 3640 (36V x 40A = 1440W) and the 4840 (48V x 40A = 1920W). The 3640 requires a 36 volt power source that can produce 50A peak current and 30A continuous current. The 4840 requires a 48 volt power source that can produce 50A peak current and 30A continuous current. Both controllers use a Hall-effect throttle and supply battery voltage information to the throttle. **Phoenix** controllers come with reverse for 3 and 4 wheeled vehicles.



Phoenix 4840 Controller

You have a choice of two controllers to power the **RoadRunner** motor. They are the 3620 (36V x 20A = 720W) and the 4820 (48V x 20A = 960W). The 3640 requires a 36 volt power source that can produce 25A peak current and 15A continuous current. The 4840 requires a 48 volt power source that can produce 25A peak current and 15A continuous current. Both controllers use a Hall-effect throttle and supply battery voltage information to the throttle. **RoadRunner** controllers come with reverse for 3 and 4 wheeled vehicles.

You have a choice of two controllers to power the **Sparrow** motor. They are the 3625S (36V x 25A = 900W) and the 4825S (48V x 40A = 1200W). The 3640 requires a 36 volt power source that can produce 50A peak current and 30A continuous current. The 4840 requires a 48 volt power source that can produce 50A peak current and 30A continuous current. Both controllers use a Hall-effect throttle and supply battery voltage information to the throttle.

### Forward/Reverse Switch (Phoenix and RoadRunner)

Phoenix and RoadRunner controllers include a **reverse switch** for trikes and four-wheelers. The switch uses a tiny key (provided) to change from forward to reverse. Change of direction must be made when the wheel is stopped. Using reverse as a brake can overheat or damage your controller, and it draws power from your batteries.

### Power Switch

Controllers have undergone revisions for type and position of switches. Early models had a tiny key switch for power (same switch as Phoenix Reverse). The next revision changed the tiny key switch to a large red button. In either case, turning the system off at the controller still allows a tiny amount of current to be drawn from the batteries. To turn the system off and on, all you need to use is the large key switch. When it's off, there is no power being drawn from the batteries.

### Throttle

We offer a number of throttles. They are all compatible across our entire product line. If your throttle has a gauge, however, it must be the same voltage as your system to give a correct reading.

If you have twist shifters on your bike, you will need to choose a thumb throttle. Otherwise, a half-twist or full twist may be used.



Thumb Throttle with gauge



Full Twist Throttle



Half-Twist Throttle with gauge

### Cruise Control with Brake Inhibit

If you purchase the cruise control option, you will have the ability to set a speed and release the throttle. Our cruise control works just like the one in your car. Turning the unit off by pressing the CRUISE button or engaging either brake will shut off the unit. The brake inhibit also prevents the throttle from operating.



Cruise control

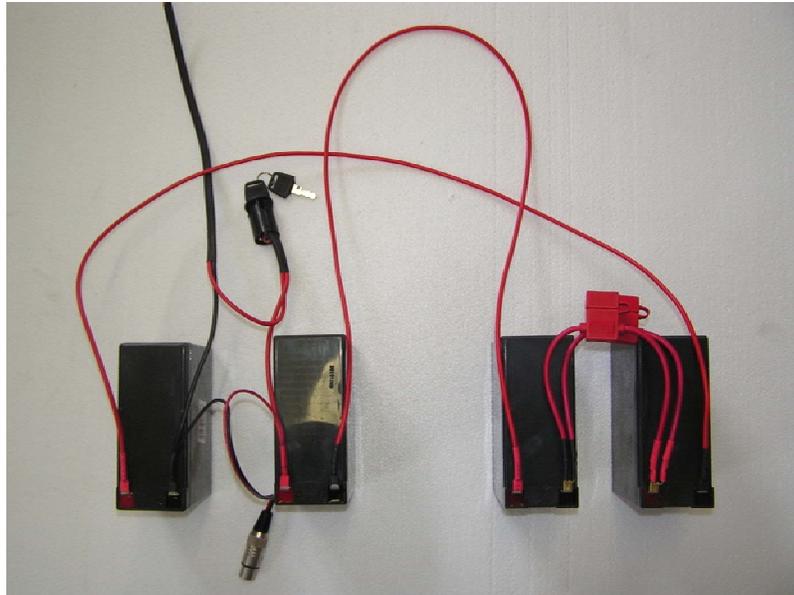


Brake inhibits

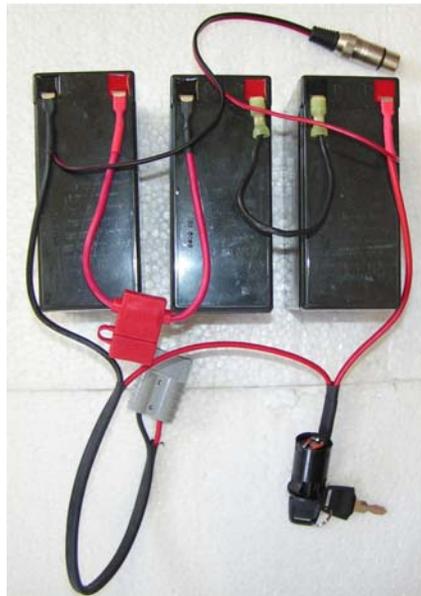
### Wire Set with Charger Port and Key Switch

If you buy an entire kit, the wiring has already been done for you. If not, you should use a voltmeter to make sure your connections are correct BEFORE plugging in the charger or controller. Permanent damage can result to wiring and other components. If you do not have a voltmeter, we will supply one for \$5 through your dealer. We will not replace components damaged by incorrect wiring. Wire sets include heavy-duty key switch, fuseholder, jumpers, XLR charger port, and 50A Anderson connector to controller.

48 Volt wiring



36 Volt wiring



### **Batteries**

Your Phoenix electric hub system can be powered by any type of battery that can supply the correct voltage and current required by your controller. (See the Controller section for more information.) We supply Sealed Lead Acid (SLA) batteries with the Phoenix system. These batteries are rather large and heavy compared to other more exotic chemistries, but at this writing, they are the only battery capable of supplying the amount of power to fully “light up” the Phoenix system. They are rugged, require no special temperature controls, and they typically last 2-4 years in EV applications. We expect Lithium-based batteries to become available soon, but they will cost many times the price of SLA, and their more sophisticated chargers will add to that. Lithium-based batteries store more power per pound and can withstand many, many more recharge cycles.

### **Power Bag**

Kits include a cargo bag and rack for 36V systems, and a cargo bag and basket for 48V systems. The 36V system batteries are in the top of the bag with the panniers empty for your own cargo. The 48V systems use the side panniers for the batteries and the top compartment is free for your own cargo.

### **Rack**

Kits include a rack for 36V systems. The 36V battery pack slides easily on and off the rack with a special locking system. The 48V configuration is heavy, not practical to carry, and is not as easily removable.



Rack for 36V System

48V Power bag and basket

### **Charger**

Kits include a charger at the correct voltage and for the correct battery type. All chargers use XLR connectors. If you have more than one system, be sure to use the correct charger for that system. Use of a 48V charger on a 36V system will “cook” the batteries, distorting their shape and destroying their capability to store power. Use of a 36V charger on a 48V system will likely damage the charger.

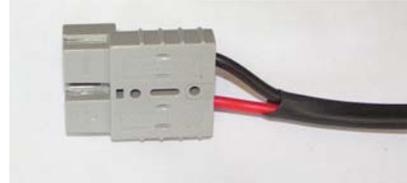
# Connections

## General

We have designed our systems so that it is easy to tell which connectors go together. Small connectors on the throttle, cruise control, and brake inhibits are indexed so that they will only go in to the correct mate, and only in the correct direction. The motor connections are color-coded. All connections go to the controller.

## Battery pack

The battery pack uses an Anderson 50 Amp connector that mates with the same on the controller.



## Motor

There are three color-coded leads coming from the motor. These wires are used by the controller to select the motor winding that will receive the power. The silver connector carries hall-effect signals back to the controller to tell it where the wheel is in its revolution. This information allows the controller to put the electromagnet power in the right place to keep the wheel turning. Every revolution sees power applied to each wire, one at a time.



## Controller

The “front” of the controller has the matching connectors to the motor. The “back” of the controller has the connection to the battery.



# Tips

## Tires

The higher the pressure, the less rolling resistance. Tires capable of higher pressure will give you better range and speed. The smoother the tire, the less rolling resistance. Slicks give you better range and speed than knobbies.

## Fork Width

We have successfully installed Crystalyte motors on many bike frames. Dropout width for front motors is 100mm. Do NOT try to bend a front suspension fork, and do NOT try to bend aluminum or other alloys! We recommend steel forks with large dropouts, usually found on less expensive bikes.

## Torque

Torque is twisting motion. If you apply throttle without first securely tightening the axle bolts, the motor will try to turn inside the dropouts, permanently damaging the wires coming out of the motor. Be sure the axle is secured very tightly to the dropouts.

## Batteries

Your Crystalyte hub motor system uses sealed lead acid (SLA) batteries. The acid is fully absorbed into a glass mat and the batteries are totally sealed. There is no maintenance to be done. You can, however, form habits that will greatly extend the life of your batteries. Always plug in the charger right after use. SLA batteries do not develop a memory, so you can charge them anytime, charge them fully, or charge them partially and ride again. But if you let them sit for weeks in a discharged state, they may never take a charge again. Take note: **your batteries produce enough energy to weld steel**. Be very careful not to short any leads. If you are at all unsure about wiring your batteries please consult a professional. You must always test with a voltmeter BEFORE connecting the controller or charger to the battery pack after wiring.

## Controller Placement / Battery Portability

If you must take your batteries off your bike on a regular basis, it may make sense to mount your controller on the bike frame itself. The throttle, cruise, brake inhibits, and motor can remain wired to the controller. The only connection you will have to mess with is the one from the batteries to the controller. We use a heavy-duty, durable, large, easy-to-use connector from battery pack to controller that you will find much easier to deal with than the small ones.

## Using other types of batteries

There are a number of battery chemistries available to choose from. Be sure your battery pack can produce a peak of 50 amps at the voltage of your controller (36V or 48V), and continuous current of 30 amps. NiMH battery packs need to be temperature-regulated by some type of battery management system. High temperatures will result in damage to the batteries.

# Troubleshooting

No power light on controller	Batteries supply the power. A fuse is installed during final assembly. Never bypass the fuse! The fuse is there to protect the batteries and the wiring. It will NOT protect the controller. A blown fuse is almost always an indicator of a bad controller or something wrong with the wiring. If you blow a fuse, check the wiring for missing insulation. If the wiring is correct, replace the fuse with the spare fuse provided. If the replacement fuse blows immediately upon turning on power, the controller is probably bad and must be replaced.
Axle turns in dropout	Not tight enough. Use lock washers supplied and tighten. Note: Damage from this problem is NOT a manufacturing defect covered by your warranty.
Short range	Batteries not fully charged, batteries weak. Test batteries individually with voltmeter. If one is more than 1V different than the others, replace it. A more thorough test is to use a load tester. Most battery shops will test your batteries.
Low power	Batteries not charged.
Stops then restarts 5-10 minutes later	Controller overheating. Be sure batteries are good and that the controller is positioned where it can get air for cooling.
Vibration	One of the Hall effect sensor wires is not making good contact. Unplug and reconnect the hall effect sensor wire. If the problem persists, there could be a problem inside the motor.

# Safety Checklist

For the safest and best performance of your Crystalyte conversion kit, these steps should be taken before each ride when new, and periodically thereafter:

- Check battery bag to make sure it is tightly secured to the rack.
- Check bag for tears or rips. Potholes, or other rough terrain can lead to bag damage due to the weight of the batteries and friction.
- Check ALL nuts and bolts on the bike. This includes both wheels, the battery rack, brake system, etc. If the nuts are not tight on the electric wheel, the axle can spin in the dropouts leaving broken wires and damaged forks. These nuts must be very tight to assure the proper performance.
- If your hub has a torque arm, make sure the bolt is tight and that there is no play in the connection between it and the fork.
- Check spokes on both wheels. The electric wheel often requires more attention due to the torque of the motor. Spoke and wheel maintenance is part of normal bicycle maintenance procedure. If you think the spokes are not tight enough, you are probably right. Please do not take chances. The spokes should all have the same tension. To check the tension, you can “pluck” the spoke like a guitar string, and you should hear very close to the same tone on each spoke.
- Check the adjustments of your brakes. Traveling at electric-powered speeds, properly adjusted brakes are a MUST! Consult your bike owner’s manual or a professional for proper adjustment procedure.
- Check the pressure in your tires. The required pressure can be found on the sidewall of the tire. Tires lose an average of 2-3 PSI per week. Low pressure will cause sidewalls to collapse, and that is how most blowouts occur. When filling a tire with little pressure in it, make sure it is seated properly on the rim. There is a bead, or line, that goes around the edge of the tire’s sidewall just above where it meets the rim. That line must be even with the rim for its entire circumference on both sides. If the tire is not seated properly, the tube will blow itself out between the rim and the sidewall of the tire and burst. Tires aired to their full recommended pressure create less rolling resistance, increasing speed and range.
- When riding at night, we strongly recommend the use of a headlight and rear light. A bike is much harder to see at night than a car, so extra precautions are necessary. One way to reduce your chances of being cut off, or side clipped by a vehicle is to use either an air horn, or a loud enough device that will make drivers aware of your presence. We recommend a motorcycle safety course. They teach very useful skills and tips that can be applied when riding a high speed bike.
- Examine welds and frame members for cracks or evidence of tearing.

## Periodic Electrical Checks

- Check all electrical connections making sure that they are all tight. Bad contact means energy is wasted as heat, which can cause a breakdown of wire insulation. Any wire with melted insulation indicates a poor connection nearby. Disconnect the batteries and do not operate if insulation is melted or wire is exposed. Replace with 10 gauge wire and .25 terminals or call our service center for replacement wiring.
- Make sure the battery terminals are not exposed. Things like charger ports can end up across both terminals creating a short circuit, which may ruin 1 or more batteries.

## Etcetera

### Disclaimers

This publication is **not** a substitute for a bicycle mechanic. **If you have any doubt about the safety of your bike, or if you doubt your ability to assemble it safely, take it to a bicycle shop now.** Charges are usually minimal to assemble and adjust a new bike, and your safety is well worth the money.

Truing wheels (keeping wobble out of wheels) is usually the most difficult maintenance challenge for cyclists. There are a number of good online “How To” resources for every type of bicycle maintenance, but many prefer to have their bike tuned up periodically by a professional. The electrical system and motor require no maintenance.

We have tried to be 100% accurate in the development of this guide, but we are human, subject to making mistakes, and cannot guarantee the absolute correctness or completeness of this guide. If you have any questions or concerns not covered by this guide, you should contact your Dealer.

### Warranty

We have engineered our systems for maintenance and trouble-free operation. We test every system we ship, so we know it works before it gets into your hands. We also realize manufacturing defects do occur. Electronic component defects usually show up within the first two weeks of use. We stand behind our systems and will cover all manufacturing defects by replacing failed parts. We will not cover abuse. That is, we expect our customers to realize their light electric vehicles have limits. Most of the same kinds of rules apply to electric vehicles as gas-powered vehicles. You can't hold the throttle and brake at the same time for long or something is going to break. In the case of a car, it will probably be the transmission. In the case of an electric vehicle, it will probably be the controller. Driven responsibly, you can expect years of use from your Phoenix, RoadRunner, or Sparrow system.

For 90 days from date of purchase, we will replace any defective part of your Crystalyte power system. The warranty extends to 180 days for the motor. Here's how it works: Contact your dealer or call EV Depot at 785-749-0949. Our technicians will listen to the symptoms you describe and ask you to ship the defect to us. We will repair or replace your unit and ship it back to you. Be sure to save your tracking number or postal confirmation number in case it doesn't arrive at EV Depot.

As you would expect, abuse of the system is not a manufacturing defect and is not covered under warranty. That includes increasing the voltage over the specification of the controller or motor. Over-volting a controller WILL blow it. Every time. Don't do it. Running the motor without it being securely tightened to the frame will cause the axle to turn in the dropouts, permanently damaging the wires coming out of the motor. This type of failure is not the result of a manufacturing defect and is not covered by warranty.

### **Upgrades, Parts, and Accessories**

Many of our Authorized Dealers stock a number of parts and accessories for electric and pedal bikes. Many offer upgrades and accessories to make your ride more comfortable. From faster chargers to speedometers to lights, they will try to satisfy your electric transportation needs.

Phoenix, RoadRunner, and Sparrow are manufactured for and distributed in the US by EV Depot. EV Depot supplies Independent Bike Dealers (Bike Shops), EV specialty stores, and online resellers. Consumers should contact their local bike shop or other retail outlet to purchase.