



## User's Guide

Zone Spark

Neighborhood Electric Vehicle

and 6-Passenger Low Speed Vehicle

Thank you for your purchase. This guide provides operational and maintenance information to maximize your enjoyment.

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## I. OVERVIEW

The low speed vehicle is environment-friendly and suitable for use on qualified streets (up to 35 mph). It can be used on a golf course, or as a people mover/utility car in vacation villages, villa areas, resort hotels, private residential areas, tourist scenic spots, or any other place where this type of vehicle is allowed.

### **WARNING!**

The Zone Spark meets FMVSS 500.517 (Federal Motor Vehicle Safety Standards for Low Speed Vehicles). Please learn whether there are any restrictions in the area where you intend to use the vehicle. Contact your local DEPARTMENT OF MOTOR VEHICLES for any information on compliance requirements for licensing. All low speed Neighborhood Electric Vehicles are subject to federal guidelines as well as local state law.

## II. SAFE OPERATION INSTRUCTIONS

The low speed vehicle is designed for a simple operation; however, please make sure to observe the following safe operation instructions:

### **BEFORE OPERATING THE VEHICLE:**

- ALWAYS read this first before you start driving the vehicle.
- ONLY authorized people should drive this vehicle, from the driver's side ONLY.
- Drive the vehicle ONLY in areas where the vehicle is allowed by law or local regulations and the conditions are safe to do so.
- DO NOT allow more people on the vehicle than the vehicles' designed capacity.
- DO NOT overload the vehicle, otherwise, the motor may get damaged, and the vehicle may lose control, putting the driver and passengers in danger.
- DO NOT operate the vehicle while under the influence of alcohol or drugs.
- DO NOT make the vehicle climb any slope beyond its grade ability.
- DO NOT overtake other vehicles at crossroads, in blind areas, or in any dangerous areas.
- CHECK WITH YOUR LOCAL GOVERNING AUTHORITIES to ensure that you remain in compliance with any laws, rules or regulations regarding the operation of a Low Speed Vehicle. The Zone Spark meets FMVSS 500.517 (Federal Motor Vehicle Safety Standards for Low Speed Vehicles).

### **WHILE OPERATING THE VEHICLE:**

- Keep your entire body inside the vehicle, remain seated, buckle up with the seat belts, and hold on while the vehicle is moving.
- Do not start the vehicle until all occupants are securely seated and fastened set belts.
- Keep your hand on the steering wheel and your eyes on the path or road you are travelling.
- Always back up slowly and watch behind you carefully. Vehicle does make a beeping noise while in reverse.

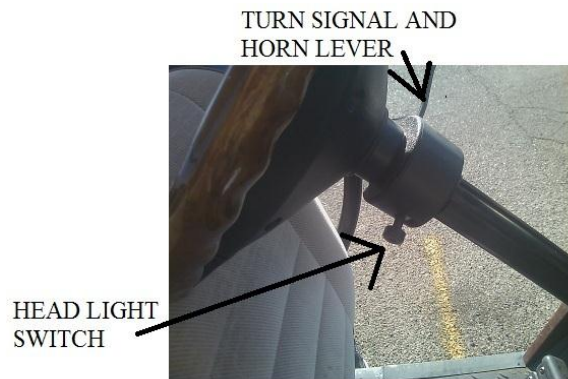
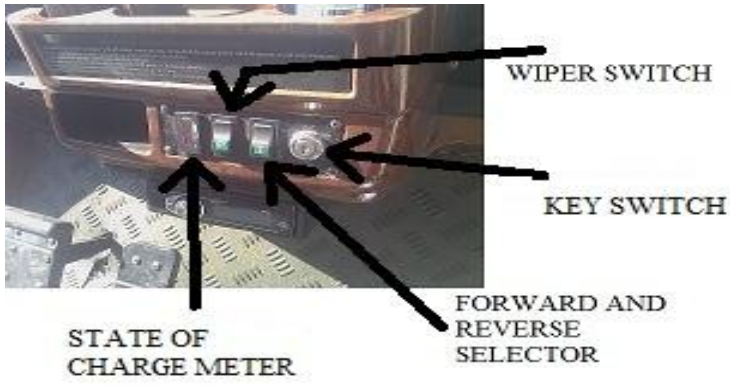
- Avoid starting or stopping suddenly.
- Avoid turning the steering wheel too sharply at high speeds.
- Always drive slowly up or down inclines. Do not make any modifications or additions to the suspension which may affect the capacity or safety of the vehicle.
- Children should not be allowed to play in the car. Children should be seated between adults and protected by them while the car is moving.

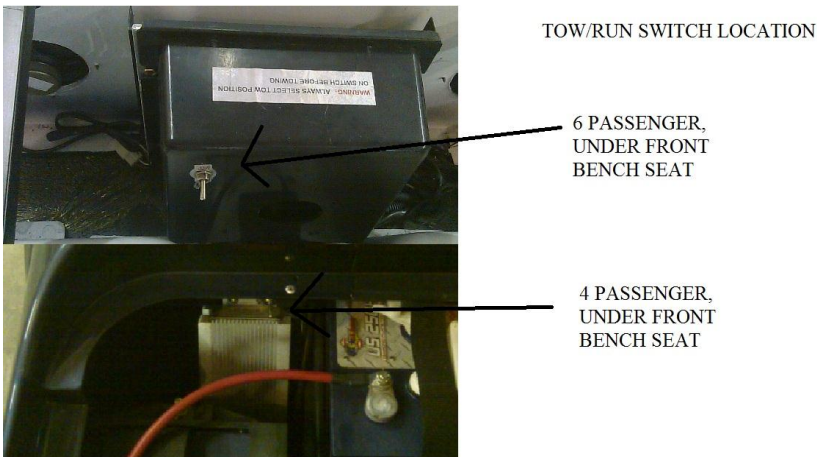
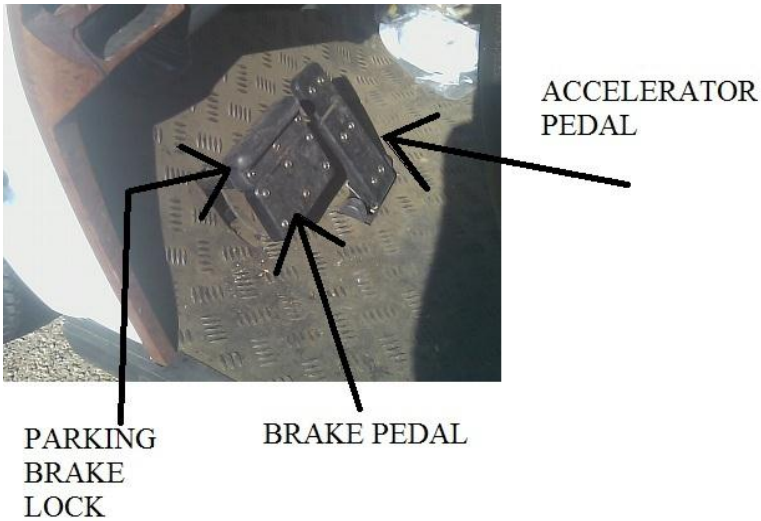
### III. TECHNICAL DATA

ITEMS	FOUR PASSENGERS	SIX PASSENGERS
Voltage (V)	48V	48V
Battery Setup	8 x 6volt	8 x 6volt
Dimention (in.) (L x W x H)	114" x 42" x 78"	145" x 42" x 78"
Driving Range (est miles)	50	50
Turning Radius (ft.)	11.6	14.9
Net Weight (lbs)	1450	1610
Maximum Load Capacity (lbs)	780	850
Maximum Grade Ability	15% Loaded	15% Loaded
Noise (dB)	≤ 70	≤ 70
Braking Distance	60-65ft	60-65ft

### IV. CONTROLS

Locate the controls on your vehicle before driving. Familiarize yourself with their locations and functions. The pictures below give a general location and description of major components. After the pictures, additional details are provided for each of the controls.





## FUNCTION OF CONTROLS:

### KEY SWITCH

The power key switches on the vehicle's electrical system. To engage the motor and drive the car, insert the key and turn clockwise to the "On" position. The switch engages the 12v accessory system (headlights, horn, radio, turn signals) at the same time. The parking brake lights will remain illuminated while the key is on and brake system is in the lock position.

### FORWARD AND REVERSE SELECTOR

This selector is a three-position switch; depressing the upper part activates the forward direction of the vehicle, pressing the lower part activates reverse, and the middle position is neutral.

**WARNING!** Switch must be fully depressed into the proper position. DO NOT shift from Forward to Reverse until the vehicle has come to a complete stop.

Note: While in reverse, a beeping noise occurs.

### STATE OF CHARGE METER

There are 10 divisions in this meter from 0 – 1. This meter will descend from the top (1) to the bottom (0) as the battery discharges. When the battery pack is too low, the bottom two indicator lights will flash. For best performance, recharge your car when the battery pack is roughly three quarter of capacity or any opportunity possible to do a surface charge.

### TURN SIGNALS/HORN SWITCH

This switch is used to turn on/off the turn signals. Move handle lever upward to switch on the right signal, move handle lever down to switch on the left signal. The signals are not self cancelling. Gently pulling the handle towards the driver sounds the horn.

### HEADLIGHT SWITCH

Attached to the column control unit, on the lower right side is a small push/pull button. Pull button out to turn on the head and tail lights. Push button into the column turns off the lights.

### ACCELERATOR PEDAL

The accelerator pedal is used to control the speed of the vehicle. Press pedal down slowly to increase the speed. The car will speed up with the gradual depression of the pedal, eventually reaching full speed when the pedal is pressed down to the floor completely. The vehicle will slow down with the lifting of the pedal. When the pedal is fully lifted, the electric brake will function and aid in slowing the car to a stop.

**WARNING!** The electric brake is not a substitute for the parking brake.

### SERVICE BRAKE/PARKING BRAKE

The brake pedal is used in deceleration and stopping. The effective braking force is around 66 foot pounds. The distance of travel of the pedal should not exceed 2/3 of overall distance.

The effective parking force is around 44 foot pounds. To activate the parking brake, press the foot pedal on the top ¼ until an audible clicking sound is heard. The park brake should be used any time the vehicle is left unattended.

NOTE: If the park brake fails to lock, please repeat above procedure until it fully engages.

**WARNING!** It is prohibited to step down on both the brake pedal and the accelerator pedal at the same time. This can cause severe damage to the motor and/or controller.

**WARNING!** The parking brake will automatically release when the accelerator pedal is depressed. If the key switch is in the “ON” position, depressing the accelerator may cause the vehicle to abruptly move. Disengage the brake before activation of vehicle.

### CHARGING SYSTEM

The charging system on this vehicle is located at the rearmost of the car under the rear seat. The charger is either a DELTA-Q or an ELCON brand charger. The on-board charger units are fully sealed and enclosed by a rear cover. The charge port to plug the vehicle in is located on the passenger or driver side of the car just above the floorboard. Charge status indicators are located next to the ports and are as follows:

- a) DELTA-Q. The indicator will display a **quick flashing green light** during the bulk of the charge cycle. Once the batteries reach 80% of capacity, the light will display a slowly flashing green light. Once the **batteries are fully charged**, the **LED** will be **solid green**.
  
- b) ELCON. The round indicator will display a **flashing red light** during the bulk of the charge cycle. Once the batteries reach 80% of capacity, the light will flash amber. Once the batteries are **fully charged** the light will **flash a steady green**.

### RUN/TOW SWITCH

The purpose of switch is to disengage the electrical system from the battery pack. In the event you have to push or tow the vehicle outside of its own power, you must place it in the TOW position. If you do not, the anti-roll away feature will energize and slow the vehicle down. This can damage the controller or motor if left in RUN and vehicle is towed.

The secondary use for this switch is for storage. By placing the vehicle in the TOW position and removing the electronics from the battery pack, it will greatly reduce the parasitic voltage draw and keep your batteries from losing charge as fast.

## V. OPERATION

### Starting your vehicle:

- a) Depress brake pedal or accelerator pedal gently to remove parking brake. Keep brake applied.
- b) Turn the vehicle key clockwise to the “ON” position.  
**WARNING!** Do not step on accelerator pedal when turning on the power key, otherwise, the vehicle may suddenly start to move.
- c) Select desired direction of travel.

- d) Check that your path is clear in the direction you will be going, remove pressure from brake pedal and slowly press down on the accelerator.

#### Stopping your vehicle:

- a) To stop the vehicle, release the accelerator, gradually press down on the brake pedal.
- b) When the vehicle comes to a complete stop, apply the parking brake.
- c) Place car in the neutral position.
- d) Turn key counter-clockwise to the off position.

## VI. MAINTENANCE

User should perform regular maintenance on vehicle to ensure good performance.

#### BATTERY MAINTENANCE:

**WARNING!** Battery electrolyte is poisonous and dangerous; the acid can cause severe burns. Battery gasses are flammable and explosive. Keep away from open flames at all times. Always wear protective clothing, gloves, and goggles when handling batteries. **KEEP OUT OF REACH OF CHILDREN.**

#### a) Cleaning of Batteries:

The exterior of the battery, the battery connections and battery cables, should always be cleaned of any acidic corrosion. The battery compartment should be checked and cleaned once every 2-4 weeks. To clean the battery, place vehicle in wash area, place the vehicle in the TOW position, make sure the battery caps are tight, and use a common garden hose. If corrosion persists or has gone unattended and has gotten bad, special attention must be used in cleaning. Using a gallon jug, place 3TBS of baking soda and 1tsp of dish soap into jug and fill with warm/hot water. Dump over all batteries and let soak for 5-10 min. rinse off with water hose.

**WARNING!** Although the electronic components are covered, do not use high pressure or direct spray to anything other than the batteries. Wait 10 min for car to dry before driving.

#### b) Checking Terminals and Nuts:

The connection of the cable and battery should be kept tight at all times (about 70 inch pounds) and in good condition. Every time you check the water levels on the batteries, you should check the tightness of the cables to prevent spark or damage to battery post. Any cables that look corroded or damaged should be replaced immediately.

#### c) Recharging

The vehicle has a high capacity, flooded lead acid battery bank installed in it. These deep cycle batteries are not like the ones you will find in an automobile. A deep cycle battery should be run to 50% of its charge capacity before charging. This will ensure

that all of the useful plates inside the batteries are utilized and will limit premature failures. There is no harm in charging the vehicle as necessary to gain a full charge. It is in fact recommended that you give the vehicle an opportunity charge whenever it is not in use. The on-board chargers that come equipped on the vehicles are self contained and fully automatic. The initial 20 charge cycles will equalize and “mature” the pack to optimize their performance. During this time, the batteries may take extra time to charge, (up to 16 hrs). After they reach their maturity, average charge time is 18-12 hrs. Once the batteries have reached their full capacity, the State Of Charge meter on the dash will reset to indicate a full charge.

If the car is going to remain unattended for up to two weeks, turn the Tow/Run switch to the Tow position and disconnect the charger. If the vehicle is to be stored over two weeks, turn the Tow/Run switch to the Tow position and leave the charger plugged into the car. The smart charger will monitor and maintain a static float voltage during this time. When the vehicle is ready to be put back into service, unplug the charger and plug it back in to ensure the maximum charge is given to the battery pack. Place vehicle in run mode.

#### d) Watering

After the batteries have had a chance to receive a full charge is the only time you should adjust the water levels. If you should notice that the plate is exposed prior to charging, add just enough to cover the plate, then add appropriate amount after full charge. Only distilled or pure water should be used to fill cells. Tap water contains trace minerals that can plug the pores on the lead plate. The water levels of the battery should ONLY cover the plate by  $\frac{1}{4}$  to  $\frac{1}{2}$  of an inch. Do not fill battery water so the level reaches the molded neck of the cell. The battery needs to be able to vent the gases caused by charging; overfilling of the battery can cause the electrolyte to overflow. This will reduce the amount of acid in the battery cell and can lead to premature failure. If any acid is settling on the top of the battery, using a garden hose as directed in battery cleaning will neutralize it and keep the battery from corroding. Never add pure acid to a battery.

**WARNING!** Electrolyte is a solution of acid and water; avoid any contact with skin and eyes. Wash any affected area with soap and water immediately after contact. Flush eyes with water for 15 minutes. If irritation persists contact your local physician.

#### e) Testing

Two types of tests to obtain a good indication of the battery charge level are the Specific Gravity reading and an Open-Circuit Voltage reading. Seek a technician for guidance. Any other type of tests should be conducted by a trained technician with the appropriate tools.

The factory recommended gravity of a fully charged lead acid battery should read 1.277. The open circuit voltage of a fully charged lead acid battery should read 6.37v or 50.93v for the full pack. (See Chart)

Percentage of Charge	Specific Gravity	Open Circuit Voltage						Freezing Point (F)
		6V	8V	12V	24V	36V	48V	
100	1.277	6.37	8.49	12.73	25.46	38.20	50.93	-75
90	1.258	6.31	8.41	12.62	25.24	37.85	50.47	-60
80	1.238	6.25	8.33	12.50	25.00	37.49	49.99	-45
70	1.217	6.19	8.25	12.37	24.74	37.12	49.49	-30
60	1.195	6.12	8.16	12.24	24.48	36.72	48.96	-15
50	1.172	6.05	8.07	12.10	24.20	36.31	48.41	-10
40	1.148	5.98	7.97	11.96	23.92	35.87	47.83	0
30	1.124	5.91	7.88	11.81	23.63	35.44	47.26	+10
20	1.098	5.83	7.77	11.66	23.32	34.97	46.63	+20
10	1.073	5.75	7.67	11.51	23.02	34.52	46.03	+32

#### f) Battery Charging

**WARNING!** Before charging the vehicle, please read any and all information provided with the charge unit.

**WARNING!** Explosive hydrogen gas is produced while batteries are charging. Keep vehicle away from any open flames. Optimal ventilation for vehicle charging is in a building that can recycle the air 5 times per hour.

**WARNING!** Before charging vehicle, make sure the AC outlet is capable of handling 20amps of constant draw. Contact your local electrician for verification of load capacity. DO NOT charge more than one vehicle at a time on a single breaker.

The key must be in the “off position to charge. Plug AC cord into vehicle charge receptacle first, then plug into wall outlet. Let the charger run until it reaches full charge. Remove cord from wall outlet then remove cord from the vehicles charge receptacle. Charger unit is fully sealed. Under no circumstances should you try to open the charger case. Failure of the charger unit **MUST** be repaired by an authorized dealer. Any tampering of the charger unit will void its warranty.

#### MAINTENANCE of the SEP-EX MOTOR:

Periodic Inspection of the motor will ensure a long life. Before doing any work on or around motor, Tow/Run switch should be placed in the Tow position. Keep motor clean from dust, dirt, and any fine debris that collect on/around it. Low pressure air (20-30psi) works best for cleaning. Every 3-4 months use low pressure air to blow any dust and carbon from brush area at the end of the motor. The brushes are located under a metal ring that wraps the circumference of the motor at the end furthest from the mounting point to the transaxle. After blowing any debris from motor, check the 4 motor cables for correct torque. Any other service required for sep-ex motor must be performed by certified technician.

## MAINTENANCE of the CURTIS 1268 MODEL CONTROLLER:

**WARNING!** There are no user serviceable parts inside the controller. No attempt should be made to open, repair or otherwise modify the controller. Doing so may damage the controller and will void the warranty.

The controller equipped on this vehicle is a model 1268 CURTIS separately excited motor controller. This controller has a self-diagnostic program built in. It will monitor and oversee operation of your vehicle while you drive and while it is parked. If at any time your vehicle fails to respond to your control, the controller may aid in the troubleshooting of the fault. The controller is covered with all the vehicles electronics. DO NOT spray high pressure air or water directly at any of the components.

The controller uses an internal capacitor to maintain its service program and monitor feature. This means a constant battery draw; though it is very low amp, if the vehicle is to remain unused for more than 1-2 weeks, ALWAYS turn the Tow/Run switch to the Tow position.

## GENERAL MAINTENANCE

As the new owner of an electric vehicle, constant care and maintenance will give you many years of continual use. Certain tools may be required for periodic maintenance and they are readily available at most hardware or auto parts stores.

- a) Tire pressure: The 10 inch aluminum wheels equipped on the car requires 25psi at all times.
- b) Grease: There are four (4) grease points on the vehicle; One on each steering spindle, one on the rack and pinion and one on the steering middle shaft. Use of a grease gun will be required for maintaining.
- c) Rear End: The vehicle has a Direct Helical Drive Transaxle. It is a splash lube system with built in ventilation. The drain plug on the bottom cover is also used for filling the unit. From total empty, the axle should take 8-12 ounces of a 90 weight gear lube.
- d) Batteries: Special care should be taken with the battery pack in this vehicle. Constant cleaning of the battery set will NOT cause damage. It is best to keep them as clean as possible at all times. Battery water should be checked constantly until you find out how your batteries consume and dissipate water. NEVER let your batteries run on low or no water. Damage will be caused immediately to exposed cell plates.
- e) Electronics: Battery cables, motor wires, contact and controller wires, and any plug connections should be checked for proper torque (70 inch pounds) and tightness once a month. The Tow switch should be engaged during any check of electric connections.

Scheduled maintenance of your new vehicle should be done by a certified technician. Once per year (or once every 6 months, depending on use) the vehicle should be checked for brake wear and proper function. Brakes less than 25% of useful pad (1.2mm) should be replaced immediately. Front wheel bearings should be pulled and inspected, then if all is good, re-packed and re-installed. The differential pan should be dropped so it can be cleaned and refilled with fresh gear oil. The tires should be checked and rotated, straight front to back swap. The structural integrity should be inspected, all bolts tight at all points of the car. A full battery load test should be done if available to check useful life of the battery pack.

## VII. STORAGE

The battery charger has a built in monitor and “float” feature. If your vehicle is to be stored for a period of time longer than two weeks, it is recommended that the charger remain plugged in to maintain full battery voltage. If this is not an option, it is required to fully charge the batteries at a minimum of once per month. This will ensure the electrolyte in your batteries will remain at a high freezing point. Electrolyte of a 30% charged battery will freeze and destroy the battery at 0 degrees F. The steps listed below should be followed any time you plan on leaving the vehicle un-attended.

- 1) Park vehicle in a dry, safe, and well ventilated place. A breathable cover would be optimal if you have one.
- 2) Turn the key to the off position and store key in a safe place.
- 3) Move the tow/run switch to the TOW position.
- 4) Check the tire pressure to make sure 25 psi is present.
- 5) Charge the car the night before it is to be unattended.
- 6) Check battery water level after the car has received an overnight charge.

**WARNING!** The battery water level should only be checked and added after a full charge.

## VIII. FREQUENTLY ASKED QUESTIONS

Q: I left my car on charge overnight, why is it still not charged?

A: During the first 20 charge cycles, the batteries will go through a “maturing” process. Charge time can take 16 hours depending on the depth of discharge.

Q: My car charged for 5 hours, why does the dash meter still show a low charge?

A: The state of charge meter will not reset until the vehicle has received a full capacity charge.

Q: I plug my car in to charge, why do the LED’s flash and change color?

- A: Colored LED flashes are indications of the state of charge. Refer to charger section of this manual for details of LED color definitions.
- Q: Why does my car ride very rough?
- A: This vehicle is based off a golf car chassis. The shock absorbers are only used for stability. At higher speeds, the vehicle may feel loose or bouncy. The tires on this car may have also developed flat spot from any length of time being stored.
- Q: What size breaker should I use to charge my car?
- A: A 20 amp dedicated outlet is recommended; if any other appliance is used on the same circuit, use a 30 amp. GFI outlets are ok to use. Any questions regarding upgrades or sufficient power should be directed to your electric company or a qualified electrician.
- Q: How do I turn on the headlights?
- A: On the column mounted combo switch, bottom right side, a push pull button is used to activate the lights.
- Q: What type of water do I add to the batteries?
- A: Distilled only. Add water to the batteries as needed and only after a full charge.
- Q: Can I add battery acid or other additives to the batteries?
- A: No. The batteries have porous plates that will collect foreign objects and degrade the usefulness. Anything other than distilled water should not be added except by a qualified battery professional.
- Q: My car is equipped with a battery life saver. How do I use it?
- A: The battery tender is a pulse de-sulfater. It should be left in the On position at all times *except* when the car will remain idle or unused for longer than 2 weeks.
- Q: Why does my radio have static?
- A: The antenna is located under the dash and can cause interference. Moving the antenna or relocating it to a different point on the vehicle will solve this problem.
- Q: How can I get the best life and performance out of my batteries?
- A: A battery life saver and battery watering kit gives ease to maintenance and added life to your battery pack.
- Q: I have a short range per charge on my car, what can I do?
- A: Check for any loose cables. Cycling batteries will create heat that will naturally soften the lead. Constant battery maintenance is a must. Refer to maintenance section for instructions. Battery pack may need a charging algorithm adjustment.
- Q: Why does the amber light flash on my Delta-Q charger mean?

A: The amber light denotes an internal temp too high for normal. The charge unit then reduces its output power until temperature is maintained. Ambient air over 85 degrees may cause the unit to be warmer than usual and is not a failure. In some cases it may be required to check the charge algorithm and adjust as necessary. Note: Contact manufacturer of the charger for specific information on what algorithm to use with the battery choice you've made.

## IX. Reset Algorithm for Chargers

If the **battery pack at any time is replaced**, contact the manufacturer of your charger (Delta Q or El Con) to obtain the correct algorithm setting to reset the charger for the new battery pack purchased.

Listed below are steps to adjust the charger from a normal 215 amp/hour, flooded lead-acid battery, to the US250 HC/XC battery with 283 amp hours.

### 1. How to Reset Algorithm for **Delta Q Charger**

Remove positive cables from the batteries- passenger side. (Big black cable with red shrink wrap.) Also remove small 12 gauge-ish RED wire.

NOTE: Make sure you are near a charging receptacle. Vehicle must be plugged in for procedure.

- a. Locate LEDs on charger itself. Specifically looking for  $\frac{3}{4}$  full battery. The battery will flash current algorithm in system. If you have trouble getting to your charge unit, you can also use the LED mounted on the body.
- b. Once located, plug AC cord into car and into outlet as if charging. Lights on LED will flash in sequence, letting you know current algorithm.
- c. As soon as the  $\frac{3}{4}$  full battery starts to flash on the charger, or the LED on the body, place small 12 gauge-ish RED wire directly to the positive post and hold for exactly 3 seconds.
- d. Remove wire.
- e. Now the  $\frac{3}{4}$  battery LED on the charger or body should flash the next algorithm.
- f. Repeat steps c and d until the battery LED flashes 7 times.
- g. Once 7<sup>th</sup> algorithm is reached, hold the RED charge cable (12 gauge-ish wire) to the positive post for 10 seconds. This saves the current algorithm. You will hear a faint click coming from the charger and the bar graph LED will flash and start to light up.
- h. Unplug AC cord from car.
- i. Unhook red cable from positive post.
- j. Wait 10 seconds.
- k. Hook positive cables back up to the battery.
- l. Ensure correct torque is applied (70-90 inch pounds or 8-9 foot pounds).

## 2. Setting Algorithm for **ElCon Charger**

NOTE: Make sure you are near a charging receptacle. Vehicle must be plugged in for procedure.

- a. Loosen charger from the rear compartment beneath the rear facing seat.
- b. On bottom side of charger, driver side, look for black sticker that says “48 VOLT”. Remove to expose black button.
- c. Press and hold button and connect car to the AC outlet (plug in car). Keep finger on button.
- d. LED on charger will flash....when it flashes 6 times, remove finger from the button.
- e. Disconnect AC Power – remount charger to finish procedure.

Note: This corrects the minimal boiling of the batteries, extended charge times, and thermal cutbacks on charging system.

## X. Troubleshooting Charts and Guides

TROUBLESHOOTING CHART			
LED CODE	PROGRAMMER LCD DISPLAY	EXPLANATION	POSSIBLE CAUSE
1,1	HW FAILSAFE	Self-test or watchdog fault.	1. Controller defective.
1,2	THROTTLE FAULT 1	Wiper signal out of range (pot low fault).	1. Throttle input wire open. 2. Throttle input wire shorted to B+ or B-. 3. Throttle pot defective.
1,3	SPEED SENSOR FAULT	No pulses from sensor.	1. Speed sensor not connected. 2. Speed sensor defective.
1,4	HPD	High Pedal Disable fault.	1. Improper sequence of direction and throttle inputs.
1,5	MOTOR STALL	Motor stall at current.	1. Slope too steep for vehicle weight. 2. Mechanically locked motor. 3. EM brake wiring failure. 4. Speed sensor defective.
2,1	LOW BATTERY VOLTAGE	Low battery voltage.	1. Battery voltage < undervoltage cutback threshold. 2. Corroded battery terminal. 3. Loose battery or controller terminal.
2,2	OVERVOLTAGE	Overvoltage.	1. Battery voltage > overvoltage shutdown threshold. 2. Vehicle operating with charger attached. 3. Battery disconnected during regen braking.
2,3	THERMAL CUTBACK	Over-/undertemperature cutback.	1. Temperature > 85°C or < -25°C. 2. Excessive load on vehicle. 3. Improper mounting of controller 4. Operation in extreme environments.
2,4	MAIN DRIVER ON	Main contactor coil held low.	1. Main contactor missing or wire to coil open. 2. Controller defective.
2,5	AUX COIL FAULT	Missing aux (brake, relay) coil.	1. Aux coil open or not connected.
3,1	MAIN DRIVER OFF	Main contactor driver held high.	1. Main contactor coil shorted. 2. Controller defective.
3,2	MAIN WELDED	Main contactor welded.	1. Main contactor stuck closed. 2. Main contactor driver shorted.
3,3	PRECHARGE FAULT	Internal voltage too low at startup.	1. External short, or leakage path to B- on external B+ connection. 2. Controller defective.
3,4	FIELD MISSING	Field winding fault.	1. Motor field wiring loose. 2. Motor field wiring open.
3,5	AUX DRIVER OFF	Aux (brake, relay) driver held high.	1. Aux coil shorted. 2. Controller defective.
4,1	CURRENT SENSE FAULT	Armature or field current sensor fault.	1. Controller defective.
4,2	DRIVER OVERCURRENT	Contact driver or aux driver overcurrent.	1. Contactor or aux coil shorted.
4,3	M- SHORTED	Internal M- short to B-.	1. Controller defective.
4,4	AUX RELAY DNC	Aux relay did not close.	1. Aux relay missing or wire to coil open.

Cont. - - -

TROUBLESHOOTING CHART, cont'd			
LED CODE	PROGRAMMER LCD DISPLAY	EXPLANATION	POSSIBLE CAUSE
4,5	WELDED AUX RELAY	Welded aux relay.	1. Aux relay stuck closed. 2. Aux relay shorted.
5,1	KEY SWITCH SRO	SRO fault.	1. Keyswitch not off at power-up. 2. Keyswitch shorted.
5,2	MAIN COIL OPEN	Missing main contactor.	1. Main contactor coil open or not connected.
5,3	AUX DRIVER ON	Aux (EM brake or WalkAway™ relay) driver coil held low.	1. Aux output short to ground. 2. Controller defective.
5,4	CIRCUIT BRKR OPEN	Circuit breaker or fuse open in WalkAway™ circuit.	1. Breaker/fuse tripped or open. 2. Breaker/fuse defective. 3. Relay/fuse sense line broken.
5,5	MAIN DROPOUT	Main contactor open.	1. Main contactor defective.

### LED DIAGNOSTICS

A built-in Status LED is visible through a window in the label on top of the controller. When the controller detects a fault, the Status LED flashes the 2-digit fault code. The code is flashed continuously until the fault is corrected. For example, code “3,2”—welded main contactor—appears as:

□ □ □ □ □	□ □ □ □ □	□ □ □ □ □	etc.
( 3 , 2 )	( 3 , 2 )	( 3 , 2 )	

The codes are listed in the Troubleshooting Chart. Only one fault is indicated at a time, and faults are not queued up. If multiple faults are active simultaneously, the code of the highest priority fault is flashed. After all faults have been cleared, the code of the last active fault will continue to flash for one minute. This feature is designed to help service personnel identify intermittent faults when no programmer is available.

These same fault codes will also be flashed by the external fault LED (connected to Pin 22), if one is included in the system.



## EL-CON TROUBLESHOOTING GUIDE

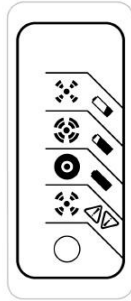
### Alarms




	LED Flashing Sequence (One Cycle)	Indication
1	R G _ _ _ _ _	Wrong Battery
2	R G R _ _ _ _	Overcharged
3	R G R G _ _ _ _	The temperature of battery is too high
4	R G R G R _ _ _	Incorrect AC Input Voltage
5	R G R G R G _ _	The thermal sensor of charger is in fault
6	R G R G R G R _	The interface of communication is in fault
7	G R _ _ _ _ _	The temperature of charger is too high
8	G R G _ _ _ _	The relay of charger is in fault; Repair
9	G R G R _ _ _ _	Charger is in fault; Repair

### Note:

1. R—red    G—green
2. “\_” denotes one second stop
3. Above LED flashing sequence is just one cycle, the LED will flash repeatedly when in fault

## DELTA-Q TROUBLESHOOTING GUIDE









LED Colour	Indication (following "Power-On Self Test")	
Green	 <b>Solid:</b>	Charging complete. Charger in Maintenance Mode.
	 <b>Flashing:</b>	Short: <80% Charge.
Red	 <b>Flashing:</b>	Charger error. Reset charger power and refer to Troubleshooting Instructions below.

### Maintenance Instructions (for qualified personnel only)

1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to the level specified by the battery manufacturer. Follow the maintenance and safety instructions recommended for each model of battery by the battery manufacturer.
2. Make sure charger connections to battery terminals are tight, clean, and protected against accidental contact by metal tools, or personal objects.
3. Do not expose charger to oil, dirt, mud or direct heavy water spray when cleaning vehicle.
4. If the detachable input power supply cord set is damaged, replace with a cord that is:
  - a.) for North America - UL or CSA listed/approved detachable cord, 3 conductor, 16AWG minimum, and rated SJT; terminating in a grounding type IEC 60320 C14 plug rated 250V, 13A minimum; or
  - b.) for all other countries – a safety approved detachable cord, 3 conductor, 1.5mm<sup>2</sup> minimum, rated appropriately for industrial use. The cord set must be terminated on one end with a grounding type input connector appropriate for use in the country of destination and, on the other end, an output grounding type IEC 60320 C14 plug.

### Troubleshooting Instructions

If a fault occurs, count the number of red flashes between pauses and refer to the table below:

Red Flashes	Cause	Solution
	Battery High Voltage	Check battery size and condition and reset charger (interrupt AC power for 15 seconds).
	Battery Low Voltage	Check battery size and condition and reset charger (interrupt AC power for 15 seconds).
	Charge Timeout caused by battery pack not reaching required voltage. Charger output was reduced due to high temperatures	Check connections. Operate charger at a lower ambient temperature.
	Check Battery: battery could not be trickle charged up to minimum voltage	Check for shorted or damaged cells.
	Over-Temperature: Charger shut down due to high internal temperature.	Ensure sufficient cooling air flow and reset charger (interrupt AC power for 15 seconds).
	Charger Internal Fault	Reset charger (interrupt AC power for 15 seconds). Return to qualified service depot if fault persists.

Note: This is a Class A product complying with United States Federal Communications Commission, Code of Federal Regulations; 47CFR part 15. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

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