



electric transportation engineering corporation

GSE-200SP, GSE-200DP, GSE-250DP Single & Dual Port 15kW eTec SuperCharge™ System For Ground Support Equipment

INSTALLATION AND OPERATION GUIDE



**electric transportation engineering corporation
401 S. 2nd Avenue
Phoenix, Arizona (USA) 85003
Phone: (602) 716-9576
Fax (602) 256-2606**

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SPECIFICATIONS

Application:	GSE battery charging
Output Power:	15kW maximum
Battery Voltages:	24VDC - 96VDC (Nominal)
Battery Types:	Lead Acid (valve regulated or flooded)
Operating Temp:	0° C to +50° C (100% output to 40°C, 85% to 45°C, 75% to 50°C)
Environment:	Indoor/Outdoor, wall mount or foot mount
Dimensions:	(W/H/D) 36/48/27 inches (Add 15" height for mounting foot)
Input Current:	24 Amps (rms)—all versions

	GSE-200SP	GSE-200DP	GSE-250DP
Input Voltage:	480 VAC (+/- 15%), 3-phase, 60 Hz (3-wire + ground)	480 VAC (+/- 15%), 3-phase, 60 Hz (3-wire + ground)	575 VAC (+/- 15%), 3-phase, 60 Hz (3-wire + ground)
Output Current:	0-200 ADC	0-200 ADC	0-250 ADC
Charge Stations:	Single Output	Dual Output, Sequenced	Dual Output, Sequenced
Weight:	950 lbs	975 lbs	975 lbs

1.0 INTRODUCTION

The eTec GSE-series of battery charging systems are designed to satisfy the complete charging requirements of electric GSE traction battery systems. Using the patented Super-Charge™ algorithm, the GSE-series eliminates potential damage from overcharging, maximizes charge efficiency and enables a quick charge.

The GSE-series is capable of charging a wide range of battery voltages. Using the new, standard CANOpen GSE charging protocol, the charger communicates to the battery-

mounted Battery Identifier II to determine exactly the charging requirements for each battery.

The charger includes protection to prevent operation in extreme temperatures, and uses temperature compensation in its battery-charging algorithm.

This guide provides all the necessary instructions for installing and operating the eTec GSE-series of chargers. Please follow these instructions in the order in which they are presented in this guide.

Special warnings and precautions are included in section 2.0 and throughout this guide. Please observe them in detail to avoid personal injury and damage to the equipment.

Prior to installation, unpack the charger and position it in a suitable, designated area. Before using the equipment, read all the instructions and any **DANGER**, **WARNING**, and **CAUTION** markings posted on the charger should be read and understood before installation, operation, maintenance or servicing of this product.

These instructions do not purport to cover all details or variations in equipment, or to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to eTec.

The contents of this Install and Operating Guide shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of eTec. The warranty contained in the contract between the parties is the sole warranty of eTec. Any statements contained herein do not create new warranties or modify the existing warranty.

Technical Support

In the event that the installer encounters difficulties during the system installation or during normal operation of the charging system, please contact an eTec technical representative:

eTec

**electric transportation engineering
corporation**

401 S. 2nd Ave.

Phoenix, AZ 85003

Ph: 602-716-9576

Fax: 602-256-2606

e-mail: service@etecevs.com

web: www.etecevs.com

2.0 WARNINGS AND PRECAUTIONS

Qualified Personnel

A "qualified person" is someone who is familiar with the installation, mounting, start-up and operation of electrical equipment and the hazards involved. Such personnel must meet the following qualifications:

- 1) Trained and authorized to energize, de-energize, clear, ground and tag electrical circuits and equipment in accordance with established safety procedures.
- 2) Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- 3) Trained in rendering first aid.

Symbols Used in This Guide



NOTE

This symbol indicates information about the product or the respective part of the user guide that must be observed for proper equipment use or functioning.



CAUTION!

This symbol indicates that minor personal injury or material damage can result if the prescribed precautions are not followed.



DANGER! SHOCK HAZARD

This symbol indicates death; severe personal injury or substantial property damage can result if proper shock hazard precautions are not

taken. The charging circuits operate at high amperage levels.

TO PREVENT SHOCK HAZARDS

Before Applying Power to the System:

Check all components for damage, and check to ensure that there are no loose or disconnected wires, cables or mechanical connections.

Do NOT disassemble the equipment. Call a qualified service person when service or repair is required. Incorrect re-assembly may result in a risk of electric shock or fire.

Use of an attachment not recommended or sold by eTec may result in a risk of fire, electric shock, or injury to persons.

Risk of explosive gases.



CAUTION!

Working in the vicinity of a lead acid battery is dangerous. Batteries generate explosive gases during normal battery operation. To reduce the risk of battery explosion, follow these instructions, proper battery handling procedures and those published by the battery manufacturer of any equipment you intend to use while in the vicinity of the battery. Review the cautionary markings on these products.

In the Event of a Malfunction:

Do not disassemble the equipment. Call a qualified service person or an eTec technical representative when service or repair is required. Incorrect reassembly can result in a significant risk of electric shock or fire. Unau-

thorized servicing of the equipment may result in voiding of the product warranty.

3.0 INSTALLATION

Hazardous voltages are present in this electrical equipment during operation. Failure to observe the safety instructions can result in severe personal injury or property damage.

Only qualified personnel should work on or around the equipment after first becoming thoroughly familiar with all warning, safety notices and maintenance procedures contained herein.

The successful and safe operation of this equipment is dependent on proper handling, installation, operation, servicing and maintenance.

3.1 Transport

Vibration and sudden jolts must be avoided during transport—such as when setting the equipment down. Please observe the instructions on the packaging for transport, storage and professional handling.

Inspect the charger enclosure for any dents or damage that might have occurred during shipping. If any equipment is damaged, you must inform the shipping company immediately and file a formal claim for damage.

Open the enclosure door and remove any Quality Assurance tags or document packages that may be placed inside the charger during manufacture. Inspect all components to make sure all connections are tight and that all components are securely attached inside the enclosure.

3.2 Environment

Chargers are sophisticated electronic devices and should be treated accordingly. The use of conformal-coated circuit boards and NEMA type 3R enclosures improves tolerance to hostile environments. However, in a condensing environment all ingredients for electrolysis are present – water, electricity and metal. These environments should be avoided.

3.3 Mounting

Safe operation of this equipment requires the equipment to be mounted and commissioned by qualified personnel taking into account the warning information provided in this Instruction Manual.

During installation, general safety regulations for work on electrical power equipment must be observed as well as the professional handling of tools and the use of personal protective equipment.

The local guidelines and regulations must be observed when mounting and installing the equipment.



CAUTION!

The GSE-Series of chargers are large, heavy devices. Care must be taken to ensure that both the surface to which the unit is mounted and the hardware used for mounting are rated to support the full weight of the device plus any additional loads expected to be experienced during operation

The GSE-Series of chargers are supplied with wall-mounting brackets. A mounting foot accessory can be purchased separately for floor mounting. If mounting on a wall, mounting fasteners with both tensile strength and shear strength sufficient to support the charger must

be used. The mounting substrate must be inspected to ensure that it is structurally sound and in good condition. In wall mount applications, the foot mount assembly should be removed.

When floor mounting the unit, a location should be chosen that allows for free access to the unit for servicing while protecting it from general vehicle traffic. The charger must be mounted only on non-flammable surfaces. Refer to local code regulations for the amount of clear space that must be provided for the front and sides of the unit.

The unit must be placed on a flat, level surface and securely attached to the floor using an appropriate fastening system. The area under the charger and between the mounting feet must be kept clear from obstacles and debris as this is the air intake and filter service door for the charger cooling fans.

The unit should be left attached to the shipping pallet to facilitate movement to the installation location. **DO NOT ATTEMPT TO LIFT THE UNIT FROM THE BOTTOM WITHOUT THE PALLET IN PLACE.** If it is necessary to use chains or straps to lift the charger from the top eyebolts, a spreader bar *must* be used to prevent warping the top panel.

3.4 AC Wiring



DANGER! SHOCK HAZARD

Hazardous voltages are present in this electrical equipment during operation. The equipment should be disconnected from the supply before any work is performed. Otherwise, it shall be observed that live electrical components (at hazardous voltage levels) are exposed, which presents a shock hazard.

Only professionally trained, qualified personnel should work on or with the equipment.

The user is responsible for the installation of this unit and any other associated devices or units specified by eTec to be used with this unit. All of the recognized regulations applicable to the locality of installation must be observed. Cable, conduit, dimensioning, fusing, grounding, shutdown, isolation and over-current protection should be especially observed.

The GSE-200SP and GSE-200DP charger is factory-set as 480VAC, 60Hz three-phase input. The GSE-250DP charger is factory-set as 575VAC, 60Hz three-phase input. It is best to confirm the voltage and current ratings by referring to the nameplate or by contacting an eTec technical representative.

The installation should be completed by qualified personnel such as licensed electricians to meet the local codes and standards. Consult local code and the NFPA-70 regarding proper disconnecting means, wire size, connectors and conduit. Because each installation is different, the GSE-Series of chargers are not supplied with any knockouts for the AC supply. The termination for the AC supply is in the upper left-hand corner inside the charger in the form of a circuit breaker or power distribution block. eTec recommends penetrating the enclosure as close to this location as is possible to avoid having to run excess wiring through the inside of the charger. All penetrations must be made using watertight connections.

This charger is not phase sensitive, and the branch circuit feeder conductors shall be connected inside the enclosure to the terminals marked:

L1, L2, L3 and GND

	GSE-200SP	GSE-200DP	GSE-250DP
Maximum Actual Current and Voltage Ratings	Amperes: 24A Voltage: 480VAC (+/-15%), 3ph, 3-wire	Amperes: 24A Voltage: 480VAC (+/-15%), 3ph, 3-wire	Amperes: 24A Voltage: 575VAC (+/-15%), 3ph, 3-wire
Suggested Branch Circuit Ratings	30A	30A	30A

Suggested Fusing

30A Time Delay

Minimum Branch Circuit Feeders*

- (3) #8 Copper, 90 °C Conductors
- (1) #10 Copper, Ground Conductor

* These are minimum circuit sizes required for proper charger operation. Building codes and other applicable regulations may require different specifications.

3.5 Output Wiring



CAUTION!

Be sure of the polarity when making battery connections. Serious damage, risk of shock, generation of explosive gases, and fire can result from improper connections. Only qualified personnel shall execute maintenance and service work.

The GSE-Series of chargers require a specific output cable assembly and termination configuration to mate with the vehicle. The cable may or may not be installed on the charger depending on the customer's preference. Contact eTec for optional cables.

In the event that service or repair is performed on the output wiring, refer to the troubleshooting section of this guide and/or by contacting an eTec technical representative.

The output cable must be supported by means of a U-Shaped hook or other support to avoid contact of the connector plug with the ground when the charger is not in use. To maximize cable life, the hook should be designed such that the minimum bend radius of the cable is maintained when the cable is in place. Consult the cable manufacturer for cable data.

4.0 MAINTENANCE AND SERVICE



DANGER! SHOCK HAZARD

This charger operates at high voltage! *Some components inside the charger maintain hazardous voltage levels up to 5 minutes after the charger has been de-energized. As such, the equipment must only be opened and serviced after that time. High DC voltages may be present inside the charger anytime the DC output charger is connected to a vehicle—disconnect the output cable prior to opening the charger and/or performing any service or maintenance. Only qualified personnel shall execute maintenance and service work.*

The power and control terminals can still be at hazardous voltage levels even though the AC input is turned off. To reduce the risk of electric shock, disconnect all of the AC input and DC output wiring before attempting any maintenance. Turning off the charger, alone, will not reduce this risk. **Disconnect batteries before servicing any connected equipment.** If it is necessary for the charger to be powered up while being serviced:

- a) Never touch any live components.
- b) Only use the appropriate measuring and test equipment and protective clothing.
- c) Always stand on an ungrounded, isolated pad.

NOTE: If these warnings are not observed, service on the equipment can result in electric shock, fire and/or significant material damage. To maintain the proper function of your charger, use replacement parts authorized by eTec. Always have your product Order Number and Serial Number available when contacting the eTec service department. These numbers, and other important data, are located on the eTec nameplate.

4.1 General Service

The only customer-serviceable part in the charger is the intake air filter.



CAUTION!

The cooling fans may turn on at anytime whether or not there is a vehicle currently being charged. Always disconnect the charger from supply power before performing filter maintenance.

To maintain efficiency and ensure product longevity, this filter must be inspected monthly and replaced as necessary. The filter can be accessed from the bottom of the unit by removing the screws retaining the filter pan. Replacement filters must be the same size and material as specified by eTec¹. **DO NOT USE A FLAMMABLE FILTER MATERIAL.** Filter material should carry the UL mark. Replacement filters can be purchased from eTec.

While the filter medium will contain larger dust and dirt particles, airports typically generate fine carbon dust that will settle on the inside of the charger. To maintain efficiency and minimize the heat buildup (and potential component damage), this dust accumulation must be removed from the charger on a regular basis (at least quarterly). Contact an eTec technical representative to schedule this maintenance.

There is a thermostat inside the unit that controls the on/off points for the ventilation fans. This device should be set at 80°F at all times. The thermostat should be inspected periodically to ensure it is set correctly and functioning properly.

¹ Per ASHRAE Test Specification 52.1-1992: 2000 cfm @ .15" W.G. Initial Resistance

Contact an eTec technical representative to schedule all other maintenance and service.

5.0 OPERATION

5.1 Settings

The charger is fully configured prior to leaving the factory. The charger is capable of charging batteries ranging from 24V to 96V (nominal). The GSE-series of chargers are designed to work in conjunction with a vehicle-mounted device that contains the parameters necessary to properly charge each battery. The charger is designed to work with any such device conforming to the GSE industry standard CANOpen communication protocol (Device Profile for Battery Modules, CiA DSP 418). However, to obtain all the benefits of the SuperCharge™ system, every vehicle should be equipped with eTec's Battery Identifier II device. This unit contains all the necessary parameters to apply the SuperCharge™ algorithm and to properly track and perform regular maintenance (equalizing) charges for each battery.

The charger will not work with a vehicle that is not equipped with a device conforming to the afore-mentioned Device Profile for Battery Modules.

5.2 Start-up Sequence

After the proper connection has been made to the AC line, the AC input breaker or disconnect switch may be closed. The control system will perform an internal check during which time each indicator light is individually illuminated and then all lights will illuminate for approximately 10 seconds. The software revision is then flashed out in the following manner: short flashes indicate ones and long flashes indicate tens, each digit is separated by a short blank. For example, three short

flashes followed by seven short flashes would indicate software revision 3.7. Once all lights are extinguished, the charger is ready to begin charging.

5.3 General Operation

When a battery charge is required, park the vehicle with the vehicle charge port near the charging unit and securely connect the DC output cable to the vehicle. The GSE-200DP and GSE-250DP are equipped with two charging cables; Port A on the left and Port B on the right. Vehicles can be plugged into either port and two vehicles can be plugged in at the same time.

This charger is equipped with automatic charge initiation. Upon securely connecting the charge connector, the charger will begin communicating with the Battery Identifier II and determine the proper charging parameters for that battery. Once proper communications are established, the control system will determine if the battery is in good condition to charge (checking for proper voltage and temperature levels.) by checking the following parameters:

- Battery voltage polarity
- Low battery voltage
- High battery voltage
- Low battery temperature
- High battery temperature
- Vehicle charging contactor state
- Charger output contactor state

When the system determines that a charge can be applied, the charger will turn on and begin to ramp up the current applied to the battery. Several steps in current are made to again insure that the battery is in proper condition for charging:

- Battery temperature
- Battery voltage
- Battery resistance

Within 60 seconds, the charger will ramp up to the maximum current that the battery can accept. NOTE that the charger is limited to a maximum of 200A or 15kW, whichever is achieved first.

The GSE-200SP is equipped with one set of indicator lights, the GSE-200DP and GSE-250DP display panel is equipped with two sets of indicator lights, one for each of the two ports. These indicator lights operate independently and indicate the operational state for each port as described below.

During the charge event, the operator indicator lights will illuminate to indicate the status of the charger:

Orange: Charging is underway.

Green: Charging has completed and it is ready to disconnect the vehicle from the charger.

Red: A fault condition has been identified. Refer to the troubleshooting section for additional details.

Blue: An equalize charge is required. The blue light will illuminate immediately when the system determines that an equalizing charge is required. The operator should plan to leave the vehicle connected to the charger for an extended period of time.

White: Wait, Power Sharing or Soft Start. In certain circumstances, the charging system may determine that a delay is required. If the charger is connected to a power sharing system, the light will indicate that the system has entered a power sharing mode and that charging current is reduced or temporarily suspended. Charging

will automatically resume when the initiating condition has been removed. If the charger is equipped with the Soft Start option, this light will indicate a Soft Start is being performed.

5.4 Charge Sequencing; Two Vehicles

The GSE-200DP and GSE-250DP are capable of servicing the charging needs of two vehicles connected to the charger. To maximize energy throughput to each vehicle, the charger delivers energy to one vehicle at a time and switches power delivery between vehicles as necessary. The charger is programmed to charge the battery with the lowest state of charge until the two connected batteries are at near equivalent states of charge.

When a second vehicle is connected to the charger, the charge will be interrupted on the first vehicle and the charging process will initiate with the second. (In the instance where two vehicles are plugged in simultaneously, one vehicle will receive charge and the white Wait light will illuminate on the second while the startup process is completed with the first vehicle.) Once the charger determines the state of charge for the second vehicle, a determination is made which vehicle will be charged. Once both batteries are at similar states of charge, the charging process will sequence between vehicles at 5-minute intervals.

During the charging process, the orange Charging light is illuminated for each vehicle. No indication is given to the operator as to which vehicle is receiving charge.

5.5 Charge Completion

The charger can be left unattended and will stop delivering current when the battery has

reached a pre-determined point. The green Complete indicator light will illuminate.

On a dual port charger, when two vehicles are connected to the charger, the first battery to go to complete will illuminate the green Complete light. While the second vehicle is still charging, its orange Charging light will remain illuminated.

The DC output cable can be disconnected from a vehicle with a green Complete light.

In most instances, the charger will terminate before the battery is completely charged. This is done to minimize the charging time and to protect the battery from excessive heating. As required by the battery, an equalize charge is periodically applied (see Section 5.7). Contact an eTec technical representative to discuss alternative charging strategies.

5.6 Charge Interruption

At any time during the charge event, the vehicle can be disconnected from the charger. BEFORE disconnecting the charge cable from the vehicle, press the red STOP button to stop current delivery to the port to which the battery is connected. The GSE-series of chargers are equipped with a rapid shutdown system that will terminate the charge event anytime the pilot circuit is disconnected—usually by pulling on the charge connector.



NOTE

While the rapid shutdown system is designed to quickly turn off the charger, excessive use of this rapid-shutdown feature may lead to accelerated wear of the charge connector, vehicle charging receptacle or charging contactors (both in the charger and vehicle).

Pushing the STOP button only stops the charge event for that port assuming it is a dual port charger. In the event that two vehicles are connected to the charger, pushing the STOP button at one port will cause the charger to switch charging to the remaining vehicle. There will be a brief delay while this switch occurs.

Once the STOP button is pressed at either port, the vehicle at that port must be disconnected and reconnected in order to resume charging at that port.

5.7 Equalization

From time-to-time, it is necessary to perform a maintenance charge on a lead acid battery to maintain its capacity and to ensure long life. The SuperCharge™ system automatically determines when this maintenance (“equalization”) charge is required and will illuminate the blue Equalize light immediately upon plug in to indicate the need for such a charge.

The system will automatically enter the equalize charge mode upon completion of the regular charge. The equalization charge will add several hours to the total charge time.

When two vehicles are connected to a Dual Port charger, the equalization charge for either battery will not begin until both batteries reach the Complete phase. If both batteries need an equalization charge, the battery with the most accumulated charge amp-hours since the last equalize will receive the equalize charge first. That equalize charge will need to go to complete (or manually terminated) before the equalize charge on the second vehicle will begin.

At the end of the equalize charge, the green Complete light will be illuminated for the appropriate charging port.

If the vehicle is disconnected anytime before completion of the equalize charge, the system will attempt to deliver a complete equalize charge every time that vehicle is subsequently connected. This will continue until a complete equalize charge is delivered. Contact an eTec technical representative to discuss alternative equalizing strategies.

6.0 SOFTWARE OPTIONS

This section applies ONLY to Version 3.7 of software. Currently there are two software options that may be incorporated into the charging algorithm, De-Stratify It and Soft Start. If the software has been “built” for one of these software options it may be enabled via a dip-switch setting. Note that making the Dip switch changes noted below will not invoke these options unless they were built into the software set at the factory.

6.1 Maintenance Saver

Maintenance Saver is enabled by shutting power off to the charger at the service disconnect, setting dip-switch S2-1 to the open position then turning power back on to the charger.

Maintenance Saver is a special mode for charging Flooded Lead Acid batteries which will prevent electrolyte stratification. During the regulate mode the charger periodically delivers full current for a short duration to the battery. This causes a burst of small bubbles to form on the plates which then rise to the top. This bubbling causes a stirring action in the electrolyte to keep the acid and water from separating. The end result is a more homogeneous electrolyte mix without the excessive gassing that is usually required toward the end of a charge event. Because less gassing is required, water consumption is reduced, thus

requiring less frequent maintenance intervals to add water to the cells.

6.2 Soft Start

Soft Start is enabled by shutting power off to the charger at the service disconnect, setting dip-switch S2-2 to the open position then turning power back on to the charger.

Soft Start will be used to charge a battery that is over discharged (low terminal voltage), extremely cold or for some other reason exhibits high internal resistance. Soft Start uses much lower currents to charge a battery under these conditions. As such, a full charge will take much longer to complete than a typical charge event when Soft Start is employed.

When a vehicle requiring a Soft Start is connected, the Charging and Wait lamps will be illuminated for the current port during the Soft Start.

In the case of a Dual Port charger, the Wait lamp for the other port will be illuminated to indicate that it is unavailable during a Soft Start charge. If a battery is charging normally on one port, and second vehicle is connected and requiring a Soft Start, the Soft Start battery gets precedence and a Wait light will be illuminated for the healthy battery.

Once the Soft Start is done, the Wait lamp will be turned off. Charging may continue at normal rates and the Charging light will remain illuminated. Soft Start is complete once 1/5th of the battery's capacity (in Amp-hours) has been delivered or 2/5^{ths} for a cold battery. If the battery does not fall within normal charging parameters before these limits are reached, charging will stop and the Fault light will be illuminated.

If the vehicle arrives at the charger requiring a Soft Start and an equalization, the equaliza-

tion will be suppressed until the next charge event. If a Soft Start was performed on a vehicle, the next charge will incorporate an equalization unless the Soft Start was due to an excessively low temperature.

The Battery Identifier II has a parameter to store the number of times a Soft Start has been performed.

7.0 TROUBLESHOOTING

The GSE-Series of chargers are equipped with a red Fault light on the front panel of the unit. This lamp will illuminate in the event an error occurs during the initial connection or charging period. When the red Fault lamp is illuminated, it flashes to indicate the fault logged by the system. The lamp will flash with long and short flashes to indicate the fault code. For example, long-short-short-short indicates fault code 13. The fault code will be repeated three times and then the light will remain steadily illuminated.

Fault Codes:

- 0 No Fault Has Occurred
- 1 Charger contactor stuck in closed position
- 2 Vehicle contactor stuck in closed position
- 3 Battery voltage too low to charge
- 4 Battery voltage too high to charge
- 5 Charger contactor will not close
- 6 Could not deliver current to the battery during ramp-up mode to measure resistance
- 7 Current spiked abnormally high during charging
- 8 High resistance battery or cables
- 9 Contactor opened up during charging (contactor may be destroyed)
- 10 Battery temperature below allowable limit (-40°C)
- 11 The current control signal was decremented below zero during current control
- 12 Battery module CAN communication failed
- 13 E-Stop switch failed or depressed during connect

- 14 ISR line at microprocessor failed
- 15 GFI trip or circuit failure (for chargers optionally equipped with GFI circuit)
- 16 Excessively high battery temperature or temperature sensor disconnected
- 17 No battery voltage signal after close contactor command
- 18 Falling terminal voltage during bulk charging mode
- 19 Ahr delivered exceeded allowable limit when not performing an equalization
- 20 Current increased beyond allowable limit during Regulate mode
- 21 Bridge Power Manager communication failure
- 22 Invalid BPM packet received
- 23 Charger DC output contactor on the port that is not charging is closed
- 24 Battery over temperature > 55°C
- 25 Low resistance measurement (Probable Iso-Amp failure)
- 26 Current did not go to zero during res-free measurement
- 27 Current is below 5A and should not be (current transducer failure)
- 28 Battery module parameter invalid
- 29 Fault code no longer defined
- 30 Fault code no longer defined
- 31 RAM failure
- 32 Battery module temperature invalid
- 33 Charger delivered > 120% Ah capacity before reaching I_{finish}
- 34 Resistance went above upper set-point during Soft Start
- 35 Soft Start delivered more than C/5 Ampere Hours
- 36 Iso-Amp voltage was exceeded
- 37 Resistance doubled during Soft Start

See Appendix A for a more complete description of each fault.

When an error occurs, the control system will log the fault. The charger stores the last six faults in memory. Faults can be retrieved with a laptop computer employing eTec's charger

diagnostic application (CCC Diagnostics—refer to the application documentation for details). Troubleshooting should be performed by qualified maintenance personnel only.

To clear any fault condition, disconnect the vehicle from the charger, and then reconnect the vehicle to the charger. This will force the charger to proceed through the startup and charging sequence, but the original fault will be stored in memory.

If a fault continues to occur or the charger fails to operate, contact an eTec technical representative via the information listed below.

**eTec
electric transportation engineering
corporation**

401 S. 2nd Ave.
Phoenix, AZ 85003
Ph: 888-383-2387
Fax: 602-256-2606
e-mail: service@etecevs.com
web: www.etecevs.com

Appendix A

Description of Fault Codes

Fault Code	Comment	Description
0.	No Fault Has Occurred	
1.	Charger contactor stuck in closed position	The charger determined that the auxiliary contacts on the charger contactor(s) were in a closed state before the contactors were powered on. This might indicate a stuck charger contactor or failed auxiliary contacts.
2.	Vehicle contactor stuck in closed position	The charger did not see an increase in voltage upon closing the vehicle contactor. This indicates a broken or stuck vehicle contactor.
3.	Battery voltage too low to charge	The measured battery pack voltage was below 1.5 volts per cell when connected to the charger. Batteries discharged to this level should be checked for damage by a competent battery technician before charging.
4.	Battery voltage too high to charge	The measured battery pack voltage was above 2.45 volts per cell when connected to the charger. This may indicate that the Battery Identifier is programmed incorrectly for this battery.
5.	Charger contactor will not close	The charger contactor relay(s) was commanded on but the auxiliary contacts on the contactors did not close as required to indicate contactor closure. This may indicate a burned out or failed contactor coil.
6.	Could not deliver current to the battery during ramp-up mode to measure resistance	The analog signal to the Siemens electronics was incremented to deliver current but the target current was not reached
7.	Current spiked abnormally high during charging	Current spiked more than 30 amps above previous value when updated at 1-second intervals
8.	High resistance battery or cables	The measured resistance in the charging circuit (including battery internal resistance is greater than 200mΩ. A damaged battery module, corroded cable or terminal or loose lug or clamp connection are some potential causes
9.	Contactor opened up during charging (contactor may be destroyed)	The charger DC Output contactor(s) auxiliary contacts changed from an open to a closed circuit during the charging process. Opening under load may cause irreparable damage to the contactor

10.	Battery temperature below allowable limit (-40°C)	The temperature reported by the battery identifier was below -40°C. Charging a battery at temperatures below 0°C may cause damage to the battery (frozen electrolyte may also cause irreparable damage to the battery). Make sure the temperature sensor is in intimate contact with the battery case and that it is insulated on the back and sides to prevent reading air temperature
11.	The current control signal was decremented below zero for some unknown reason	The current command signal sent to the charger electronics went below zero when trying to control current. Battery internal short and charger internal short may be the cause.
12.	Battery module CAN communication failed	The charger lost communication to the battery-mounted identifier device. Check cabling between the CAN device and the control board.
13.	E-Stop switch failed or depressed during connect	The E-stop circuit was open during the initial start up of the charge event. Check to make sure the button is not stuck down or that nothing is propped against the button. Check E-stop circuit.
14.	ISR line at microprocessor failed	Internal failure on the Charger Controller Card
15.	GFI trip or circuit failure (for chargers optionally equipped with GFI circuit)	(Only applies to units with GFI device)
16.	Excessively high battery temperature or temperature sensor disconnected	The battery temperature reported by the battery-mounted CAN device was above 50°C during charge. Battery damage can result when charged above 50°C. Check to make sure the temp sensor is not touching a current carrying cable or battery interconnect strap. Check that the temp sensor is not exposed to direct sunlight. Check that the temp sensor is not disconnected.
17.	No battery voltage signal after close contactor command	The vehicle contactor was powered on and no voltage was measured inside the charger. Check for failed contactor. Check for battery disconnected from vehicle
18.	Falling terminal voltage during bulk charging mode	During the constant current phase of the charge event, the battery voltage began to decrease. A weak, dry or failed battery module is the likely cause
19.	Ahr delivered exceeded allowable limit	The charger delivered more energy than allowable to the battery. During a normal charge, this will be equal to an estimated value of the battery's capacity at a 150A rate. When an equalize charge is required, this value is 120% of the estimated capacity at the 150A rate

20.	Current increased beyond allowable limit during regulate mode	During the current regulation mode of the charge event, current began to increase and continued to increase beyond the allowable limit. This fault usually indicates a problem with one or more battery modules in the pack
21.	Bridge Power Manager communication failure	The Charger Controller Card is configured to communicate to a Bridge Power Manager (BPM) device. No communication was received from the BPM
22.	Invalid BPM packet received	The Charger Controller Card is configured to communicate to a Bridge Power Manager (BPM) device and the CCC received a communication packet from the BPM that was incorrectly configured or that contained bad information
23.	Charger DC output contactor on the port that is not charging is closed	The auxiliary contacts on the DC output contactors were closed while the other port was charging. This indicates a possible failure of the DC Output contactors on the idle port
24.	Battery Overtemp—exceeds 55°C	The temperature signal received from the BI2 indicates battery temperature exceeding 55°C. Hot batteries can be damaged by high currents—both discharge and charging. Check connection between Temperature Sensor and BI2. Check that the temperature sensor is not touching an interconnecting strap, cable or bolted connection. Allow battery to cool sufficiently before resuming charging
25.	Low resistance measurement	The ETEC SuperCharge™ systems continually measure resistance of the DC output system. If the measurement falls below a pre-determined level, this fault will occur. Check that the DC sensing circuit to the Iso Amp board is good. Also check connection between Iso Amp and CCC boards. Replace Iso Amp board
26.	Current did not go to zero during res-free measurement	The current transducer current reading should be close to zero amps at the time of the res-free measurement. This is possibly a current transducer or Iso-Amp failure.
27.	Current is below 5A and should not be	During a charge, the current should be greater than 5 amps but the current transducer reading is lower than 5 amps. This is possibly a current transducer or Iso-Amp failure.
28.	Battery module parameter invalid	The Battery Identifier presented one or many parameters that are not valid. The Battery Identifier or the communication link may be damaged.
29.	Fault code no longer defined	This fault code was removed in Version 3.3 of software.

30.	Fault code no longer defined	This fault code was removed in Version 3.3 of software.
31.	RAM failure	Upon charger power up the charger has detected an internal memory problem.
32.	Battery module temperature invalid	The Battery Identifier is reporting invalid temperatures
33.	Charger delivered > 120% Ah capacity before reaching I _{finish}	The charger delivered more energy than allowable to the battery. During a normal charge, this will be equal to an estimated value of the battery's capacity at a 150A rate. When an equalize charge is required, this value is 120% of the estimated capacity at the 150A rate
34.	Resistance went above upper set-point during Soft Start	Soft Start was not able to recover the battery because the resistance is too high
35.	Soft Start delivered more than C/5 Ampere Hours	Soft Start delivered C/5 and the battery still has a problem
36.	Iso-Amp voltage was exceeded	The charging voltage exceeded the capabilities of the iso-amp to measure the voltage. The charging algorithm cannot be performed
37.	Resistance doubled during Soft Start	Soft Start was not able to recover the battery because the resistance started increasing