User's Manual

Automatic Switch-Mode Battery Charger

IMPORTANT

Read, understand, and follow these safety rules and operating instructions before using this battery charger. Only authorized and trained service personnel shall be permitted to operate or perform any maintenance or service. This manual should be considered a permanent part of your machine and should remain with the machine at all times.

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Safety

Danger

Failure to obey the safety rules and instructions in this manual will result in death or serious injury.

Label and Safety Rules Legend

DANGER	Indicates the presence of a hazard that **will** cause death or serious injury
WARNING	Indicates the presence of a hazard that **may** cause death or serious injury.
CAUTION	Indicates the presence of a hazard that **will** or **may** cause serious injury or property damage.

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Safety: General

- Do not operate a charger that is not working correctly. An electric shock hazard or battery explosion hazard from overcharging may exist.
- Make sure the charger is the correct voltage and type for the battery or battery pack to be charged. Use of an incorrect charger may result in battery explosion and serious injury and/or property damage.
- Do not attempt to service the charger yourself unless you are a trained service technician. The warranty is void if the charger case has been opened. Always follow installation instructions closely. The high voltages inside the charger are a shock hazard and can cause serious injury or death.
- Though the charger is resistant to water and spray washing do not fully immerse or spray wash for an extended (more the 5 seconds in one position) time. Liquid can get inside charger and may cause serious injury or death.
- The charger is designed for use in industrial areas. It is not designed to be used in medical (hospital) environments where interference with life critical equipment could cause death or serious injury.
- There could be a spark during charging. Be careful when using fuels, solvents or other flammables near the charger or batteries. An explosion could result causing death or serious injury.
- This charger is intended only for use on GACELL equipment and batteries installed on that equipment. Use on other batteries may result in overcharging and battery explosion causing serious injury or death.

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Safety: Power

- To reduce the risk of an electric shock, connect only to a properly grounded single phase (3wire) outlet.
- Ensure that the AC voltage supplied to the charger is within the ranges in the specification table. Voltages outside this range, particularly high voltages, can result in an electric shock and fire hazard.
- If you use an extension power cable with your charger, ensure the total current draw of the items plugged into the extension power cable do no exceed the current rating of the extension cable and meet all national and local electrical code requirements. See Specifications page for current draw of charger. Overloaded extension cords can catch fire and cause property damage, serious injury or death.
- Do not operate charger if wiring is damaged including cut insulation or pinched wires. An electric shock could cause serious injury, or death.

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Safety: Batteries

- See battery suppliers guide for proper care of batteries and follow directions carefully. Failure to follow battery care instructions can result in battery explosion and property damage, severe injury, or death during charging.
- When attaching charger leads to battery terminals be careful that tools do not short between battery terminals. Shorting between battery terminals may cause extreme arcing resulting in explosion or extreme heat that can cause burns.
- Do not disconnect charger terminals while batteries are charging. Sparking can occur which could ignite flammable battery gases and cause an explosion. Always turn the charger off first (unplug from AC).
- Do not touch battery terminals or any exposed electrical parts. Contact with terminals or other exposed electrical parts may cause an electric shock. Remove watches, rings, and jewelry to avoid arcing and electric shock.

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Initial Installation

Only trained technicians with knowledge of the equipment and batteries the charger will be used with should install the charger.

Ensure that the charger is the correct type and voltage for the battery pack to be charged. This charger is only to be used with lead acid type flooded or Absorbed Glass Mat (AGM) type batteries only.

CAUTION: Use of an incorrect charger for the type of battery or battery voltage can result in battery explosion and serious injury and property damage.

Determine if the batteries to be charged are flooded or Absorbed Glass Mat (AGM) lead acid type. For AGM type batteries the yellow wire loop at the back of the charger should be cut and the wire ends taped. This selects the charging profile for the AGM type batteries.

Wire the output (separate red and black wires) of the charger to the battery. For on-board or other installations the charger can remain permanently connected to the battery. Connect the red wire to the POSITIVE (POS, P, +) terminal of the battery. Connect the black wire to the NEGATIVE (NEG, N, -) terminal. Ensure that any terminals used are capable of carrying 20 amperes, that all crimp connections are good, and that the connections are clean and tight.

If the equipment requires use of an interlock connect the black and white wires as necessary. The wires connect to relay contacts inside the charger that are open when the charger is on and closed when the charger is off. The wires are not polarity (+ or -) sensitive.

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Operation

WARNING: There could be a spark during charging. Be careful when using fuels, solvents or other flammables near the charger or batteries. An explosion may result causing serious injury or death.

WARNING: To reduce the risk of an electric shock, connect only to a properly grounded single phase (3wire) outlet. Electric shock hazard may cause serious injury or death.

CAUTION: To reduce the risk of fire, use this charger only on AC circuits and extension cords capable of handling the AC Input currents (Max. Amps) defined in the electrical specifications. Use must be in accordance with all National and Local Electrical Codes for the location of use. Overloaded cords or circuits present a fire and shock hazard and may result in property damage, serious injury, or death.

1) Plug the charger into a single phase AC socket with a nominal voltage rating of 100V, 110V, 115V, 120V, 220V, 230V, or 240V and a frequency rating of 50 or 60Hz. The charger automatically senses and adjusts to the AC voltage and frequency
2) The charger will flash the LEDs in a start-up check then start charging the batteries. The "GEL" LED on the front panel identifies the charge profile for the battery type. If the lamp is off, the charger is operated in the charging profile for normal flooded lead acid batteries. If the GEL LED is on, the charger operates a charging profile for sealed gel (AGM) type lead acid batteries.
3) The three green LED's indicate the charging progress. When the battery is 0 to 50% charged the 50% LED flashes. When the battery is between 50 to 75% charged the 50% LED is on while the 75% LED flashes. When the battery is between 75 to 100% charged the 75% LED is on and the 100% LED flashes. When the battery is fully charged the 50%, 75% and 100% LEDs are on. Charging time is dependent on depth of battery discharge, battery condition, and temperature.

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4) If the charger is left plugged in after charging is complete (all LEDs on) the charger goes into maintenance mode to keep batteries charged while in storage. In this mode constant voltage is maintained while replenishing internal battery losses for long term storage. This keeps batteries charged while in storage but does not boil-out the electrolyte over time.
5) Turn-off charger by unplugging (disconnect from AC voltage).

Technical Operation Summary – The charger is an advanced, microprocessor controlled, high frequency switching type charger. From 0% to 75% a constant current is provided to the battery (bulk charging) until a pre-set battery voltage is reached. From 75% to 100% a constant voltage is maintained and the charging current decreases (absorption charging). When the charging current falls below 2 to 3A charging is complete. The charging curve is temperature compensated using the starting temperature of the charger as the battery temperature. The charger will work even with batteries in a severe discharge state with terminal voltages as low as 2V and there is no need to 'boost charge" weak batteries before charging. The charger has an 24 hour timer in case charging can not be completed due to battery problems – see troubleshooting section. The charger senses and flashes error codes for problems – see troubleshooting section.

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Charging State & LED Display

LED / Charging State	50%	75%	100%	HP/BT	GEL
0 to 50% charged	Blinking	Off	Off	X	X
50% to 75% charged	On	Blinking	Off	X	X
75% to 100% charged	On	On	Blinking	X	X
100% charged	On	On	On	X	X
Power reduction	X	X	X	On	X
Charge for flooded type batteries	X	X	X	X	Off
Charge for Sealed type batteries	X	X	X	X	On
See Troubleshooting	X	X	X	Blinking	X

Note 1) X in the table means “don’t care”, LED may be off, blinking, or on.

Note 2) Power Reduction: If the charger’s internal temperature exceeds a specific level, the HP/BT lamp stays on and the output current is reduced. If the temperature exceeds a limit despite the reduced output charging will stop. Charging restarts automatically once the charger internal temperature reduces to a normal level.

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Maintenance

WARNING: Disconnect from AC voltage before doing any service. When plugged-in the AC wiring is an electric shock hazard. Disconnecting the DC output wires near the batteries when the charger is ON may cause the batteries to explode resulting in serious injury or death.

WARNING: Risk of an electric shock causing serious injury or death. Do not touch un-insulated parts of the charger wires, battery connector or battery terminals. Be careful with tools as shock or arcing from shorting of electrical parts may cause serious injury or death. Remove rings, watches, and jewelry to avoid arcing and electric shock.

1) All electrical connections must be kept clean and tight. Sometimes connections can look good outside but be corroded inside causing an output connection error (one flash failure, see troubleshooting).
2) The charger cools through the case fins. If the fins become covered with debris the charger's over-temperature protection system may reduce charging power. Clean-off fins to improve cooling.
3) Replace the charger if case damage breaks the water-tight seal.
4) Inspect wiring weekly, including AC plug, AC cord, DC wires to battery, and interlock wires for cut insulation, pinching, or other damage. Repair to avoid electric shock.
   AC Ground – green with yellow stripe
   AC Neutral – light blue
   AC Line (Hot) – brown
   DC Battery Negative (-) - black
   DC Battery Positive (+) - red
5) Follow battery supplier recommendations for battery care and maintenance.

Note – most battery charging problems relate to battery care and not charger problems.

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Troubleshooting

WARNING: Do not operate the charger if it is malfunctioning. Personal injury or property damage could result. Electric shock hazard may cause serious injury or death.

WARNING: Do not disassemble the charger. High voltages inside the charger are an electric shock hazard and may result in serious injury or death.

Identify the problem from the following list and refer to the appropriate section for detailed instructions.

1. **CHARGER DOES NOT TURN ON.**
2. **3 LED's BLINK SIMULTANEOUSLY**
3. **HP/BT LED BLINKS**
4. **BATTERIES DO NOT FULLY CHARGE**
5. **THE AC SUPPLY CIRCUIT BREAKER OR FUSE IS BLOWN**

1. CHARGER DOES NOT TURN ON.

Double check the outlet to ensure it is working by trying out another known good piece of equipment on the outlet. Check the AC plug and wire to ensure both are in good condition. Replace charger if everything else is correct.

CAUTION: If the AC plug or receptacle is broken, twisted, bent or loose, it cannot make a good electrical connection and an electric shock hazard may exist. Have it repaired or replaced by a qualified person immediately. DO NOT USE THE CHARGER UNDER THIS CONDITION. Fire, injury, or death may result if not corrected.

2. 3 LEDS BLINK SIMULTANEOUSLY

The faults identified below cause the 3 LED's to blink simultaneously and a buzzer to sound. If the cause of the fault is removed the charger restarts automatically, the LEDs go into normal operational mode, and the buzzer stops.

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- **3 LEDS BLINK ONCE SIMULTANEOUSLY : OUTPUT CONNECTION ERROR**.
  -> CHECK THE BATTERY AND CHARGER CONNECTION AND CORRECT

(The output may not be connected to the batteries or the connections to the batteries may have corroded or loosened. The output may be shorted due to improper connection to the batteries or pinched wires. The output may be connected in reverse polarity to the batteries. The charger is not damaged by any of these problems.)

- **3 LEDS BLINK TWICE SIMULTANEOUSLY : AC VOLTAGE PROBLEM**.
  -> CHECK THE AC INPUT VOLTAGE. THE CHARGER IS INDICATING THE AC VOLTAGE IS TOO LOW OR TOO HIGH. CORRECT.

(See the electrical specification table for the allowable AC voltage input ranges. This is an unusual problem and would most likely occur with a very poorly regulated engine-generator set providing the AC voltage to the charger)

- **3 LEDS BLINK THREE TIMES SIMULTANEOUSLY : CHARGER IS OVERHEATED**.
  -> NO ACTION REQUIRED. WHEN THE CHARGER COOLS, CHARGING WILL RE-START AUTOMATICALLY. CHECK AND CORRECT FOR DIRT OR OTHER DEBRIS ON CHARGER THAT MAY BE REDUCING COOLING.
- **3 LEDS BLINK FOUR TIMES SIMULTANEOUSLY : INPUT OR OUTPUT** OVER CURRENT.
  -> NO ACTION REQUIRED, CHARGER WILL CORRECT AND RE-START AUTOMATICALLY.

3. THE HP/BT LED BLINKS

The 24 hour timer has elapsed or a bad cell in the battery has been detected. Causes:

-> BATTERIES ARE EXTREMELY DISCHARGED. UNPLUG AND THEN PLUG-IN CHARGER TO RE-START CHARGE CYCLE TO COMPLETE CHARGING.

-> BATTERIES ARE WEAK, OLD, OR HAVE ONE OR MORE BAD CELLS. BATTERIES WILL STILL CHARGE BUT CAPACITY WILL BE REDUCED. REPLACE BATTERIES.

-> BATTERY PACK TOO LARGE FOR THE CHARGER. USE HIGHER OUTPUT CHARGER OR UN-PLUG, WAIT 20 SECONDS, THEN PLUG-IN CHARGER TO RE-START CHARGE CYCLE TO COMPLETE CHARGING.

4. BATTERIES DO NOT FULLY CHARGE

If the batteries are charged overnight, make sure the AC supply is not being switched-off at night with other building circuits. Check battery condition following the battery supplier's instructions. Check for dead cells or reduced capacity. Replace charger only if other problems are not found.

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5. THE AC LINE CIRCUIT BREAKER OR FUSE IS BLOWN

An overloaded AC circuit, defective circuit breaker, defective fuse, or a charger problem can cause this condition. First check to see what the total load is on the AC circuit to avoid overload. If total AC load is OK connect the charger to a different AC outlet (on a different circuit) in the building. If the charger operates properly on other AC outlets, a qualified person should correct the AC circuit problem. If the AC supply checks good, the charger should be replaced.

Note: Over 1/2 of all battery chargers returned as "failed" are good. Please follow the troubleshooting procedures carefully and check all other items before returning the charger as failed.

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Replacing the Charger

WARNING: Disconnect from AC voltage before doing any service. When plugged-in the AC wiring is an electric shock hazard. Disconnecting the DC output wires near the batteries when the charger is ON may cause arcing and the batteries to explode resulting in serious injury or death.

WARNING: Risk of an electric shock causing serious injury or death. Do not touch un-insulated parts of the charger wires, battery connector or battery terminals. Be careful with tools as shock or arcing from shorting of electrical parts can cause serious injury or death. Remove rings, watches, and jewelry to avoid arcing and electric shock.

WARNING: Do not disassemble the charger. Take it to a factory-authorized service agent when service or repair is required. High voltages inside the charger are an electric shock hazard and can result in serious injury or death.

Replace only with charger designed for use with the batteries and machine to ensure compatibility with all machine systems. Make sure the charger is unplugged before replacing and be careful tools do not short battery connections which can cause electric sparks. Ensure connections are the same as the original charger with wires connected by a qualified person (see tag on AC cord):

AC Ground – green with yellow stripe
AC Neutral – light blue
AC Line (Hot) – brown
DC Battery Negative (-) - black
DC Battery Positive (+) – red
Interlock – small white wire
Interlock – small black wire

Make sure all connections are clean and tight to provide a good electrical connection. Check all machine operating systems after replacement to ensure proper operation (see machine operating manual).

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Specifications

Electrical Specifications		
Item	AC Input	DC Output
Voltage	115V (85-132V) 230V (170-264V) (Automatically Selects)	Max. 31.7 VDC (29.6V@26°C for Flooded) (28.3V@26°C for GEL)
Max. Current	5A at 85V 2.5A at 170V	Max. 19.0 ADC
Frequency	60 / 50 Hz	-
Phase	SINGLE	-
Output Power		600 Watts

Applicable Battery Specifications: For use with 24Volt, 150 ~ 305 Amp-Hour, deep cycle lead-acid Batteries - flooded or sealed gel (AGM) type

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