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

 **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.
- 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.
- The charger contains chemicals known to the State of California to cause birth defects or other reproductive harm. Wash hands thoroughly after handling.
- The charger surface can get hot while operating and contact with the skin or surrounding materials should be avoided.

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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.
- The charger includes an interlock relay to prevent the machine from operating while charging. Please see the machine manufacturer's documentation for correct wiring and test to ensure correct operation.

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.

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- 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 battery terminals or other exposed electrical parts may cause an electric shock. Remove all watches, rings, and jewelry to avoid arcing and electric shock.

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 GEL 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.

The charger profile is selectable by means of a yellow wire loop inside the charger. **Before power on**, keep the yellow wire loop intact for wet gassing or flooded lead acid batteries. For sealed GEL type lead acid batteries, cut the yellow wire loop and ensure the ends do not short to any part.

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 white 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.

CAUTION: The charger surface may get hot while charging. Avoid skin contact with the charger surface. Keep surrounding materials away from charger surface to avoid heat damage and to allow cooling.

1) Connect the DC output wires to the battery.
2) Connect the power supply cord to a properly grounded 100VAC/50 or 60 Hz, 115VAC/60 Hz, or 230 or 240VAC/50 or 60 Hz. socket. This charger automatically senses and adjusts to the AC input voltage.
3) The charger will start automatically within a few seconds. Once the charging starts, the LED's indicate the charging progress as described in the following Operating and Fault Codes table. The charger will start even with severely discharged batteries (down to 4V or lower terminal voltage).

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4) The charger goes into maintenance mode after the batteries are fully charged, and the CHARGE LED is steady “on” In this mode, the charger no longer supplies power to the batteries, but it continues to monitor battery voltage. If the voltage drops below 37.5V due to self-discharge during storage, the charger will re-start and complete a charge cycle.
5) Turn off the charger by disconnecting AC cord.
6) If the DC connection to the battery is unplugged and plugged back in the charging cycle will be restarted.
7) If the charger is left plugged into AC and the DC is unplugged **after charging is completed**, the FAULT LED will two flash once every 4 seconds with no buzzer sounding. This indicates the charger is in standby mode and ready to start charging at any time the DC is again plugged-in.
8) If the charger is left plugged into AC and the DC is unplugged **before charging is completed**, for 10 seconds the FAULT LED will flash together and the buzzer will sound. After 10 seconds the charger reverts to the standby mode described in 7) where the LEDs flash once every 4 seconds but there is no buzzer and the charger is ready to charge again.

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 charge curve is temperature compensated to ensure correct charging in cold or hot conditions. If the charger temperature is above the ambient temperature before charging starts, the charger will adjust the charge cycle and somewhat undercharge the batteries. Normally the charger will be at ambient temperature at the start of charge and the charger will adjust and correctly charge the batteries for that temperature.

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The Charger starts to reduce the output current gradually when the internal temperature gets too high. The charger stops at excessive temperature, and restarts automatically when the internal temperature decreases to a normal range.

As long as the battery voltage is at least 4V the charger will start. Deeply discharged batteries take a longer time to charge then normal batteries and may require two charge cycles.

The charger has an 20 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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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 (+) – white
   Interlock wires – small black and white
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.

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.

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

PROBLEM	CHECK GUIDE
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.
The AC supply 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 the total load 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.
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 items.
	If batteries are new they sometimes need 20 to 30 charge/discharge cycles before they charge normally. With new batteries the charger green LED may only show flashing after overnight charging. The batteries and charger are fine – the machine should be used and charged overnight. Within a few weeks green LED will go steady on at the end of charge.
	If batteries are old check the battery condition following the battery supplier's instructions. Check for dead cells or reduced capacity. Replace charger only if other problems are not found. If the charger LEDs are showing charging progress and charger case gets warm after several hours the charger is probably good and the batteries bad.
	If the green LED is "off" and the red LED is steady "on" after a long charge time, the batteries have not fully charged after 20 hours of charging time. If this occurs with new batteries the machine should be used normally and the problem should go away after several weeks of use. If the batteries are old they may be bad and should be checked.

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Operating and Fault Codes

POWER YLW LED	CHRGE GRN LED	Fault RED LED	CONDITION / CHECK GUIDE
Off	Off	Off	No AC power to charger or inside auxiliary power supply failure.
On	Off	Off	AC power on but charger is not operating,
On	SLOW BLINK	Off	Normal, battery is under 80% charged
On	FAST BLINK	Off	Normal, battery is over 80% charged
On	On	Off	Normal, battery is 100% charged
On	Off	On	Charger has timed-out at 20 hrs
			Batteries are extremely discharged. Unplug and than 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.
On	Off	Two flash	Output open circuit or short circuit or reverse polarity connection of charger to battery This indicates the charger is in standby mode and ready to start charging at any time the DC is again plugged-in.
			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.
On	Off	Three flash	Battery voltage is too high (may be connected to wrong voltage battery)
On	Off or BLINK	Four flash	Charger is OK but output has been reduced due to overheating. No operator action required except to make sure charger fins are clean. A Four flash may occur anywhere in charge cycle with overheat.
On	Off	Five flash	AC Voltage too high or too low. Check AC voltage and connect charger to correct voltage.
			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
On	Off	Six flash	Charging current is cut-back to 9 to 10A because battery voltage is less then 29V. No operator action required. When battery voltage increases above 39V full charging current of 19 to 20A will be restored and the “six flash” will stop.

* When a fault occurs a buzzer sounds in the charger. If the fault is removed, the charger restarts automatically.

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 parts department charger 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:

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

Interlock wires – Small white and black wires from center back of charger

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 manual).

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Specifications

Electrical Specifications		
Item	AC Input	DC Output
Voltage	115V (85-137V) 230V (170-264V) (Automatically Selects)	36V nominal 47.5V max
Max. Current	13A at 85V 6.5A at 170V	Max. 20 ADC
Frequency	60 / 50 Hz	-
Phase	SINGLE	-

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