

# User's Manual

## Automatic Switching-Mode Battery Charger

MODEL HB600-24B

### 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. This manual is a supplement to the manuals and information provided by SIGNET SYSTEM. If you have any questions call SIGNET service.

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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.

## **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 than 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 surface can get hot while operating and contact with the skin or surrounding materials should be avoided.

## **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 not

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.
- 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.

## 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) Determine whether flooded or GEL (sealed) type batteries are being charged. The charge profile is set by a yellow wire loop at the back of the charger. If the yellow wire is a loop (connected) at the time of the charger start up (plugged into AC voltage), then the charging will be for a flooded battery. If the yellow wire loop has been cut (opened) before charger start up then charging will be for a GEL type battery. The selected profile is valid until AC power is turned off
- 2) 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
- 3) The charger will flash the three green LEDs in a start-up check then start charging the batteries. If the charger has been set to "GEL" in step 1) the "GEL" LED is lit.
- 4) 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.

- 5) 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. The charger continuously measures battery voltage and restarts the charging cycle if the battery voltage drops below about 25V. This keeps batteries charged while in storage but does not boil-out the electrolyte over time.
- 6) Turn-off charger by unplugging (disconnect from AC voltage).

**Charging State & LED Display**

LED	50%	75%	100%	GEL
<b>Charging State</b>				
GEL battery charging	X	X	X	On
0 to 50% charged	Blinking	Off	Off	
50% to 75% charged	On	Blinking	Off	
75% to 100% charged	On	On	Blinking	
100% charged	On	On	On	
See Troubleshooting	Off	Off	Blinking	

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

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 1V and there is no need to ‘boost charge’ weak batteries before charging. The charger has an 18 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.

## 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

Interlock wires – 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.**

## 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. **100% LED BLINKS WHILE 50% AND 75% LED'S ARE "OFF"**
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 LED'S 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.

#### ▶ 3 LED'S 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 : OUTPUT OVER CURRENT.**

-> NO ACTION REQUIRED, CHARGER WILL CORRECT AND RE-START AUTOMATICALLY.

### **3. 100% LED BLINKS WHILE 50% AND 75% LED'S ARE "OFF"**

The 18 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.

### **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 items.

- If batteries are new they sometimes need 20 to 30 charge/discharge cycles before they charge normally. With new batteries the charger LEDs may only show 50% on, 75% on, and 100% flashing after overnight charging. The batteries and charger are fine – the machine should be used and charged overnight. Within a few weeks all three LEDs 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 50% and 75% LEDs are "off" and the 100% LED is blinking after a long charge time, the batteries have not fully charged after 18 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.

### **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 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.

**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.**

## 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 wires - White and black

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).

# Specifications

Electrical Specifications		
Item	AC Input	DC Output
Voltage	115V (85-132V) 230V (170-264V) (Automatically Selects)	24V nominal
Max. Current	9A at 85V 4.5A at 170V	Max. 19 ADC
Frequency	60 / 50 Hz	-
Phase	SINGLE	-
Output Power Max		600 Watts

## **PROPER CARE OF DEEP CYCLE MOTIVE POWER BATTERIES**

Motive power batteries are subjected to severe deep-cycle duty on a daily basis. Although these batteries are designed to withstand such use, suitable care will greatly extend battery life. Always consult with the specific recommendations of your battery supplier for proper care. Some general recommendations follow but are not intended to replace the battery manufacturer's recommendations.



**CAUTION: Always wear protective eye shields and clothing when working with batteries. Batteries contain harmful acids. Do not put wrenches or other metal objects across the battery terminals or battery top. Arcing or explosion of the battery can result.**

1. When installing new batteries, be sure the polarity of each battery and the overall battery pack is correct.
2. New batteries should be charged fully before their first use. It is difficult to know how long the batteries have been stored and their charge state.
3. Batteries should not be discharged beyond the manufacturers recommended levels to avoid permanent damage. Most manufacturers recommend no more than 80% depth of discharge. Best battery life is obtained if brand new batteries are only discharged 50% until 20 cycles charge/discharge cycles are completed.
4. Maintain the proper electrolyte level by adding water when necessary for "flooded cell" type batteries. Distilled or de-ionized water is free from contaminants and preferred. Follow the battery manufacturers' recommendations on adding water and never allow the electrolyte level to overflow the top of the battery (note the electrolyte level is lower during discharging and higher during charging.). Old batteries require more frequent additions of water than new batteries do.
5. Hard crystalline sulfates may form when batteries in storage are not maintained in a charged active state. Internal self-discharging can bring about the start of this condition in as little as three days in hot temperatures. Batteries allowed to sit un-maintained in storage will self discharge, and sulfate to various degrees and lose capacity. Repeated charging without using the batteries between charges can recover some of the lost power, range, and life, but some permanent loss should be expected.
6. When the temperature falls below 65 °F (18 °C), the batteries should be placed on charge as soon after use as possible. Cold batteries require more time to recharge fully.
7. The top of the batteries and battery hold-downs must be kept clean and dry at all times to prevent self-discharge. Electrolyte spilled on the batteries never dries or evaporates.
8. All connections to batteries must be maintained clean and tight. Bolted connections may loosen with time due to the heating and cooling of the connections through normal use and should be checked as part of your maintenance program. Connections often look good from the outside but have developed an oxide coating on the inside that inhibits good current flow.
9. Follow all operating instructions, cautions, and warning as specified in this manual, on the charger, in the battery supplier's manual, and in your vehicle/equipment manual.