

Need for enhanced Battery life and issues involved in Charging

Batteries have been used extensively over the years and many improvements have been made over this time, which have enhanced battery life and usability. Even with these improvements, batteries eventually suffer from several predictable failure modes including:

Sulfation, Loss of electrolyte, Electrolyte stratification, Hydration, Positive grid corrosion, External damage to case and terminals and Positive electrode active material softening and shedding.

Careful control and maintenance can delay the onset of common failures and even enhance the life of the battery. Some of the typical failures are caused by exposure to these conditions:

- Beyond normal limits of heat (either the surroundings or through improper charging)
- Overcharging/undercharging
- Deep-discharge or regular operation at a partial state of charge

Solution using the SIRIUS "SMART CHARGE" Technology

MP Series Chargers are able to offer an ideal balance between enhanced battery life, maximum capacity use and safe charging. This SELF-COMPENSATING CHARGER compensates for Battery age, ambient temperature, Mains voltage variations and Depth of discharge. The unique charge evaluation circuit monitors the state of charge of the battery and automatically terminates the charging when battery is 100% CHARGED. This means NO OVER-CHARGE or UNDER-CHARGE and EXTENDED BATTERY LIFE.

SIRIUS MP1 can be safely used for "Any-time opportunity charging":

The Sirius "SMART CHARGE" technology provides charge, based on the present state-of-charge of the battery – this means that the battery can be connected to the charger even for brief periods of 10 – 15 minutes, any-time an opportunity is found during the working shift. This means that the battery can be kept between 30 – 80% SOC throughout its working shift. This in turn means that the vehicle always works with a "strong battery, which lowers the stress on the electrical parts.

It is therefore recommended that the battery be connected to the charger for brief "free periods whenever possible (during lunch breaks etc).

EQUALISATION

In any multiple-cell battery-charging operation, cells will charge at different rates, which is a significant cause of the buildup of sulfates on battery plates and results in reduced capacity as well as premature failure. This means that equalization is required to level the state of charge among cells in a

ELECTRICAL SPECIFICATIONS

AC Input Voltage	190 - 255Vac, 50/60Hz
DC Output Voltage / Current	24V / 20A - 50A
	30V / 20A - 40A
	36V / 20A - 40A
	48V / 20A - 40A
Recommended Battery Size	50Ah to 350Ah
Recommended Battery Type	LA Batteries
Charger Efficiency	Approx. 80%
Power Factor	0.80
Operating Temperature	0°C to 70°C
Storage Temperature	-25°C to 70°C
Temperature Compensation	Internal
Application	Pallet Trucks, Stackers, Floor Cleaners, Tow Trucks

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INSTALLATION

RECEIVING CHARGER

When received, the charger should be unpacked and checked for any transit damage.

LOCATION OF CHARGER

The charger should be installed in a cool, dry, well-ventilated location away from corrosive fumes and steamy atmospheres. Allow at least 200mm free space on all sides for proper ventilation.

AC CONNECTIONS

WARNING . . . WARNING . . . WARNING . . . WARNING

ENSURE THAT THE CABLE IS ISOLATED FROM AC MAINS SUPPLY

WARNING . . . MAKE SURE POWER ON MCB in front panel IS OFF

1. The charger operates in the voltage range of 190 to 255 volts AC.
2. Neutral connection is mandatory for charger operation.
3. Make proper EARTH connection.
4. Select cable sizes to minimize the cable drop.

DC CONNECTIONS

WARNING . . . WARNING . . . WARNING . . . WARNING

ENSURE THAT THE BATTERY +ve CONNECTOR IS CONNECTED TO THE CABLE MARKED POSITIVE (RED) and THE BATTERY-ve CONNECTOR TO THE CABLE MARKED NEGATIVE (BLACK).

FAILURE TO DO THIS WILL DAMAGE CHARGER

Switch OFF the AC supply before making or breaking connections to the battery.

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OPERATOR PANEL CONTROLS AND INDICATIONS

POWER ON MCB

This MCB isolates the input power to the charger.

RED MAINS ON LAMP

This lamp indicates the charger is turned ON.

NORMAL/EQUALISE Miniature Rocker Switch

This switch is used to shift between NORMAL and EQUALISE modes of operation. The Charger should put OFF when mode is to be changed. Mode changes are not recognized when charger is ON.

LED Indications and Descriptions

LEGEND / COLOUR	CONDITION DESCRIBED
CHARGING / REFRESHING (GREEN)	CHARGING : This GREEN LED comes ON when Charging process is ON. REFRESHING : This GREEN LED flashes to indicate that the charger is performing 10 minutes REFRESHING Charge.
80% CHD / OVERRIDE (YELLOW)	80% CHD : This YELLOW LED will come ON when battery has been approximately 80% charged. OVERRIDE : This YELLOW LED flashes to indicate the charging process is terminated because of override condition
CHARGED / EQUALISING (GREEN)	CHARGED : This GREEN LED indicates the battery charging is completed and ready for use. EQUALISING : This GREEN LED flashes to indicate the 4 hour equalize charging phase.
DC FAULT (RED)	This RED LED indicates the presence of output DC FAULT conditions
AC FAULT (RED)	This RED LED will come ON if any of the AC FAULT conditions exists
EQUALISE (RED)	This RED LED will come on if EQUALISE mode of charging is selected.

LCD Display Format

VOLTAGE	CURRENT
24.0	30.00
6:30	195.1
TIME	AMPERE HOUR

DESCRIPTION OF OPERATION

NORMAL MODE

The Sirius MP1 will perform the following operations after AC power is given and a suitable battery is connected to the charger:

- a. The charger will run a self-test program - all the LEDs will come ON one by one and the Digital indicator on the front panel will display the Charger Voltage and Current specification. Then all the LEDs will go OFF.
- b. After ensuring that the AC input supply is healthy, the charger will check whether the battery voltage lies within 1.90V/cell and 2.95V/cell, If so, charging will commence - "CHARGING" LED will come ON. MP1 charges the Battery at a constant current 100% of the starting current I_{START}.
- c. If the battery voltage sensed during power-on time is greater than 1.50 V/cell and less than 1.90 V/cell, MP1 charges the Battery at a constant current, which is 50% of the starting current I_{START}. When the Battery voltage reaches 2.0V/cell, the MP3 increases the charging current to I_{START}.
- d. During charging LCD displays On-charge Battery voltage, Charging current, Charge ampere hour returned as well as the Charging duration.
- e. The charge controller will taper charging current while the battery on-charge voltage builds up naturally. "80% CHARGED" Yellow LED will come on when the battery voltage has reached 2.40 V/Cell. The finishing current will be 25% of starting current at 2.65 V/cell.
- f. The controller evaluates the state of charge in the post gassing period by the dv/dt method. When the voltage is found to be constant within a specified window for a period of time, MP1 terminates charging and signals CHARGED. The charging process is also terminated if the Battery on-charge voltage exceeds 2.65 V/cell and internal time limit has elapsed.
- g. After the battery is fully charged "CHARGED" LED will come ON.
 - * The "CHARGING" LED will go OFF
 - * The "80% CHARGED" LED will go OFF
 - * The current output % LEDs will go OFF
 - * The digital indicator shows the Battery open cell voltage, the Ampere Hours returned to the battery and the Charging time.
- h. After charging is complete, if the battery is not required for immediate service, it can be left connected to the charger with the switch ON. The Sirius MP1 will deliver Refreshing charge at regular intervals (10 minutes for every 6 hours) to maintain the battery in a fully charged condition. While refreshing takes place, digital display flashes the message "REFRESH CHARGING" and "CHARGING" LED also flashes to indicate this phase.

EQUALISE MODE

The EQUALISE mode of charging, which is available with SIRIUS MP1 is to be used when cells have to be balanced or INITIAL charging is required.

In equalise mode, EQUALISE LED will come ON and the charger initiates the charging process even if the battery voltage is as low as 1.0V/cell (Deep discharged battery).

For equalise charging, The charger first finishes the normal charging process with dv/dt sensing, then maintains a constant current of 25% of I_{START} for 4 hours. While equalising takes place, digital display flashes the message "EQUALISING" and CHARGED/EQUALISING LED starts flashing. Equalise charging will terminate automatically after this time period.

In the charged condition CHARGED LED will illuminate and EQUALISE LED will remain ON.

Abnormal Charging Situations and Annunciations

1. DEEP DISCHARGED BATTERY

LED status	LCD status
"CHARGING" LED ON	Voltage Charging time alternated with a flashing "DEEP DISCHARGED" message.
	Current Ah Returned with a flashing message.

CAUSE:

Battery Open Circuit Voltage less than 1.9V/cell.

2. OVER DISCHARGED BATTERY

LED status	LCD status
"CHARGING" LED ON	Voltage Charging time alternated with a flashing "OVER DISCHARGED" message.
	Current Ah Returned with a flashing message.

CAUSE:

On-charge voltage below 1.9V/cell even after 30 secs of charging.

In both of the above situations, Charging start with 50% of the starting current (I_{START})
When the Battery voltage reaches 2.0V/cell, the MP1 increases the charging current to I_{START} and charging will continue normally – recharge time may be extended.

Abnormal Charge Terminations and Annunciations

1. 100% CHARGED with DEEP DISCHARGED BATTERY

LED status	LCD status
"CHARGED" LED ON	Voltage Charging time alternated with a flashing "DEEP DISCHARGED" message.
	Current Ah Returned with a flashing message.

REASON:

This indicates normal termination of charge with a deep discharged battery.

2. 100% CHARGED with OVERDISCHARGED BATTERY

LED status	LCD status
"CHARGED" LED ON	Voltage Charging time alternated with a flashing "OVER DISCHARGED" message.
	Current Ah Returned with a flashing message.

REASON:

This indicates normal termination of charge with an over discharged battery.

Fault handling, Annunciation and Troubleshooting tips:

General Notes on Troubleshooting tips:

Dangerous voltages are present inside the charger - all relevant isolators are to be switched OFF when passive checks are made.

All tests, checks and measurements are to be made by qualified personnel.

The following documents are to be referred to conduct troubleshooting:

- a) GA drawings - internal and external
- b) Electrical schematic
- c) PCB/Module Layout diagrams

Wherever the troubleshooting procedure calls for checking cable connections, these should be done with power switched OFF.

The results of each check in the Troubleshooting tips given may be communicated to Sirius Controls (P) Ltd. before parts replacement or any other corrective action is taken.

1. AC FAULT CONDITIONS:

The charge controller continuously monitors the mains AC supply for under-voltage, over-voltage, phase failure and sequence errors.

Under any of these error conditions, controller shuts OFF the rectifier and **AC FAULT** RED LED will come ON

The charger restarts automatically when the AC supply is restored to health.

1. AC UNDER VOLTAGE

LED status	LCD status
"AC FAULT" LED ON	AC UNDER VOLTAGE Charging time Ah Returned

CAUSE:

Phase voltage with respect to Neutral less than 190VAC

2. AC OVER VOLTAGE

LED status	LCD status
"AC FAULT" LED ON	AC OVER VOLTAGE Charging time Ah Returned

CAUSE:

Phase voltage with respect to Neutral greater than 260VAC

Troubleshooting Tips:

- 1) Check the AC supply to the charger at AC Input terminal TP1 for the following:
(Refer to electrical schematic SC/D&D/ELS/ and GA drawing SC/D&D/GAD/)
 - a. Switch ON the POWER ON MCB in front panel
 - b. With multimeter in AC voltage mode, measure the voltage at TP1/Phase with respect to TP1/Neutral. This voltage should be within 180 VAC to 260VAC
 - c. Make sure the Earth connection is proper.
 - d. Measure the AC voltage at main transformer primary terminal (TM1/X1,X2) These terminal voltages also should be within 180 VAC to 260VAC.
 - e. Monitor these voltages while the charging process is on -if any dip in the AC voltage is observed, check the AC input wiring and terminations.
- 2) If the previous checks are ok and the input voltage is within the operating range and still AC FAULT is indicated, check the following:
 - a. Check control transformer (TC1) secondary voltage at Control PCB-CB1 (CN1 connector termination), (Refer to schematic SC/D&D/ELS/)
 - b. With the multimeter in AC mode, measure the voltages between CN1/pins 1 & 2 and CN1/pins 2 & 3 on the control PCB board. These voltages should be around 9V AC at 230 VAC input.
 - c. With the multimeter in AC mode, measure the voltage between CN1/pins 4 & 5 on the control PCB board. This voltage should be around 18 VAC at 230 V AC input.
 - d. If these voltages are well below these values the problem is with the control transformer (TC1) or with the control PCB – replace each in turn to rectify the problem.

2. DC FAULT CONDITIONS:

The charge controller continuously monitors the Battery voltage feedback and under any of the following error conditions, controller shuts OFF the rectifier and **DC FAULT** RED LED will come ON

a. BATTERY ABSENT

LED status	LCD status
"DC FAULT" LED ON	Voltage BATTERY ABSENT Current

REASON:

No battery connected **OR**
Battery connector not mated properly **OR**
Output DC fuse blown **OR**
Battery connected in REVERSE.

Troubleshooting Tips:

If DC FAULT is signaled with a "BATTERY ABSENT" message even with a proper battery connection, check the following:

- a. With multimeter in DC voltage mode, disconnect the Battery and measure the voltage at Battery terminal.
- b. Switch OFF the charger and connect the battery to the charger. Make sure the Battery connector is mated properly and the polarity is correct.
- c. Check TP2/1 (+BATT) with respect to TP2/2 (-BATT). This voltage should be same as the Battery terminal voltage. If there is any mismatch in voltage, check the Battery cable termination to the charger and to the battery connector
- d. Then measure the voltage at DC FUSE terminal, i.e at DCF1/1 with respect to TP2/2 (-BATT). If no voltage is present, check the DC FUSE and terminations. If the fuse has cleared (blown), replace the Fuse. If above checks have gone through ok, then check the voltage and current feedback connections (+DC, -DC, +IB, -IB) to control PCB (CB1/CN2)
- e. Check the voltage at control PCB test points +DC and DC. (Near to CN2 connector). This voltage should be same as the Battery terminal voltage.
- f. If this value does not match, check the CN2 connector terminations on both sides and make sure the connector inserted properly.
- g. If battery voltage is present at test points and still DC FAULT is indicated with "BATTERY ABSENT" message then replace the Control PCB (CB1)

b. INCORRECT BATTERY

LED status	LCD status
"DC FAULT" LED ON	Voltage INCORRECT BATTERY Current

REASON:

Battery voltage does not fall within 1.55V/cell and 2.90V/cell in Normal mode **OR**
 Battery voltage does not fall within 1.1V/cell and 2.90V/cell in Equalise mode **OR**
 Battery voltage and charger specifications are not matched.

Troubleshooting Tips:

If DC FAULT signaled with INCORRECT BATTERY message even with proper battery connection, check the following:

1. With multimeter in DC voltage mode, disconnect the Battery and measure the voltage at Battery terminal.
2. Switch OFF the charger and connect the battery to the charger. Make sure the Battery connector is mated properly and the polarity is correct.
3. Check TP2/1 (+BATT) with respect to TP2/2 (-BATT). This voltage should be same as the Battery terminal voltage. If there is any mismatch in voltage, check the Battery cable termination to the charger and to the battery connector.
4. Switch on the charger and check the Battery voltage displayed on LCD. If the displayed voltage does not match with the Battery terminal voltage, check the following:
5. Voltage and Current feedback connections (+DC, -DC, +IB, -IB) to control PCB (CB1/CN2)
6. Check the voltage at control PCB test points +DC and -DC. (Near to CN2 connector). This voltage should be same as the Battery terminal voltage. If not, check the CN2 connector terminations on both sides and make sure the connector inserted properly.
7. If all tests mentioned above are ok, and DC FAULT is still indicated with "INCORRECT BATTERY" message then replace the Control PCB (CB1)

3. OVERRIDE CONDITIONS:

1. PRE GASSING OVERRIDE

LED status	LCD status
"OVERRIDE" LED ON	PRE GASSING OVERRIDE Charging time Ah Returned

REASON

This indicates that the battery received 4 hours charge in pre-charging phase but the battery voltage did not reach 1.90 V/cell within this period **OR**
 Battery received 8 hours charge in Bulk charging phase but the battery voltage did not reach 2.4 V/cell within this period
 The charging process is terminated when any of these override timers lapses.

Troubleshooting Tips:

If every charging cycle ends with OVERRIDE, check the following:

- a. Make sure Charger voltage and current specs are matched with the battery voltage and Ah capacity specs.
- b. Observe if the Charger is delivering the charging current.
- c. Observe, while charging, whether the battery voltage is building up and that 80% CHD is indicated at an on-charge voltage equivalent 2.40V/cell
- d. Observe whether all individual cell voltages are building up and check that there are no faulty cells.
- e. Check whether the voltage displayed on LCD is the same as the Battery terminal voltage. If all the above checks have gone through OK, then replace the control PCB.

4. OVER TEMPERATURE CONDITIONS:

LED status	LCD status
All LEDs are OFF	OVER TEMPERATURE Charging time Ah Returned

REASON:

SCR-DIODE MODULE heat sink temperature is more than 85°C. Check the FAN operation which is mounted directly on device Heat sink

Troubleshooting Tips:

If OVER TEMPERATURE Fault happening frequently, check the following:

- FAN attached to the Rectifier heat sink functioning normally. If Fan not working or speed is very low, check the fan wiring and termination at TP3 terminal (230V AC). The above checks are OK, and then replace the Fan
- Make sure the charger getting proper ventilation (minimum 200mm free space on all sides)
- Check the Thermal switch (TS1) attached to the heat sink and the interconnection to control PCB (CB2/CN3). The sensor specification is 85°C with N/O contact. If fault sense well below 85°C, then sensor may be faulty, replace the temperature sensor.
- If all the above checks have gone through OK, then replace the control PCB.

5. NO LED DISPLAY WITH AC ON CONDITIONS:

LED status	LCD status
All LEDs are OFF	Blank or garbled display

CAUSES:

- L1 (R phase) failure **OR**
Wiring faults on AC control input **OR**
Control fuse (ACF1) failure.
- Controller PCB failure.

Troubleshooting Tips:

- Check the AC supply to the charger at AC Input terminal TP1 for the following:

- Check the Control fuse (ACF1) failure.
- Switch ON the POWER ON MCB in front panel
- With multimeter in AC voltage mode, measure the voltage at TP1/Phase with respect to TP1/Neutral.
This voltage should be within 180 VAC to 260VAC
- Make sure the Earth connection is proper.
- Measure the AC voltage at main transformer primary terminal (TM1/X1,X2)
These terminal voltages also should be within 180 VAC to 260VAC.
- Monitor these voltages while the charging process is on -if any dip in the AC voltage is observed, check the AC input wiring and terminations.

- If the previous checks are ok and the input voltage is within the operating range, check the following:

- Check control transformer(TC1) secondary voltage at Control PCB-CB1 (CN1 connector termination)

- With the multimeter in AC mode, measure the voltages between CN1/pins 1 & 2 and CN1/pins 2 & 3 on the control PCB (CB1) . These voltages should be around 9V AC at 230 VAC input.

- With the multimeter in AC mode, measure the voltage between CN1/pins 4 & 5 on the control PCB (CB1). This voltage should be around 18 AC at 230 V AC input.

If these voltages are not ok, replace the control transformer(TC1).

If these tests have gone through OK, replace the control PCB - CB1

6. CHARGING INDICATION ON BUT NO CHARGING CURRENT:

Troubleshooting Tips:

After the CHARGING LED comes ON, check the following.

- Check whether the gate firing LEDs (D3, D6 for RFW, YFW) are ON in the gate firing (GF) module. Under normal conditions these LEDs indicate the presence of gate firing pulses to the rectifier module
- If these LEDs are ON, check the cable connection between GF Module to Rectifier modules (MD1, MD2)
- Measure the AC voltage at main transformer primary terminal (TM1/X1, X2) .This voltage should be within 180 VAC to 260VAC
- If these checks go through ok, the problem is in the power section (Main Transformer and Rectifier Modules).

If Gate firing LEDs are OFF then check the following

- With the multimeter in AC mode, measure the voltages between CN1/pins 1 & 2 and pins 2 & 3 on the Control PCB (CB1) (Refer to schematic SC/D&D/ELS/). These voltages should be around 9V AC & 9V AC at 230 V AC input.
- With the multimeter in AC mode, measure the voltage between CN1/pins 4 & 5 on the control PCB board. This voltage should be around 18 AC at 230 V AC input.

If these voltages are not ok, replace the control transformer(TC1).

If these tests have gone through OK, replace the control PCB – CB1 & CB2

LIST OF RECOMMENDED SPARES

The following table lists the minimum recommended quantities for spare parts for the MP3 Charger. Since continuous operation of the charger is often critical, stocking of spares should be given high priority. As spares are used, replacements should be ordered.

DESCRIPTION	QUANTITY
DC Output Fuse*	01
DC Shunt*	01
Semiconductor Devices (SCR/Diode Module)*	01
Incoming AC Isolator - Miniature Circuit Breaker*	01
Charge Controller Module (CB1+CB2)	01
Ventilating Fan	01

* Refer the data sheet page in the manual for the specific rating to be ordered for your charger.

ROUTINE MAINTENANCE

1. BEFORE ANY MAINTENANCE IS CARRIED OUT, THE CHARGER MUST BE ISOLATED AND TAKEN TO A REMOTE POINT.
2. The unit has few moving parts requiring little attention.
3. Monthly check the charging cables. Also check the battery connectors for breakages or evidences of over-heating.
4. CHECK THE TIGHTNESS OF THE ELECTRICAL CONNECTIONS.
5. Any discoloration of the internal cables or components may be due to over-heating or component fault. Replace such cables and components.
6. Check for any obstructions to the ventilation of the cubicle.
7. Use a vacuum cleaner to remove any dust.

Do not try to repair failures, please call our Service.

Any repair or replacement of parts must be done only by SIRIUS technicians.

NOTE
Disconnect power to the system before replacing fuses.

INSTRUCTIONS FOR CALLING SIRIUS

1. Follow the troubleshooting procedure exactly
2. Make observations and readings and note them down in the space provided above the troubleshooting steps.
3. Have this sheet in front of you when you call Sirius. Or fax the sheets to Sirius.

PLEASE E-MAIL THIS FORM WITH THE OBSERVATION COLUMN FILLED TO

scpl@siriusindia.com and service@siriusindia.com

THIS WILL HELP US IN RESOLVING THE PROBLEM AS WELL AS SENDING THE CORRECT SPARES.

FOR AFTER SALES SERVICE, CONTACT ADDRESS

SIRIUS CONTROLS PVT LTD

GF, Building-1, Block-A, #288/2, Begur Main Road,
Doddur Begur, Bangalore -560068, Karnataka, India.
Ph : 91-80-25739500
Fax : 91-80-25739509
Email : scpl@siriusindia.com

FORMAT FOR REPORTING FAULT ON CHARGERS

Email to Sirius : service@siriusindia.com

Model No. _____ Serial No. _____

What is the fault _____

TROUBLESHOOTING PROCEDURE

PROBLEM	POSSIBLE FAULT	OBSERVATIONS
NO CHARGING	AC NOT PRESENT	AC PRESENT YES/NO
NO CHARGING	BATTERY NOT CONNECTED	BATTERY CONNECTED YES/NO
NO CHARGING	BATTERY VOLTAGE BELOW 1.55 V/Cell and FAULT LED ON	BATTERY VOLTAGE = _____ VDC
NO CHARGING	DC FUSE BLOWN.	FUSE/MCB OK YES/NO
NO CHARGING	NO DISPLAY OR NO DISPLAY OR DC FAULT LED ON	AC INPUT VOLTAGE = _____ VAC PCB TRAFO OK YES/NO ALL AC FAULT CONDITIONS CHECKED? YES/NO
NO CHARGING	RECTIFIER DEVICES FAULTY	SCRs, DIODEs are OK YES/NO
NO CHARGING	PCB OR MAIN TRANSFORMER FAILED	PCB TRAFO OK YES/NO MAIN TRAFO OK YES/NO