User's Manual

Systellar MPPT Solar Charge Controller

CC-MPPT-HV-300

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Introduction

Congratulations! You are the proud owner of one of the best MPPT charge controllers available in the market. CC-MPPT-HV-300 is an advanced Solar Charge Controller for charging battery banks with nominal voltage from 48V to 120V.

Main Features:

1. Maximum output current: 60A.
2. Triple interleaved non synchronous buck switches for maximum efficiency and minimum power loss and charger heating.
3. Tracks the Maximum Power Point dynamically to extract the maximum possible power from the solar panels.
4. Supports the following types of batteries: Lead-Acid (SMF / FLA / Tubular / Gel), Li-ion, LiFePO4, and Ni-Cd.
5. Fully field programmable: Battery type and battery bank configuration can be selected at the time of connecting the battery bank for the first time. It is also possible to program battery bank settings like 'end of charge voltage', 'trickle charge voltage', etc. from the front panel as per user requirements. For lead acid cell chemistry, there can be 4 / 5 / 6 / 8 / 10 etc. batteries of 12V nominal rating (six 2V cells each) in the battery bank. For other battery types, number of cells in the battery bank can be specified.
6. Solar panel maximum open circuit voltage: 265V (Absolute maximum: 300V).
7. Power saver relay output: Available (Max. 20A).
8. Soft connection of battery terminals (No spark when connection is made).

Five-stage battery charging algorithm (Deep discharge, Bulk, Absorption, Trickle, and Equalization charge) is implemented which can charge the battery with precise current and voltage to achieve fast battery charging while ensuring long battery life.

Special charging mode for Lithium-ion batteries:

The deep discharge charging stage is only for Lithium-ion batteries to bring them out of the deep discharge state without damaging them. In this stage, the charging current is limited to 30% of the maximum current.

Equalizing charge for lead-acid FLA and Tubular batteries:

Lead-acid batteries may be put in an equalizing charging stage periodically (either automatically after a pre-programmed number of days or manually).

This User Manual describes the installation and operation of this Solar Charge Controller in detail. Please read this manual carefully before installing and operating the charge controller.

Product Views

Front view of CC-MPPT-HV-300

Side view of CC-MPPT-HV-300

Installing the Charge Controller

1. Install the Charge Controller indoors near the battery bank at eye level. This will make it easy to read the LCD and make any changes in the settings.
2. Connecting cable requirement: Battery bank: 16 square mm copper wire. Solar panel array: 1 solar string in parallel — 4 mm sq copper; 2, 3 solar strings in parallel — 10 mm sq copper; 4, 5 solar strings in parallel — 16 mm sq copper.
3. It is better to use a smaller length and thicker battery cable to reduce voltage drop and power loss in the cable (No compensation for voltage drop in the battery cables is provided in the software i.e. the voltages shown on the display are the voltages on the charge controller connectors).

4. Connect battery bank negative polarity cable to the charge controller. Remove 63A fuse top from the socket. Connect the battery positive polarity cable to the fuse input. Check that the display has come on. If the display does not turn on, it is likely that the polarity of the battery bank wires is not correct. Observe correct polarity while connecting wires from the battery. If battery wires are connected in the wrong polarity, the display will not turn on. Correct the polarity before proceeding further. As soon as the battery cables are connected in the correct polarity, the LCD display will turn on. Now insert the fuse kit-kat in the socket. There will be no spark.
5. When the battery is connected for the first time, the charge controller assumes that the battery chemistry is lead-acid (FLA). The battery nominal voltage is estimated from the voltage sensed at the battery terminal. This information is presented to the user for confirmation. Press SEL for a short duration to confirm it. In case it is not correct, the user should enter battery configuration editing mode by pressing the NEXT key. Set the battery chemistry. If the battery chemistry is Lead-Acid, it is assumed that the battery bank consists of 4 / 5 / 6 / 8 / 10 etc. batteries of 12V nominal voltage (six cells of 2V nominal voltage). For other battery chemistries, the user has to enter the number of cells in the battery bank.
6. Check the open circuit voltage of the solar panels. The maximum solar panel voltage should be less than 265 volts for all battery banks from 48V to 120V (up to 5 solar panels in series in each string).
7. Connect the solar panel to the charge controller in the correct polarity. If solar panel wires are connected in reverse polarity, the display will keep showing 'Night' and the charging will not take place.
8. Once solar panel connections are made in the correct polarity, if it is daytime, the display will show 'Dawn VF' for approx. 5 sec and will then start charging the battery.
9. **CAUTION:** If the solar panel voltage is above 60 volts, take care not to touch the solar panel cable ends with a bare hand. It may give an electric shock.

Note: Connecting higher solar panel voltage to the charge controller may damage it and will void warranty coverage.

Power Saver

In systems with an inverter, during the day when abundant sunlight is available, we do not want to use the mains power for charging the batteries. The power saver has a relay which cuts off the mains power to the inverter during the day when the battery voltage is above “Power Saver on Threshold”. CC-MPPT-HV-300 has a power saver relay inside the charge controller itself. The relay capacity is 250V AC, 20A which is sufficient for a 4KW load.

Common and the N/C contacts of the relay are available on a terminal block. N wire of the mains is to be connected directly to the inverter and the phase connection goes through the power saver relay contacts. When the power saver relay is on (battery voltage above the 'power saver on threshold' voltage), the relay is turned on and the phase connection is cut off from the inverter. This will ensure that only solar power is used to power the load and charge the battery. When the battery voltage falls below the 'power saver-off threshold' voltage, the relay is turned off and the phase connection is also connected to the inverter. Now the battery connected to the inverter is charged from the main supply also.

For inverters that draw more than 20A current from the mains, the user should use an external power saver relay of the appropriate rating.

LED Indication

CC-MPPT-HV-300 has the following LED indicators:

S No	LED	Condition	Indication
1	Green	Night	Off
		Charging with current < 5A	One 100 msec blink at 2-second interval
		Charging current > 5 Amp	Two 100 msec blinks at 2-second interval
		Fully charged battery (When the battery has attained the end of charge voltage and has gone to the Absorption stage / Trickle stage)	Solid on
2	Blue	Power Saver ON	Solid ON
		Power Saver OFF	Off
3	Red	Status OK	Off
		Battery discharged	One 100 msec blink at 2-second interval
		Battery voltage too high	Two 100 msec blinks at a 2-second interval
		PV voltage too high	Three 100 msec blinks at a 2-second interval

LCD Display Messages

CC-MPPT-HV-300 has a 22 char x 8 row alphanumeric LCD display which displays the entire charging status without any interruption. The following information is displayed on the LCD:

Row	Display
1	Charger status
2	Charging stage
3	Battery bank voltage and charging current
4	SP voltage, SP current, and SP power
5	Energy harvested today and the total energy harvested to date
6	Battery and heat sink temperature
7	Power Saver on/off status
8	Status messages

During power on, programming parameters, etc. appropriate messages are displayed to guide the user.

Setting Programmable Parameters Using Keyboard Commands

It is possible to modify programmable parameters using the front panel keys and the LCD. To enter the Programming menu, press the SEL key on the front panel for more than 1 second.

Run level Menu

The following menu is displayed with one of the choices highlighted. Pressing SEL selects that choice. Pressing NEXT highlights the next choice.

S No	Menu choice	Action
1	Enter Prog Mode?	Press SEL to Enter Programming parameters mode. Press NEXT to go to the next menu choice.
2	Restart System?	Press SEL to Restart the system. Press NEXT to go to the next menu choice.
3	Restore Factory Setting?	Press SEL to Reset edited programmable parameters (if any) and restart the system with default programmable parameters. Press NEXT to go to the next menu choice.
4*	Set Equalize Chg?	If the user wants that after achieving the end of charge voltage, the battery should keep getting charged to 'Equalize charge voltage', press SEL. Now equalization stage is set. Press NEXT to go to the first menu choice.
	Reset Equalize Chg?	If the Equalize charge is already set and the user does not want to equalize charge the battery, then press SEL to reset the Equalize charge stage. Press NEXT to go to

		the first menu choice.

** Menu option 4 is displayed only if the battery is lead-acid type.*

Programming Mode

Pressing SEL when the "Enter Prog Mode?" message is being highlighted will take you to the "Programming parameters mode" menu.

Program level Menu

S No	Menu choice	Action
1	Edit Batt bank Config?	Press SEL to Edit battery bank parameters. Press NEXT to go to the next menu choice.
2	Edit Cell Settings?	Press SEL to Edit selected battery bank cell settings. Press NEXT to go to the next menu choice.
3	Edit Prog Parms?	Press SEL to Edit programmable parameters. Press NEXT to go to the first menu choice.

Battery Bank Configurations Editing

Pressing SEL when the "Edit Batt bank Config?" message is being displayed will take you to the 'Battery bank configuration' menu:

10. Battery Chemistry: a. Lead-acid FLA • b. Lead-acid SMF • c. Lead-acid GEL • d. Lead-acid Tubular • e. Li-ion • f. LiFePO4 • g. NiCad

If the battery chemistry is lead acid, you can choose a nominal battery voltage from 48V to 120V. For other battery chemistries, you can specify the number of cells in the battery.

Cell Settings

Pressing SEL when the "Edit Cell Settings?" message is being displayed will take you to the 'Cell settings' menu:

11. Battery end of charge voltage (end of Bulk charge stage, start of absorption charge stage).
12. Battery absorption charge stage period.
13. Battery trickle charge voltage (The voltage at which the battery voltage should be maintained after the end of the absorption charge stage).
14. Battery re-bulk voltage (If the battery voltage goes below this voltage, the charge controller will again go to the Bulk charging stage).
15. Battery Low cut enter voltage (If battery voltage goes below this voltage, the charge controller will display battery discharged fault). Battery Low cut exit voltage is equal to the nominal battery bank voltage.
16. Battery Equalize charge voltage (Only for Lead-acid battery). (If the battery voltage goes above this voltage, the charge controller will go to the equalize charging stage).
17. Equalizing charge interval (Only for lead-acid battery).
18. Temp Coefficient for selected Battery type (Only for Lead-acid battery). (This is useful to calculate Battery bank EOC voltage as per the sensed temperature of the battery).
19. Power saver turn-on threshold (Power saver will turn on if the battery voltage is above this value).
20. Power saver turn-off threshold (Power saver will turn off if the battery voltage is above this.)

Programmable Parameters

Pressing SEL when the "Edit Prog Parms?" message is being displayed will take you to the 'Program Parameters' menu where the following programmable parameters can be set:

21. Maximum charging current: Users can modify the maximum charge current in between 5 to 60 Amps.

Notes (Also applicable for editing of cell settings & programmable parameters):

22. To choose an option, press SEL. To change the value on the screen press INCR / DECR. To go to the next option, press NEXT. To go to the previous menu level press ESC. If ESC is pressed when the run level menu is being displayed, then it comes out of the running menu.
23. Press INCR to increase the displayed value, and DECR to decrease the displayed value.
24. Pressing INCR or DECR continuously makes the displayed parameter increment/decrement automatically till its limit.
25. All the displayed voltages are the complete battery bank voltages.
26. The programmable parameters are stored in non-volatile memory inside the Charge controller. Even if the battery connections are removed, the values of programmed parameters are retained. They are reset when the battery configuration is changed.

Equalizing Charging

It is useful to "overcharge" lead-acid (FLA / Tubular) battery bank for a limited period once every 15 days or a month or so. This is especially helpful when several batteries are connected in series. It helps in equalizing the charge in all the cells of the battery bank by bringing them to full charge. The electrolyte in the batteries is also homogenized by agitation during gassing at the time of "overcharge".

Pressing SEL when "Equalize charge now?" is displayed will set the Equalization charging stage. In case the Equalize charging stage is already set, it will be reset. The equalization charging stage will remain set till the CC can take the battery to equalize voltage and keep it there for an equalizing time. It is possible to automatically equalize the battery bank after a set number of days. For this set equalizing interval from 1 to 60 days. The default value is 15 i.e. battery bank will be put to equalizing charge every 15th day. If the Equalizing interval is set to 0, then equalizing is not done automatically and the user may set equalizing stage manually.

Note that when the equalization stage is set, it does not go to the equalization charging stage immediately. Equalization charging is the last leg of battery charging. In the equalizing charging stage, instead of stopping the battery voltage at the "end of charge" voltage, the system will allow the battery to go up to "Equalizing Charge voltage" and it will maintain it there for Equalizing time a period of Default 60 minutes as programmed in programmable parameters. Once this period is over, the battery will go into the "Trickle charging stage" and the equalizing stage will be automatically reset. When Equalizing charging is activated, if the battery bank voltage does not reach Equalizing voltage, the Equalizing charge stage will carry over to the next day.

Optional Accessories

27. Battery Temperature sensor

External Battery Temperature Sensor

The battery temperature sensor is supplied as an accessory. Paste the temperature sensor on the battery side using double-sided tape. Insert the 4-pin RJ11 connector at the end of the temperature sensor cable in the socket provided on the left side of the charge controller.

Troubleshooting

S No.	Symptoms	Remedy
1	Display is off	• Check the battery connection and polarity.
2	Not producing expected power	• Check PV connections. • Check PV conditions like dirty panels / clouds / partial shading / panel very hot. • Connect an ammeter across PV panel connections to check the short circuit current. • Check Max charging current setting. • Check that the battery is not in the Absorption or trickle charge stage.
3	Not equalizing	• Not sufficient solar power to take the battery to equalize voltage for an equalizing time. • High load on battery so that sufficient current is not available.
4	Always in Night mode	• Check PV connections. • Check the PV voltage. It should be more than the battery bank voltage by 'Min Wakeup voltage'.
5	LCD scrambled	• Press NEXT key.
6	Any other error	• Call the dealer from whom it was purchased / Systellar Innovations helpline +91 121 434 2043. Keep the Model name and product serial number handy.

Ordering Information

Product model code:

CC – MPPT - HV - 300

(Basic model name – Abs. Max. PV voltage)

Standard models are:

28. CC – MPPT - HV – 300
29. Other models (with Modbus interface or some special features) may be supplied on order.

Detailed Technical Specifications

S No	Item	Description
1.	Maximum charging current	60A.
2.	Cell chemistries supported	• Lead-Acid (SMF / FLA / Tubular / Gel) • Li-ion • LiFePO4 • Ni-Cd
3.	Charging stages	• Deep discharge charging (for Li-ion battery) • Bulk charging • Absorption charging • Trickle charging • Equalization charging (for lead-acid battery)
4.	Nominal battery bank voltage	48V to 120V. Field programmable. For Lead-acid batteries, number of 12V batteries can be specified. For other cell chemistry, number of cells in the battery bank may be specified.
5.	End-of-charge voltage	Maximum 150V. Field programmable.
6.	Solar Panel open circuit voltage	106V to 265V (2 to 5 panels in series) — see the table below.
7.	Maximum solar panel capacity	From 3,840 Wp (48V) up to 9,600 Wp (120V) depending on nominal battery bank voltage — see the 'Maximum Solar Panel Capacity' table below.
8.	Display	128x64 pixel back-lit graphic display which can display 8 rows of about 22 characters each for display of running parameters during operation and for programming various programmable parameters.
9.	Keyboard	5 Keys (INCR, DECR, NEXT, ESC & SEL) keyboard is provided on the front panel to view / program various parameters.
10.	LED indicators	Green – Charging indicator: Low charging (< 5A): single 100ms blink after every 2 sec; High charging (> 5A): double 100ms blink after every 2 sec; Battery fully charged: solid ON. Blue – Power saver: Power Saver is ON: solid ON; Power Saver is OFF: OFF. Red – Warnings / Faults: Battery discharged: single 100ms blink after every 2 sec; Battery voltage too high (charging is stopped): two 100ms blinks after every 2 sec; PV input too high (charging is stopped): three 100ms blinks after every 2 sec.
11.	User-programmable parameters	Using the keyboard and the LCD display, the following charging and other operational parameters can be programmed by the user in the field: 1. End of charge voltage. 2. Absorption charge stage period. 3. Trickle charge voltage (the voltage at which the battery voltage should be maintained after the end of the absorption charge stage). 4. Re-bulk voltage (if the battery voltage goes below this voltage, the charge controller will again go to the Bulk charging stage). 5. Low cut enter voltage (if the battery voltage goes below this voltage, the charge controller will display battery discharged warning; the charging continues; battery Low cut exit voltage is equal to the nominal battery bank voltage). 6. Equalization charge voltage (for lead-acid battery). 7. Equalizing charge interval (for lead-acid battery). 8. Temperature Coefficient of End Of Charge, Trickle charge and Equalization charge voltages. 9. Power saver turn-on threshold (power saver will turn on if the battery voltage is above this value — when the power saver is ON, the mains supply to the inverter is cut off and only the charge controller charges the battery). 10. Power saver turn-off threshold (the power saver will turn OFF if the battery voltage is below this voltage — when the power saver is OFF, the mains supply to the inverter is connected and both the inverter and the charge controller charge the battery).
12.	Heat sink temperature sense	Built-in heat sink temperature sensor stops charging in case of overheating of the heat sink. This can happen if the cooling fan is not working properly.
13.	Power saver relay	Built-in power saver relay. Common and N/C contacts are available for the connection of the input AC mains phase to the inverter main input phase. Relay capacity 250V 20A AC.
14.	Idle current from the battery	Max: 60 mA.
15.	Technology	Triple Interleaved Non-Synchronous Buck Converter.
16.	Microcontroller	ARM-based 32-bit advanced microcontroller.
17.	Optional accessories	1. Battery temperature sensor with 2 M cable. 2. RS-485 adapter card for transferring data over MODBUS (RTU protocol). (Requires special MODBUS firmware.)

18.	Operating temperature range	0°C to 45°C ambient.

Solar Panel Open Circuit Voltage

Battery bank Nom. Voltage	Max Solar panel open circuit voltage	Max No. of 550Wp panels in series
48V / 60V	265V	5
72V / 96V / 120V	265V	5

Maximum Solar Panel Capacity

Nominal Battery bank voltage	Solar panel capacity
48V	3,840 Wp
60V	4,800 Wp
72V	5,760 Wp
96V	7,680 Wp
120V	9,600 Wp

** For continuous product improvement, product specifications can change without notice.*

Special Model: CC_MPPT_HV_300_VRLA_GEL_114V_60A

Item	Description
Battery Chemistry	VRLA GEL (Fixed)
Battery nominal voltage	114V (19 x 6V Batteries in Series)
Maximum PV Open Circuit Voltage (Voc)	275V (11 x 120Wp Panels in series, 3 Strings in parallel)
PV High Voltage Cut-Off	285V

User Adjustable Charging Parameters

Parameter	Present Setting	Range	Unit
End of charge (EOC) voltage	133.95	131.1 – 136.8	V
Absorption chg time	15	5 – 150	Minutes
Trickle voltage	128.82	125.4 – 131.1	V
Rebulk voltage	119.7	115.71 – 123.69	V
Low battery cut-off enter voltage	106.59	102.6 – 112.29	V
Temperature compensation	-1.71	0 – -2.85	V/degC
Max Charging current	12	2 – 60	A

Notes:

- Battery type and nominal battery voltage are factory configured and cannot be changed.
- Do not exceed 275V PV open-circuit voltage.
- The controller disconnects PV input when PV voltage exceeds 285V to protect the system.
- For longer battery life we have set maximum charging current to 12 Amps and Absorption chg time to 15 minutes. The user can adjust charging parameters according to the battery manufacturer's recommendations under the programming menu.

Company Contact details:

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