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**Please read instructions before  
installing device**



## **Solar Controller / Battery Charger User's Manual**

## **Congratulations!**

You have made an excellent choice by purchasing this high quality HARD KORR PWM solar controller which has been manufactured to the highest standards of performance, quality and safety.

We want you to be completely satisfied with your purchase so this HARD KORR solar controller is backed by our own 2 year warranty.

If you require technical support regarding this product, please call **(07) 3801 8332** or email [info@korrlighting.com.au](mailto:info@korrlighting.com.au)

Faulty product claims made within the 2-year time frame will be repaired or replaced free of charge provided you have satisfactory proof of purchase (keep your receipt).

### **VERSION AND RATINGS**

There are three standard versions of HARD KORR PWM controllers

#### **KOR12-10**

Rated for 12V solar panel (Max. 25V)  
Rated maximum output current of 10Amp

#### **KOR12-15**

Rated for 12V solar panel (Max. 25V)  
Rated for maximum output current of 15Amp

#### **KOR12-20**

Rated for 12V solar panel (Max. 25V)  
Rated for maximum output current of 20Amp

### **WARNING**

**RISK OF EXPLOSIVE GASES: WORKING IN VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. EXPLOSIVE GASES DEVELOP DURING NORMAL BATTERY OPERATION. BE CERTAIN THERE IS ENOUGH VENTILATION TO RELEASE THE GASSES. IT IS IMPORTANT THAT EACH TIME BEFORE USING OR CONNECTING YOUR SOLAR CONTROLLER, YOU READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EXACTLY.**

- Make sure you connect the red to the positive on the battery and the black to the negative on battery
- Please double check before you connect, connecting to wrong terminals may burn out the controller
- Confirm that the power wires are tightened to the correct torque to avoid excessive heating from a loose connection.
- Refer to battery specification, be very careful not to short circuit to the battery connections.
- Accidental 'shorting' of the terminals or wiring can result in sparks causing personal injury or a fire hazard. We recommend that you cover up the panel(s) with some sort of soft cloth so you can block all incoming light during the installation. This will ensure that no damage is caused to the Solar Panel or Battery if the wires are accidentally short circuited.
- Always install a battery fuse on each circuit including the solar controller

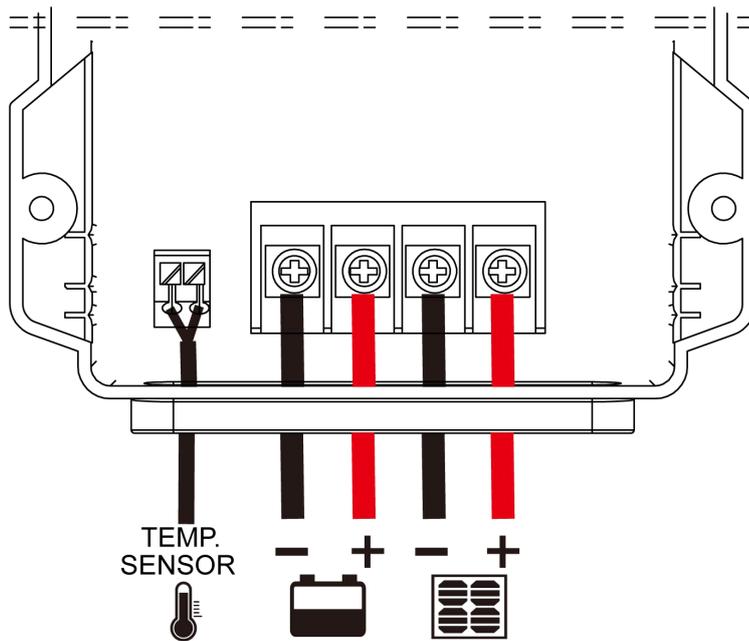
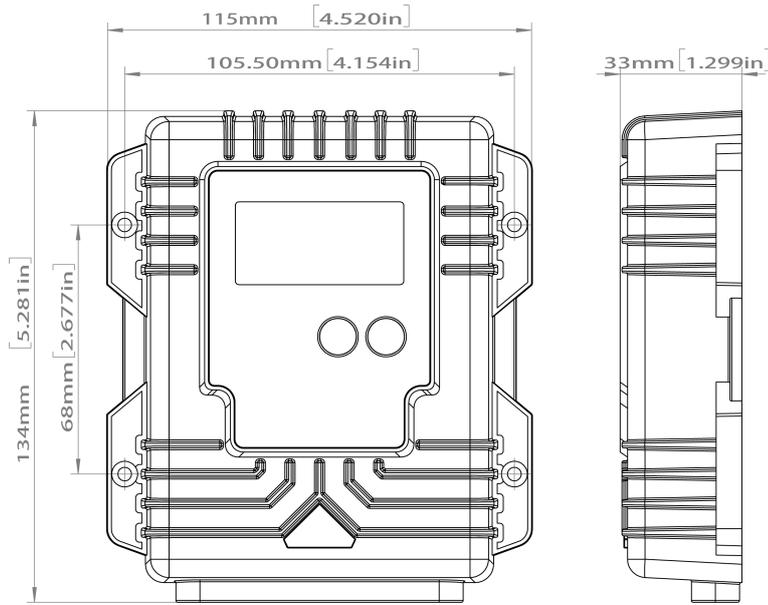
## FEATURES AND ADVANTAGES

- PWM technology, switching control by MOSFET
- Common negative grounding connection
- High efficiency and low power consumption
- Battery type setting and battery condition indication
- Smart charging control
- Charging time management
- LED indication for the battery condition and charging statuses
- Digital display charging parameters and battery settings
- Automatically active to Lithium battery against BMS protection
- Thermal protection
- Over voltage protection, Short circuit protection, Reverse polarity protection
- No sparks
- Water proof
- Solid-duty cables
- Corrosion-resistant terminals and connectors.
- Conformal coating supplied to the inside board against moisture
- Includes a port for external battery temperature sensor (BTS - optional).
- Suitable for most of the rechargeable Lead acid battery, including Flooded (WET), AGM, GEL, Calcium battery and Lithium batteries.
- Designed according to CE standard, EMC, FCC compliance.

## INSTALLATION

**The Solar Controller can be mounted as shown below.**

The quickest and easiest way to mount the unit is to use the four plastic spacers and self-tapping screws supplied and mount the unit to a flat surface,

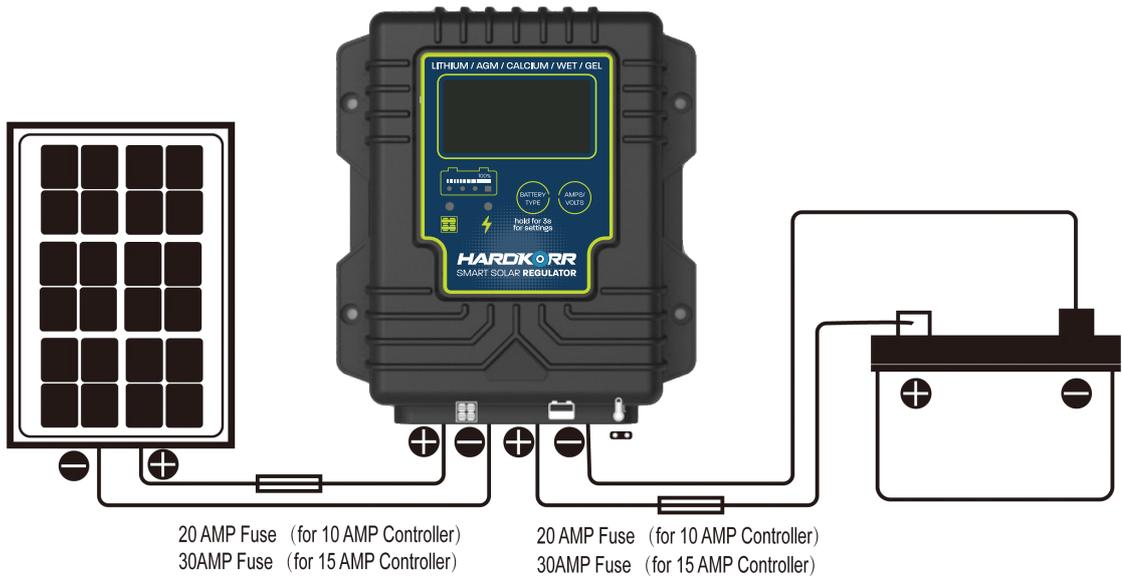


## WIRING CONNECTIONS

The Solar Controller has 4 terminals which are clearly marked 'Solar' and 'Battery'.

There is a (12V) and earth (GND) terminal for each circuit.

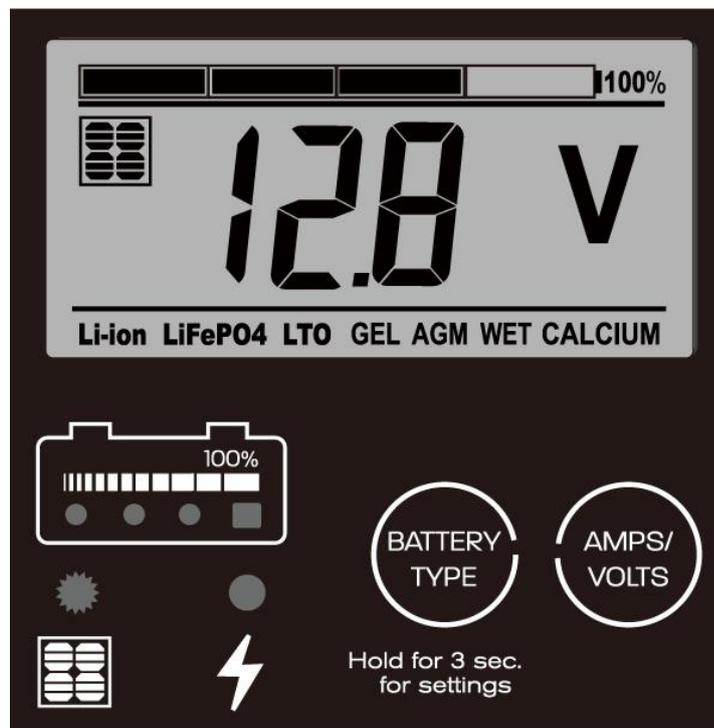
Refer to the wiring diagram as shown below, please cover the solar panel before connecting cables.



When the connections are completed, the Solar Controller will start working automatically.

### OPERATION - LCD DISPLAY

Please check your battery manufacturer's specifications to select correct battery type. The unit provides 7 battery types for selections: Lithium-ion, LiFePO4, LTO, Gel, AGM, WET (conventional lead acid), and Calcium battery.



Press **BATTERY TYPE button** and hold for 3 seconds to go into your battery type selection mode, the battery type you select will be shown on the LCD meter, the default setting is AGM Battery; the controller will automatically memorize your battery type setting.

Li-ion battery shown in LCD indicates 3-SERIES Li-ion battery shown as below:

- Lithium Cobalt Oxide LiCoO<sub>2</sub> (LCO) battery
- Lithium Manganese Oxide LiMn<sub>2</sub>O<sub>4</sub> (LMQ) battery
- Lithium Nickel Manganese Cobalt Oxide LiNiMnCoO<sub>2</sub> (NMC) battery
- Lithium Nickel Cobalt Aluminum Oxide LiNiCoAlO<sub>2</sub> (NCA) battery

LiFePO<sub>4</sub> battery shown in LCD indicates Lithium Iron Phosphate battery, LFP battery.

LTO battery shown in LCD indicates Lithium Titanate Oxide, Li<sub>4</sub>Ti<sub>5</sub>O<sub>12</sub> battery.

**Caution: Incorrect battery type setting may damage your battery.**

When the controller powers on, the unit will run self-qualify mode and automatically show below items on LCD before going into charging process

 Self-test starts, digital meter segments test

 Software version test

 Rated voltage and current test

 External battery temperature sensor test (if connected)

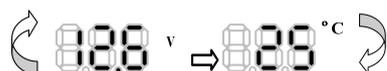
After going into charging process, the LCD displays the charging statuses as below:

Press **VOLT / AMP button** in sequence, the LCD will display in turn with Battery Voltage, Charging Current, Charged capacity (Amp-hour) and Battery Temperature (if external temperature sensor connected)

### Display in the day time-

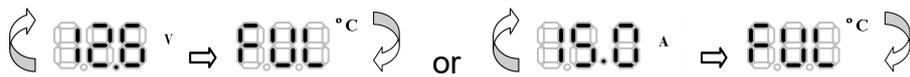


### Display during the night-



### Display when battery fully charged

Press **VOLT / AMP button** in sequence, the LCD will display in turn with Battery Voltage, Charging Current, if you do not press the button, the LCD will alternatively display the FUL and VOLT or FUL and AMP every 2 seconds



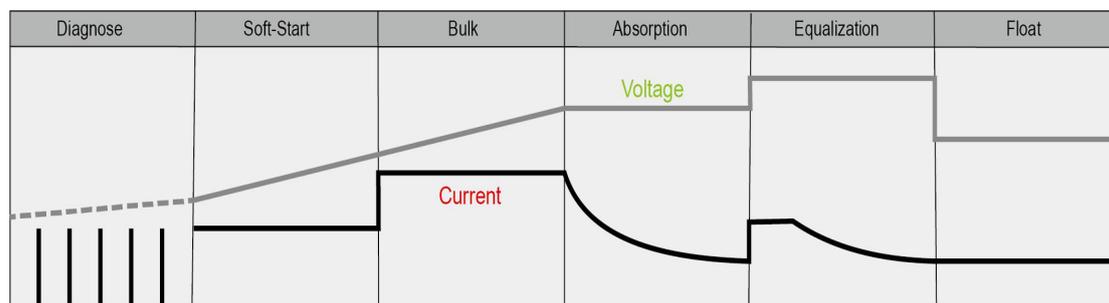
The **VOLT / AMP button** can be changed at any time during charging process.

The LCD also can be treated as an independent voltage meter or thermometer. A voltage less than 11.5V Volts indicates that the battery is discharged and needs re-charging.

## CHARGING STAGES

The unit has a 6-stage charging algorithm.

**Diagnose\* - Soft Charge – Bulk Charge - Absorption charge – Equalizing Charge\* - Float Mode**



**Diagnose \*** – Only for Lithium battery type, subjected to the Lithium battery initial voltage then determine if going to Soft start or Bulk charge; if the Lithium battery is protected by BMS, the controller will automatically send the signal periodically to the battery terminals to activate the BMS against protection.

**Soft start** - When batteries suffer an over-discharge, the controller will softly ramp the battery voltage up to 10V.

**Bulk Charge** - Maximum current charging until batteries rise to Absorption level.

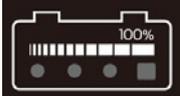
**Absorption** - Constant voltage charging and battery is over 85% for lead acid battery; a Li-ion battery, LiFePO4 battery and LTO battery will close fully charging after absorption stage, the absorption voltage level will reach 12.6V for Li-ion battery, 14.4V for LiFePO4 battery; 14.0V for LTO battery.

**Equalization \*** - Only for WET battery or Calcium battery type, when the battery is deeply drained below 10V or every 28 days cycle, it will automatically run this stage to bring the internal cells as an equal state and fully complement the loss of capacity. (Li-ion, LiFePO4, LTO, Gel and AGM battery do not run Equalization charge)

**Float Charge or Re-Bulk charge** - Battery is fully charged and maintained at a safe level.

A fully charged Lead acid battery (GEL, AGM, WET and Calcium battery) has a voltage of more than 13.8 Volts; if the lead acid battery voltage drops to 12.8V at float mode, it will return to Bulk charge; Li-ion, LiFePO4 and LTO battery have no float mode; If a Li-ion battery voltage drops to 12.0V after absorption stage, it will return to Bulk charge; if a LiFePO4 battery voltage drops to 13.4V, or LTO battery voltage drops to 13.2V after Absorption stage, they will return to Bulk charge

## LED INDICATION

LED indications							LCD Display	LCD Backlight
	ORG	BLUE	BLUE	BLUE	BLUE	GREEN		White
Soft-start charging	ON	ON	FLASH	OFF	OFF	OFF	Normal Display	ON
Bulk charge (charged capacity < 25%)	ON	ON	FLASH	OFF	OFF	OFF		
Bulk charge (charged capacity < 50%)	ON	ON	ON	FLASH	OFF	OFF		
Bulk charge (charged capacity < 75%)	ON	ON	ON	ON	FLASH	OFF		
Absorption charging	ON	ON	ON	ON	ON	FLASH		
Float charging	ON	OFF	OFF	OFF	OFF	ON		
Solar weak (At dawn or dusk)	FLASH	OFF	Subject to battery voltage					
In the night	OFF	OFF					OFF	OFF
Solar good, VB < 5V	ON	OFF	OFF	OFF	OFF	OFF	b02/ brc	FLASH
Solar good, battery reversed	ON	OFF	OFF	OFF	OFF	OFF	b01 / bov	FLASH
Solar good, battery over-voltage	ON	OFF	FLASH	FLASH	FLASH	FLASH	b01 / bov	FLASH
Solar off, battery over-voltage	OFF	OFF	FLASH	FLASH	FLASH	FLASH	b01 / bov	FLASH
Solar good, battery over 65°C	ON	OFF	Subject to battery voltage				xxC/bot	FLASH
Battery good, solar reverse	FLASH	OFF					P02/Prc	FLASH
Battery good, solar over-voltage	FLASH	OFF					P01/Pov	FLASH
Over Temperature Protection							xxC/Pot	FLASH

## SPECIFICATIONS

<b>1</b>	<b>Electrical Parameters</b>			
1-1	Rated solar panel amps	10/15/20	Max.	AMP
1-2	Normal input Solar cell array voltage	15-22		VDC
1-3	Max. solar cell array voltage (output has no load)	25	Max.	VDC
1-4	The controller lowest operating voltage at solar or battery side	8V	Min	VDC
1-5	Standby current consumption at night	5	Max	mA
1-6	Maximum voltage drop-Solar panel to battery	0.25	Max.	VDC
<b>2</b>	<b>Charging characteristics</b>			
2-1	Minimum battery starts charging voltage	3	Min	VDC
2-2	Soft start charging voltage	3-10	+/-0.2	VDC
2-3	Soft start charging current (50% PWM duty)	Up to 5/7.5/10		AMP
2-4	Bulk charge	By the maximum rated current		
2-5	Absorption charging voltage at 25°C			
	--Gel type battery	14.1	+/-0.2	VDC
	--AGM type battery (default setting)	14.4	+/-0.2	VDC
	--WET type battery	14.7	+/-0.2	VDC
	--Calcium type battery	14.9	+/-0.2	VDC
	--LTO battery	14.0	+/-0.2	VDC
	--LFP battery	14.5	+/-0.2	VDC
	--Li-ion battery	12.6	+/-0.2	VDC
2-6	Absorption transits to Equalizing or Float condition:			
	--Charging current drops to	1.5	+/0.1	AMP
	-- or Absorption charging timer timed out	4		Hour
2-7	Equalization charging active (Only for WET or Calcium battery)			
	--Battery voltage discharged to less than	10	+/-0.2	VDC
	--Automatic equalizing charging periodical	28		Day
2-8	Equalization charging voltage at 25°C	15.5	+/-0.2	VDC
2-9	Equalization charging timer timed out	2		Hour
2-10	Float voltage (GEL, WET, Calcium, AGM battery) at 25°C	13.8	+/-0.2	VDC
	Restart voltage for LTO battery	13.2	+/-0.2	VDC
	Restart voltage for LFP battery	13.4	+/-0.2	VDC
	Restart voltage for Li-ion battery	12.0	+/-0.2	VDC
2-11	Voltage control accuracy	+/- 1%		
2-12	Battery temperature compensation coefficient	-24		mV/°C
2-13	Temperature compensation range	<b>-20 ~ +50</b>		°C
<b>3</b>	<b>Protection</b>			
3-1	Against reverse polarity or short circuit at panel or battery			
3-2	No reverse current from battery to solar at night			
3-3	Over temperature protection during charging	65		°C
<b>4</b>	<b>Electrical parts</b>			
4-1	Input output terminal	M5 terminals		
<b>5</b>	<b>Physical Parameters</b>			
5-1	Controller material	Plastic, Standard ABS		
5-2	Power terminal maximum stranded wire size	#10 AWG stranded- 5 mm <sup>2</sup>		
5-3	Power terminal torque	Up to 17 in-lb (0.2n-m)		
5-4	Mounting	Vertical wall mounting		
5-5	IP grade	IP65,		
5-6	Net weight	Approx. 300g		
<b>6</b>	<b>Environmental characteristics</b>			

6-1	Operating temperature	-25 ~ 50°C / -13~122 °F
6-2	Storage temperature	-40 ~ 85°C / -40~185 °F
6-3	Operating Humidity range	100% no condensation

## FAQ

**Q. Can I connect this solar controller to an existing Anderson plug on my camper / caravan?**

A. Solar panel must connect directly to the battery - if you wish to connect your solar panel via Anderson plugs on camper trailer or caravan, you must bypass this controller.

**Q. Why am I getting no power through my solar panel?**

- A. 1. All solar panels need to be connected to a battery to work.  
 2. Make sure all Anderson connectors are plugged in.  
 3. Make sure a wire has not been pulled out of the controller.  
 4. Please ensure solar panel is connected directly to a battery  
 (Not through any secondary controller / charger)

**(Note: If reset of controller is needed, remove all wires from battery)**

**Q. Why am I not getting maximum amps per hour?**

A. Taking into consideration on a perfect day (24-28 degrees) your panel will produce maximum amps per hour.

If your battery is over 80% full the controller automatically slows down the charge into the battery, this allows the battery to get 100% full.