Photonic Universe
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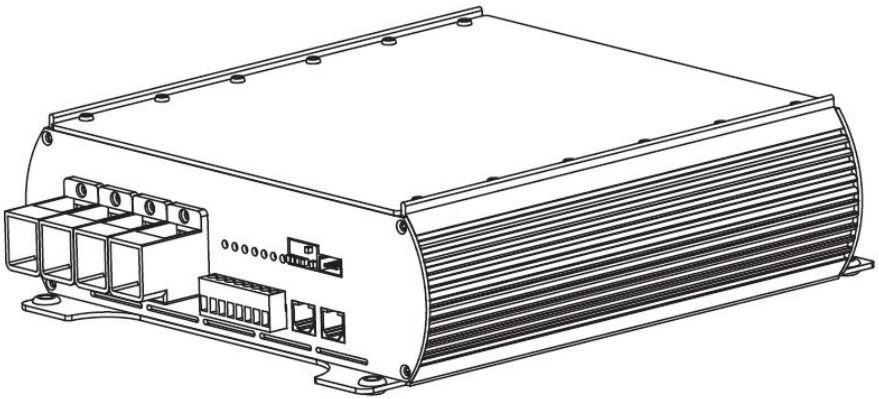
12V Triple Input Battery Charger
(Solar, DC-to-DC, Mains)

DCTRIPLE series

INSTRUCTION MANUAL



Overview

This Photonic Universe triple input battery charger is fully automatic and ideal for leisure vehicles, commercial and special purpose vehicles, boats, and any other systems with multiple batteries or power sources with an additional solar charging source. The charger operates using an adjustable three-stage charging programme and is suitable for lead acid, AGM, GEL, LiFePO4, and custom battery types. The product features high frequency switching and buck-boost power conversion technology for reliable, consistent performance.

The charger comes with a powerful built-in MPPT solar charge controller, enhancing its capability with additional charging from solar panels. The unit will charge the target battery from solar panels whenever DC-to-DC or AC charging is not active. This is useful in applications where there is no access to mains and the DC-to-DC charging function is not used for significant periods of time, such as when a vehicle is parked or in storage, or when supplementary charging from solar panels is needed. MPPT technology of this charger extracts the energy from solar panels with the maximum efficiency which significantly exceeds efficiency of other non-MPPT chargers. The solar charging function will also provide a trickle charge to the source battery to prevent it from self-discharging.

The charger includes a built-in mains charger for situations where off-grid charging is not feasible. When connected to an external AC power source, the unit automatically initiates AC charging, giving it priority over both DC-to-DC and solar charging modes. This ensures that the target battery is charged efficiently from the mains when available. Once the AC connection is removed, the charger seamlessly switches back to DC-to-DC or solar charging, ensuring continuous battery maintenance even in the absence of a grid connection.

The charger features a D+ terminal which can activate the DC-to-DC charging function automatically when the vehicle alternator starts, avoiding battery discharge when it stops. A range of protection functions enables the charger to automatically disconnect the target (OUT) battery from the source (IN) battery under extreme conditions, such as in case of overheating, overvoltage, short circuits, and over-currents. Backflow (from OUT to IN) is also prevented so the charge will not flow in the reverse direction.

The charger includes ports for a remote meter or a Bluetooth dongle (both sold separately), allowing data to be viewed on an LCD display or through a mobile phone app when connected.

An optional external temperature sensor (sold separately) can be connected to the charger for automatic adjustment of the charging voltages depending on the ambient temperature (lead-acid batteries only), keeping the charging programme to optimal voltages at very low or high temperatures.

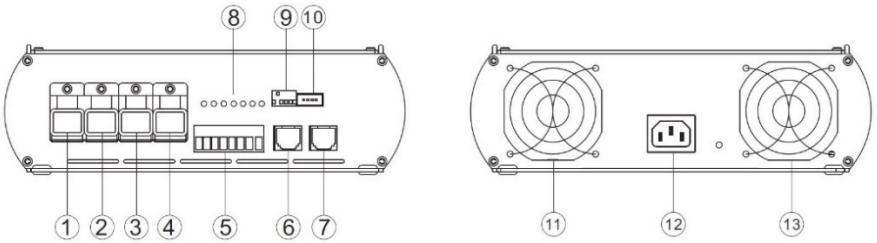
The charger also features an automatic wake-up function for lithium batteries. When the Battery Management System (BMS) of a lithium battery goes into the protection mode, the charger can automatically activate the BMS and continue charging the lithium battery.

Installation

Install the battery charger as close to the target (OUT) battery as possible and keep the surrounding area clean, tidy, and well ventilated. This space should be moisture-proof, water-proof, and corrosion proof. Leave at least 20 cm of space around the charger to allow for proper airflow.

Note: before connecting and using the charger, please choose the type of target battery (lead-acid, GEL, AGM, LiFePO4, or Custom) by setting DIP switches 4-6. If you intend to charge a lithium battery in cold temperatures, ensure to verify if your battery can be charged at temperatures below 0°C, and adjust DIP switch 3 as needed. For more information, refer to the DIP switches section in this manual.

Product features



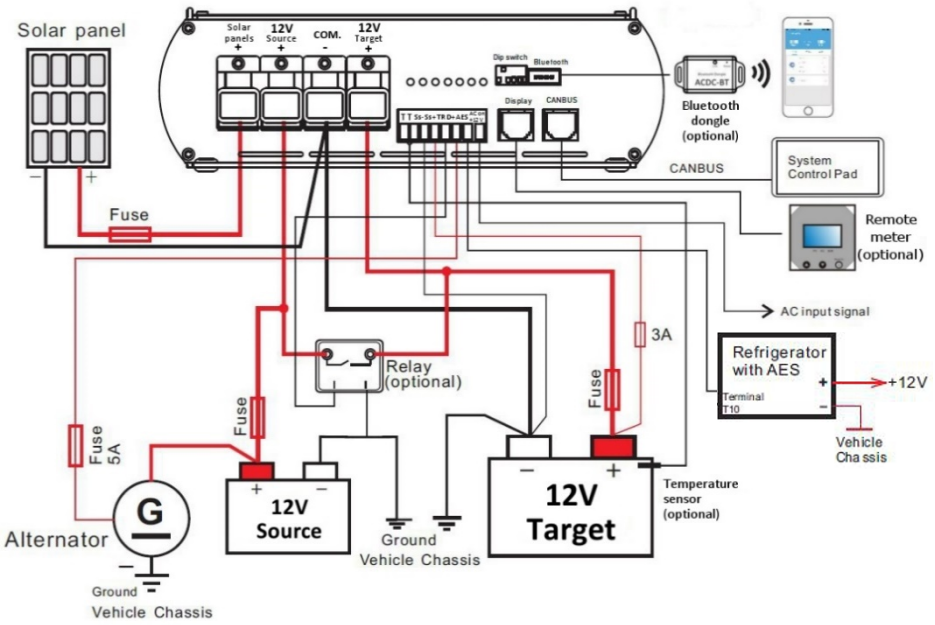
Reference	Description
1	Solar positive input (+)
2	Source battery positive input (+)
3	Common negative (-)
4	Target battery positive output (+)
5	Green terminals
6	Remote meter port
7	CANBUS port
8	LED display
9	DIP switches
10	Bluetooth dongle port
11 / 13	Cooling fans
12	AC input

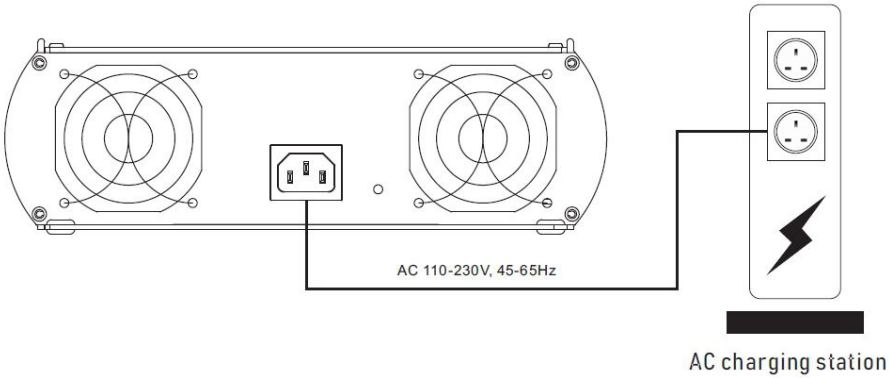
Connection diagrams

Use as short cables as possible, especially between the charger and the target battery. The recommended cable cross-section for "+" and "-" power cables is 1mm^2 cross-section for every 3A of maximum charging current. Always connect the cables to the charger terminals first before connecting them to the battery terminals, to ensure you are not working with live cables. When connecting the cables to the battery terminals, ensure the positive and negative poles are not reversed or short-circuited.

The fuses need to be located within 15cm from the terminals of the batteries. Choose the rating of the fuses according to the maximum charging current.

Install an additional switch or a circuit breaker between the charger and the solar array rated up to the maximum power, voltage, and amperage of the solar panels.





Note: DIP switch 2 sets the trigger method for DC-DC charging:

- If the trigger is set to D+ signal, the charger will require a D+ signal to start DC-DC charging. If there is no signal applied to the D+ terminal, DC-DC charging will be off.
- If the trigger is set to voltage control, DC-DC charging will turn on and off depending on the voltage of the source battery.

Please refer to the DIP switches section for more details.

Green terminals

The charger features a pluggable terminal block of 8 green terminals. In a place with limited installation space, the terminal block can be unplugged for connection or disconnection of the wires and then re-inserted. The size of the cable for this terminal block is 0.75mm² and the stripping length is about 6mm. Description of the terminal contacts is provided below.

"T T": these are the terminals for connecting an optional temperature sensor for measuring the temperature of the target battery.

If you install a temperature sensor in your system, please ensure that it is not affected by any heat source. Fix it on the case of the target battery or connect it to the negative terminal of the battery.

A temperature sensor is highly recommended for lead acid batteries in case if the ambient temperatures vary substantially from the baseline temperature of 25°C. The sensor performs two main functions:

- Charging voltage adjustment. The charging voltage for the target battery is compensated up or down depending on the ambient temperature to regulate the speed of chemical reaction inside the battery. The voltage will increase in the winter and decrease in the summer at the rate of 18mV for each degree Celsius away from the reference temperature 25°C.
- Battery protection. When the temperature is lower than -20°C or higher than 50°C, the charger limits the maximum charging current.

The charger can identify whether the temperature sensor is connected or not, or if it is damaged, short-circuited, or when an abnormal temperature is measured. In such case, the charger will automatically set the charging programme to the default temperature 25°C.

Note: there is no temperature compensation for lithium batteries.

Note: if the 0°C charging function is required, the temperature sensor must be connected.

"Ss-, Ss+": these are the terminals used for connecting optional battery cables directly to battery terminals for precise voltage measurement of the target battery. This will provide the charger with accurate readings of the voltage of the battery to ensure they are not affected by the voltage drop in heavy duty "+" and "-" charging cables. The voltage reading cables must be fused.

If these cables are not connected or the connection is interrupted, the charger will measure the voltage across the target battery terminals using the regular heavy duty charging cables connected to "+" and "-" terminals of the charger.

If multiple batteries are being used in parallel, connect Ss- to the negative terminal of the first battery, and connect Ss+ to the positive terminal of the last battery.

"TR": relay signal terminal. If a high starting current is required by some electrical loads connected to the target battery (fridge, air conditioner, inverter etc), and the target battery cannot start them on its own and its voltage drops below 12.5V, the "TR" terminal can provide a 12V + signal which can close an optional relay (purchased separately) installed between the "+" of the source battery and the "+" of the target battery. This will effectively connect the two batteries directly to each other allowing the source battery to assist the target battery in starting high current electrical loads.

"D+": this is the terminal for connecting a "D+" signal (12V +) from the alternator. This terminal controls the DC-DC function of the charger if:

- The charger is used in a vehicle
- And the source battery (IN) is the vehicle's starter battery
- And DIP switch 2 of the charger is set to "D+" signal (please refer to the DIP switches section for more information).

In such case, the DC-DC charging will only operate at times when the alternator sends a "D+" signal to this "D+" terminal (when the alternator is working). The voltage range for this signal is 8V – 16V.

Alternatively, another connection option in a vehicle where the starter battery is used as a source battery, is to connect the "D+" terminal of the charger to the 12V + signal from the ignition of the vehicle. In such case, if the ignition is ON, the charger's DC to DC function will be ON. If the ignition is OFF, DC to DC charging from the source battery will be OFF and the solar panels (if connected) will charge the target battery.

DIP switch 2 can be set to operate DC-DC charging in a voltage control mode. In such case DC-DC charging will turn ON and OFF based on the voltage of the source (IN) battery. In this mode, the D+ signal is not required to operate the DC-DC function of the charger.

"AES": this terminal is for an output signal to a fridge with an Automatic Energy Selection (AES) control port. When the excess solar energy is available due to the strong solar radiation and the batteries connected to the charger are full, the charger recognises this condition and sends the AES signal to the fridge. This will allow the fridge to switch the source of input energy gas to 12V to benefit from the excess of solar energy. If AES signal is not needed in the system, this terminal can be left unconnected.

When in use, the AES signal will activate after 5 minutes of the Absorption charging.

The AES signal will turn off in the following conditions:

1. Within the following voltage range, the AES signal will turn off after 30 minutes of operation:

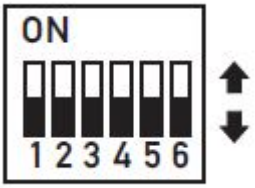
Target battery type	**Target battery voltage range**	AES turns off after working for 30 minutes
Lead-acid, GEL, and AGM	12.3V ≤ Voltage <13V	
LiFePO4	13.1V ≤ Voltage <13.5V	

2. In the following voltage conditions, the AES signal will turn off after 5 seconds of operation:

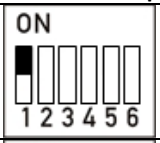
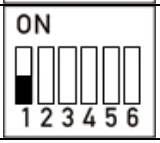
Target battery type	**Target battery voltage range**	AES turns off after working for 5 seconds
Lead-acid, GEL, and AGM	<12.3V	
LiFePO4	<13.1V	

"AC on +12V": This terminal is used to produce a signal when the AC input is connected. When the charger is connected to the target battery and AC input is available, this terminal will output a +12V/1A voltage signal. This signal can be used to indicate whether the AC input is normal or not, or to mark in your system that the charger entered the AC charging mode.

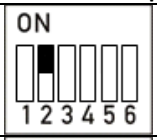
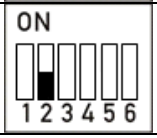
DIP switches



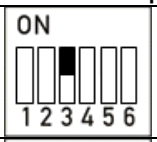
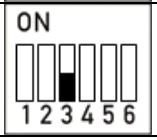
DIP switch 1: select the charging power (only for AC and DC-to-DC charging).

DIP switch position		**Description**
	1: ON	The charger runs at half the rated current.
	1: OFF	The charger runs at full power.

DIP switch 2: select the trigger method to start DC-DC charging.

DIP switch position		Description
	2: ON	Voltage control mode: no need to connect “D+” for DC-DC charging. When the source battery voltage is > 13.2V, DC-DC charging will start automatically. When the source battery voltage < 11.9V, DC-DC charging will stop.
	2: OFF	“D+” control mode: the “D+” signal must be connected and active for the DC-DC charging to start.

DIP switch 3: select the 0°C charging function for lithium batteries.

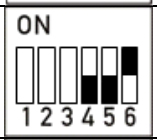
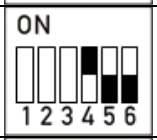
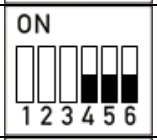
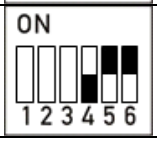
DIP switch position		Description
	3: ON	Target lithium battery will not charge if the ambient temperature is below 0°C. Charging will resume when the temperature rises back above 3°C.
	3: OFF	Target lithium battery will be charged even if the temperature falls below 0°C.

DIP switches 4, 5, and 6: battery selection.

The battery type for the target battery can be selected using DIP switches 4, 5 and 6. This setting will determine the charging parameters used for charging the target battery, such as charging voltage and temperature compensation.

Before you connect and use the charger, please set the correct battery type for the target battery from the range of 8 options below.

DIP switch position		Battery type	Boost voltage
	4: ON 5: ON 6: ON	GEL	14.3V
	4: ON 5: ON 6: OFF	Sealed lead-acid	14.4V

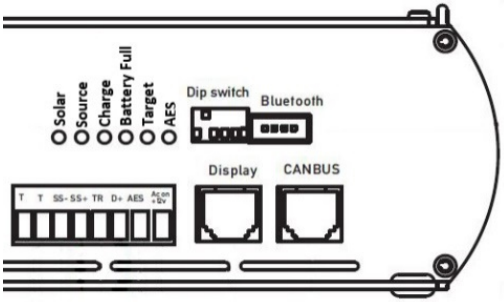
	4: ON 5: OFF 6: ON	AGM	14.7V
	4: OFF 5: ON 6: OFF	LiFePO4	13.9V
	4: OFF 5: OFF 6: ON	LiFePO4	14.2V
	4: ON 5: OFF 6: OFF	LiFePO4	14.4V
	4: OFF 5: OFF 6: OFF	LiFePO4	14.6V
	4: OFF 5: ON 6: ON	Custom	14.4V (Default)

Note: the battery type should not be changed whilst the charger is powered. If the battery type needs to be changed, first power off the charger, then change the DIP switch configuration, then turn the charger on again.

Note: any lithium battery used with this charger must have a Battery Management System (BMS). Charging of lithium batteries without BMS is not permitted.

Note: for the Custom battery type, users can modify the boost and float charging voltages through the App, using the Bluetooth module (sold separately).

LED indicators



Name	Colour	LED status	Details
Solar	Green	OFF	The charger is working in the DC-DC mode or there is no solar connected.
		Slow flashing (1 flash / 5 seconds)	Solar voltage is < target battery voltage.
		Fast flashing (1 flash / 2 seconds)	Solar voltage is > 50V
		ON	Solar voltage is normal
Source	Green	OFF	No D+ signal, no DC-DC charging.
		Slow flashing (1 flash / 5 seconds)	Source battery voltage is < 11.0V. If the source battery voltage reduces further to < 10.8V, DC-DC charging will stop. It resumes when the voltage returns above 12.5V.
		Fast flashing (1 flash / 1 second)	Source battery voltage > 16V
		ON	Source battery voltage is normal (11-16V)
Charge	Yellow	OFF	No charging
		Slow flashing (1 flash / 4 seconds)	Reduced current charging (battery temperature > 50°C or < -20°C)
		Slow flashing (1 flash / 2 seconds)	Lithium battery does not charge below 0°C
		Fast flashing (1 flash / 1 second)	Charger is overheated
		ON	Charging
Battery full	Green	OFF	No charging
		Slow flashing (1 flash / 5 seconds)	Boost (constant current) charging stage
		Fast flashing (1 flash / 1 second)	Absorption (constant voltage) charging stage
		ON	Battery full

Target	Red	Slow flashing (1 flash / 5 seconds)	Target battery voltage is normal
		Fast flashing (1 flash / 1 second)	Target battery over-voltage, high voltage disconnect (HVD)
		ON	Target battery low-voltage, low voltage disconnect (LVD)
AES	Green	ON	AES output ON
		OFF	AES output OFF

Charging modes

The charger can operate in different charging modes: mains (AC), DC-DC and solar charging.

When the charger is connected to an AC power source:

When the AC input power is available, the charger will charge from mains. DC-DC charging and solar charging will not be active.

When the charger is not connected to an AC power source:

When the AC input power is not available, the charger will revert to either DC-DC or solar charging and enable them as follows:

- When the conditions for DC-DC charging are met, this will take priority over solar charging.
- If DC-DC charging is not active, then the solar charging will be active and will provide charge to the target battery.

Source (starter) battery charging

In addition to charging the target battery, in certain conditions the charger can also trickle charge the source (starter) battery with the current up to 5A to maintain its level and ensure it's ready to start the vehicle.

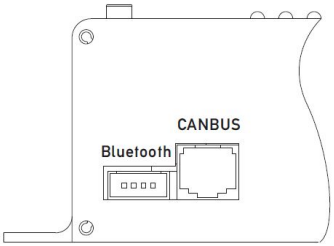
When the charger is charging from solar, it will trickle charge the source battery using any excess solar power as per the following conditions:

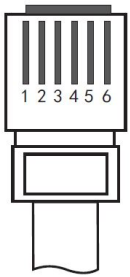
Trickle charge from solar	Conditions
ON	When both of the following conditions are met: 1. The target battery is being charged in the absorption or float stage. 2. The source battery voltage is between 5V-12.8V.
OFF	When either of the following conditions is met: 1. The target battery exits the absorption / float and enters the boost charging stage. 2. The source battery voltage is > 14.3V.

The charger can also trickle charge the source battery from the target battery in certain conditions:

Trickle charge from target battery	Conditions
ON	When all the conditions below are met: 1. The source battery voltage is between 7V-12V. 2. The target battery voltage is > 12.3V. 3. The AES signal is off.
OFF	If any of the conditions below are met: 1. The source battery voltage is > 12.3 for more than 10 seconds. 2. The source battery voltage is > 13.2V. 3. The D+ signal is connected. 4. The target battery voltage is < 12V for more than 10 seconds. 5. The target battery voltage is < 11.5V. 6. After 10 seconds of charging, the charging current is < 0.1A (the voltage difference between the batteries is small). 7. The target battery is being charged from solar in the absorption or float stage. 8. The AES signal is on

CANBUS communication connection





6Pin RJ11 Pin definition

PIN	Definition
1	NC
2	NC
3	CAN_H
4	NC
5	NC
6	CAN_L

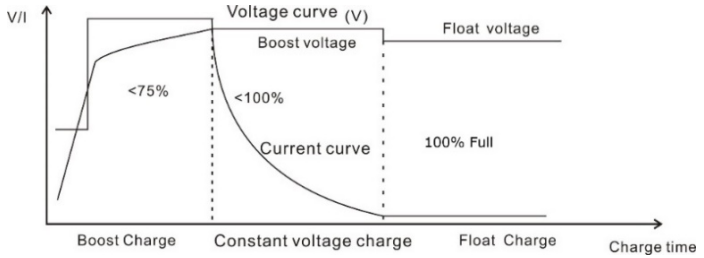
Note: Please contact the supplier to obtain the CANBUS communication protocol.

Charging process

Boost (constant current) charging stage: during this stage, the charger will charge the target battery with the maximum rated current until the target battery voltage reaches the boost voltage.

Absorption (constant voltage) charging stage: when the target battery voltage reaches the boost voltage, the charger will enter the absorption (constant voltage) charging stage. During this stage the charger will maintain the boost voltage and the charging current will gradually reduce. This stage will last for 1 or 2 hours depending on the battery type.

Float charging stage: after the absorption stage, the charger will reduce the charging voltage to the float voltage and continue charging the target battery with a low current to maintain it at this level.



Equalisation: for selected battery types, the charger will perform equalisation charging by timer once a month with a higher charging voltage, in order to bring all battery cells to the same level. Equalisation charging will last for 2 hours. Please refer to the battery types table for more information.

Note: If the target battery voltage is > 12.6V at the start of the charging process, the charger will not perform the absorption (constant voltage) stage and will instead charge to the boost voltage level and then go straight to the float charging stage.

Protection functions

Protection	Description
Target battery overvoltage	If the target battery voltage is > High Voltage Disconnect (HVD) voltage, the charging will stop. If the target battery voltage is > boost voltage value + 0.2V for 10 seconds, the charging will stop.
Target battery low voltage	If the target battery voltage is < Low Voltage Disconnect (LVD) voltage, the charging will stop. Buzzer alarm: beeps twice repeatedly for 7 seconds.
Source battery low voltage	If the source battery voltage is between 10.80V - 12.35V, the charging current is reduced. If the source battery voltage is < 10.8V, DC to DC charging stops.
Solar overpower	If the input solar power or current exceeds the maximum rated values of the charger, the actual solar charging power and current will be limited to the rated values.
Solar overvoltage	If the solar voltage is > 50V, the solar charging will stop. Buzzer alarm: beeps three times repeatedly for 1 minute.
DC to DC overpower	The maximum charging current and the maximum charging power is limited to the rating of the charger.
AC overpower	The maximum charging current and the maximum charging power is limited to the rating of the charger.
Battery reverse polarity	If the target or the source battery is connected with a reverse polarity, it will blow the fuse inside the charger and may also cause hardware damage to the charger. Please contact the supplier of the charger with all the details, including which battery was connected with a reversed polarity.

Solar reverse polarity	The charger will not be damaged if the solar panels are connected with a reverse polarity, but solar charging will remain off until the solar input is re-connected correctly.
Overheating (internal temperature)	If the internal temperature is > 80°C, the charging will stop. Charging will resume once the temperature drops to 60°C. If the internal temperature is > 75°C but < 80°C, the charging current will be reduced. Charging at full current will resume once the temperature drops to 65°C. Buzzer alarm: two consecutive beeps followed by a single beep for 1 minute.

Battery type parameters

Battery type	Boost	Float	Equalisation	High Voltage Disconnect (HVD)	Low Voltage Disconnect (LVD)	Constant voltage charging time
GEL	14.3V	13.8V	-	15.5V	11V	2h
Sealed	14.4V	13.5V	14.6V	15.5V	11V	2h
Flooded / AGM	14.7V	13.5V	14.8V	15.5V	11V	2h
LiFePO4 (13.9V)	13.9V	13.8V	-	15.5V	11V	1h
LiFePO4 (14.2V)	14.2V	13.8V	-	15.5V	11V	1h
LiFePO4 (14.4V)	14.4V	13.8V	-	15.5V	11V	1h
LiFePO4 (14.6V)	14.6V	13.8V	-	15.5V	11V	1h
Custom (Default value)	14.4V	13.7V	-	15.5V	11V	2h

Power derating

If the source battery voltage becomes low, the charging current will decrease to prevent over discharge of the source battery.

1. The charger operates in the D+ control mode (DIP switch 2 is OFF).

Source battery voltage	Charge current		Recovery voltage	Charge current	
	DCTRIPLE-30	DCTRIPLE-60		DCTRIPLE-30	DCTRIPLE-60
> 12.6V	30A	60A	-	-	
< 12.35V	25A	50A	> 12.55V	30A	60A
< 12.20V	22A	40A	> 12.50V	25A	50A
< 12.05V	19A	30A	> 12.45V	22A	40A
< 11.90V	16A	20A	> 12.40V	19A	30A
< 11.75V	13A	15A	> 12.35V	16A	20A
< 11.60V	10A	10A	> 12.30V	13A	15A
< 11.40V	2A	2A	> 12.25V	10A	10A
< 10.8V	Stop charging		> 12.60V	30A	60A

2. The charger operates in the voltage control mode (DIP switch 2 is ON).

Source battery voltage	Charge current		Recovery voltage	Charge current	
	DCTRIPLE-30	DCTRIPLE-60		DCTRIPLE-30	DCTRIPLE-60
> 13.2V	30A	60A	-	-	
< 12.6V	25A	50A	> 13V	30A	60A
< 12.4V	22A	40A	> 12.9V	25A	50A
< 12.2V	19A	30A	> 12.8V	22A	40A
< 11.9V	Stop charging		> 13.2V	30A	60A

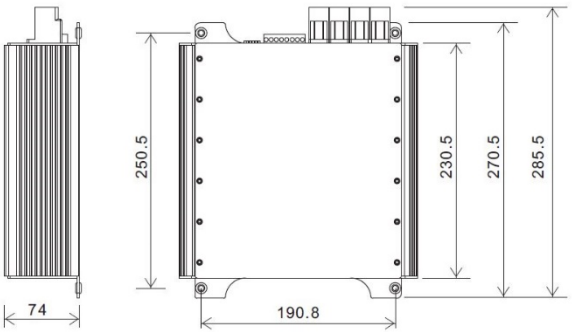
Specifications

Model	DCTRIPLE-30	DCTRIPLE-60
Target battery		
Gel, Sealed, AGM rated voltage	12V	
LiFePO4 rated voltage	12.8V	
Recommended battery capacity	45-280Ah	90-560Ah
Battery operating voltage range	8-16V	
Source battery		
Rated voltage	12V	
Recommended battery capacity	70-100Ah	
Battery operating voltage range	10.5-16V	
DC-DC charging		
Maximum charging power	390W	780W
Maximum charging current	30A	60A
Effective D+ signal voltage range	8-16V	
AC charging		
Input rated voltage	110-230V AC, 45-65Hz	
Input voltage range	90-270V AC	
Maximum charging current	20A	40A
Maximum charging power	260W	520W

Solar charging		
Maximum input solar power	250W	430W
Maximum input solar current	15A	26A
Maximum solar open circuit voltage	50V*	
Maximum charging current to target battery	20A	30A
Charging current to source battery	0-5A	
General parameters		
Temperature compensation	- 18mV/°C	
"TR" signal	12V / 1A	
"AES" signal	12V / 1A	
Target battery temperature sensor input "T T"	Yes	
Target battery voltage input "Ss-,Ss+"	Yes	
Stand-by current	28mA	
Operating temperature	From -20°C to 50°C	
Weight	2.0kg	2.3kg
Dimensions	286x234x74mm	

**At minimum environmental temperature. For colder climates this typically means that the open circuit voltage of solar panels at 25°C should not exceed 45V.*

Dimensions



CB and CBR circuit breakers (optional)

Optional surface mounted (CB series) and recess mounted (CBR series) DC circuit breakers can be purchased from Photonic Universe and used instead of fuses when connecting this charger to the source and target batteries. The range of circuit breakers includes 30A – 250A surface mounted, and 40A – 150A recess mounted circuit breakers rated for 12V systems with the product codes ***CB30 – CB250***, ***CBR40 – CBR150***.

Temperature sensor DCDC-TS (optional)

This charger is compatible with an optional temperature sensor **DCDC-TS**. The sensor will measure the external temperature of the target battery and provide the real time temperature readings to the charger for voltage adjustment and protection (please see the section about “T T” terminals for reference). The voltage adjustment applied for lead acid batteries is 18 mV/°C. If the temperature sensor is not connected, the charger will charge the target battery based on the default temperature settings for 25°C.

Remote meter ACDC-RM (optional)

An optional remote LCD meter **ACDC-RM** can be connected to the charger to display charging parameters such as real time battery voltage, charging current, charging Ah, charging Wh and any fault information.

Bluetooth dongle ACDC-BT (optional)

Using an optional Bluetooth dongle **ACDC-BT**, this charger can be connected to a smartphone app to allow the user to monitor charging parameters such as real time battery voltage, charging current, charging Ah, charging Wh and any fault information.

To setup the Bluetooth dongle and connection to the smartphone, please install the correct and up-to-date version of the app using the name, links or QR codes for the app provided in a separate user manual for the Bluetooth dongle.

If you would like to purchase any of these optional extras, please visit our online shop

www.PhotonicUniverse.com

or call 0203 150 1111 (international +44 203 150 1111) for a phone order.

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