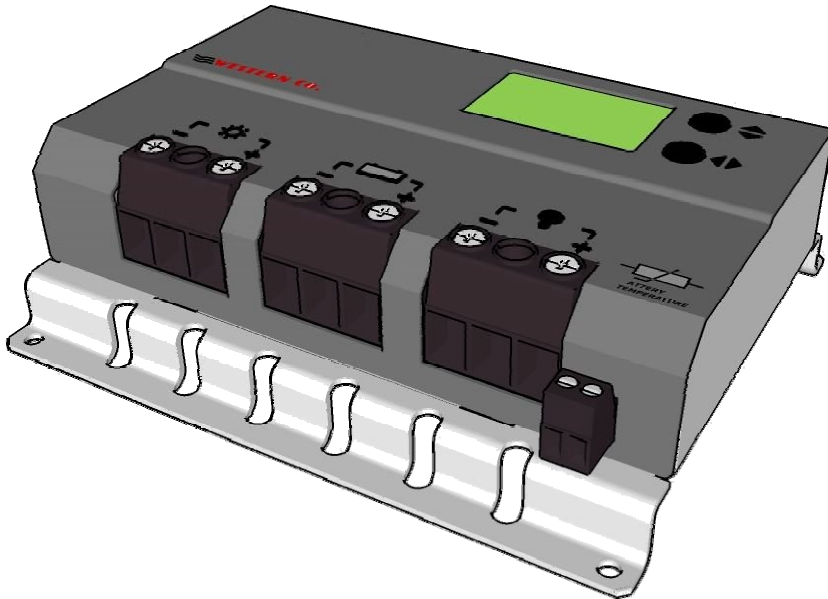


## PHOTOVOLTAIC CHARGE REGULATOR

### WMarine10



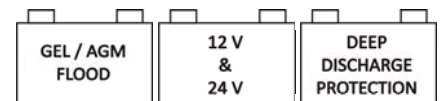
WMarine10 has got a buck-boost charge circuit with control of the maximum power point of the PV module (MPPT). The main difference between this controller and other types with buck circuit (as for instance WRM15) is that WMarine10 is able to allow the working of the PV module at a voltage than can be either higher or lower than that of battery; this allows, for example, to use a PV module with open circuit voltage of 10V for the charge of batteries both at 12V and 24V. PV module voltage during the working of MPPT circuit goes from 5V to 40V with both 12V and 24V batteries.

WMarine10 is a complete solution for the realization of off-grid PV systems, to power supply road signs systems, lighting systems, small low voltage systems and for the charge of batteries inside caravans and boats.

The several programs of load management, selectable by the user, make WMarine10 the proper solution in several applications; i.e. to power supply video cameras that have to work only during the day, or to power supply flashing systems/road signs that have to work only during night or to power supply lighting systems that have to work only for a certain number of hours during night. WMarine10 detects the day/night status according to the PV module's voltage; therefore it is not necessary to connect further sensors to the regulator. A wide display shows the working status of the regulator either through simple and intuitive icons or displaying the values of charge current, battery voltage, energy produced by the PV module, load current and energy consumed by the load.



- *MPPT charge with buck-boost circuit*
- *Max PV module power: 120W for 12V battery and 220W for 24V battery*
- *Integrated blocking diode*
- *For sealed, GEL and flooded lead acid batteries*
- *Charge voltage compensated in temperature*
- *Auto-detect of battery voltage: 12V / 24V*
- *18 programs for load management*
- *LCD with 48 symbols for user interface*
- *Low battery protection*
- *Over temperature protection*
- *Protection for battery polarity inversion*
- *Overload protection on output*
- *IP20 metal box*



## General description

WMarine10 is a photovoltaic charge regulator for leaden electrochemical batteries either sealed (SEAL) or flooded lead acid (FLOOD). In fig. 1 there is a scheme principle of WMarine10.

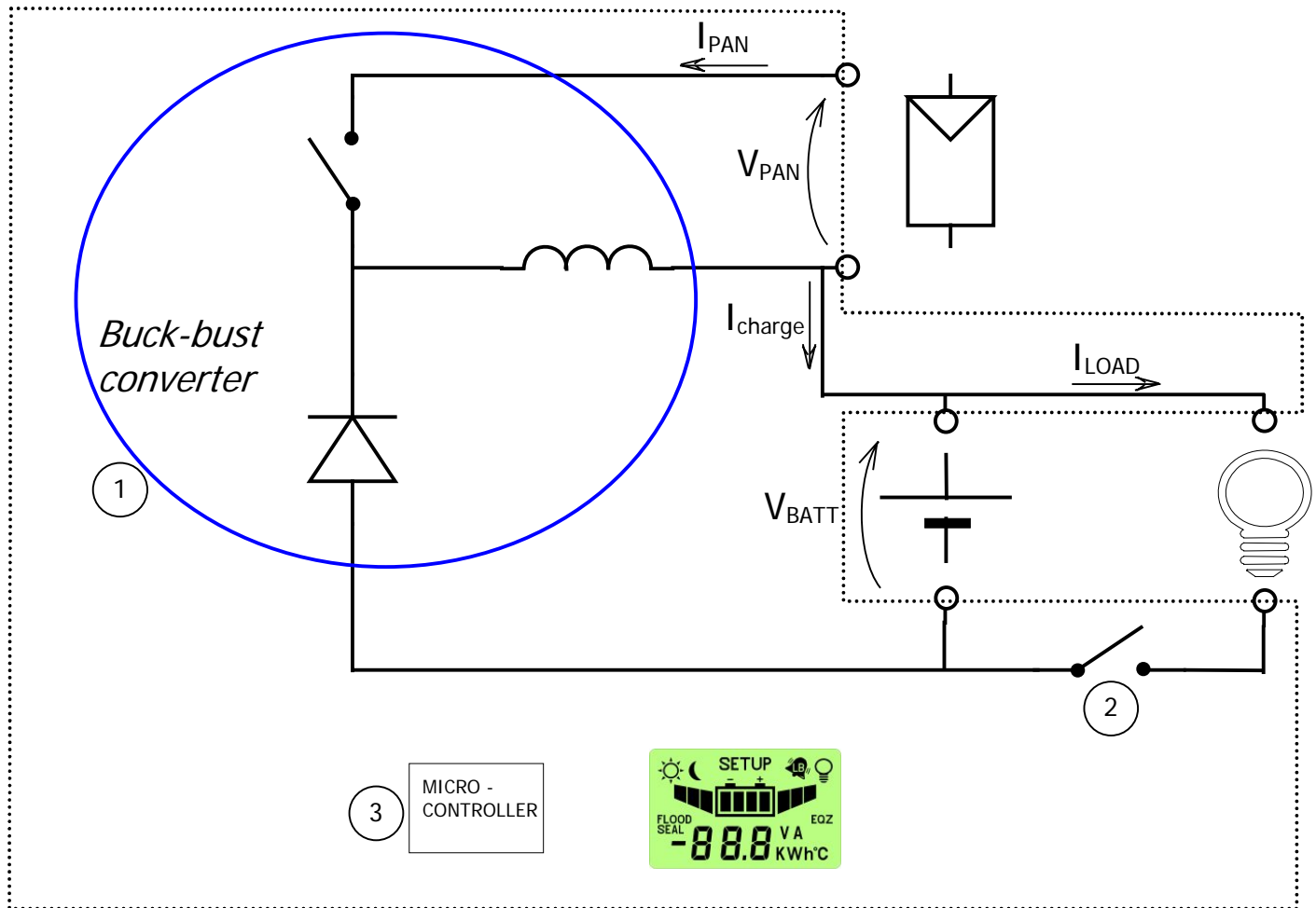


Fig. 1 Block diagram

- 4- Charge circuit: it adapts  $V_{PAN}$  and  $I_{PAN}$  (respectively voltage and current of the PV module) so to search the condition in which the power that is given by the PV module is maximum, thus realizing the MPPT (*Maximum Power Point Tracking*). In addition, it manages the battery charge by reducing the current sent towards the battery when the battery  $V_{BATT}$  exceeds its charge voltage ( $V_{ch}$ ).
- 5- Circuit for load control: it turns on/off the load according to the program set by the user and it provides to load detachment in case of discharged battery, overload or short-circuit on the load.
- 6- Microprocessor: it controls the whole circuit, it measures currents and voltages of PV module, battery and load and it shows them on the display.

## Wiring scheme

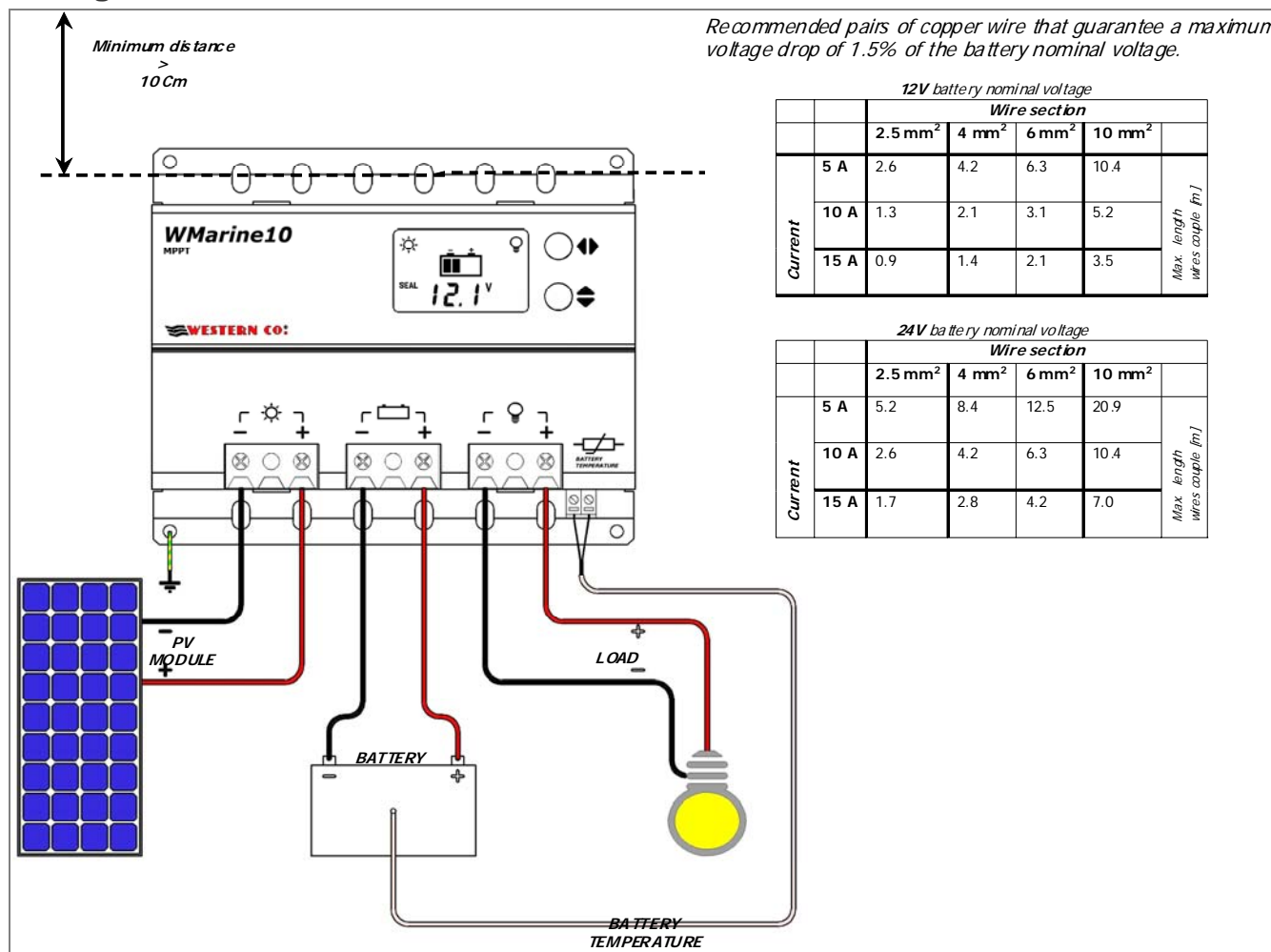


Fig. 2 Wiring scheme

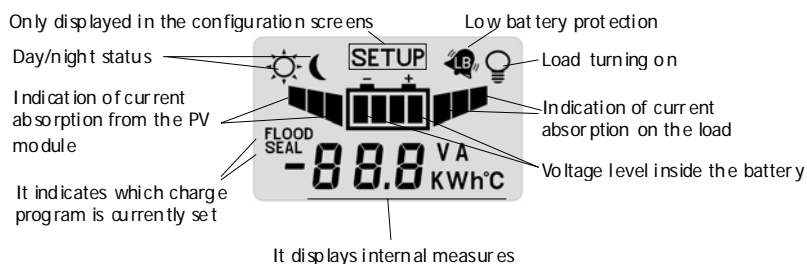
- 1) Install WMARINE10 in a dry and adequately ventilated place; it has to be fixed on a non-flammable surface and placed so to leave an unobstructed space of at least 10cm around the device that allows the cooling by natural air convection.
- 2) Connect respectively: load, sensor for battery temperature measure (supplied), PV module and, last, the battery as in the scheme fig. 2. When you connect the battery the regulator turns on and it begins to work. Use proper cable sections as indicated in fig. 2.
- 3) WMARINE10 recognizes automatically the battery nominal voltage (12V or 24V) and it adapts consequently its working thresholds. The user must configure the kind of battery in use to adequate the right charge voltage ( $V_{ch}$ ). You have to set SEAL configuration if you use VRLA or GEL sealed batteries, while you have to choose FLOOD configuration if you use flooded lead acid batteries (fig. 4).
- 4) Set the proper load management program to your own application (fig. 4).

## Testing

Once made the connections as in fig. 2 it is necessary to proceed with the testing of the system.

- 1) With the PV module exposed to sunrays, verify that WMARINE10 is charging the battery reading the values of charge current  $I_{PAN}$  and  $I_{BAT}$  (see fig. 3).
- 2) To verify that the battery temperature sensor has been properly connected, check on the LCD that at the page "battery temperature" a reliable temperature value is displayed (fig. 3).
- 3) Verify the correct turning on of the load. If the load is ON only during night it is possible to simulate the night by disconnecting temporarily one of the wires of the PV module. With load ON, check the absorbed current by reading in the proper page of LCD (fig. 3).

## Visualizations



	Main page. It displays the battery voltage ( $V_{BAT}$ ), the charge program currently selected (SEAL or FLOOD), the day/night status detected by the PV module. The load icon, if ON, indicates that the load is power supplied.
	It displays the current ( $I_{PAN}$ ) of the PV module. We remember that the current delivered by the PV module depends on its state of sun-lighting and on battery charge status. With charged battery ( $V_{batt} > 14.4V$ @12V or $V_{batt} > 28.8V$ @24V) even with a good lighting of the PV module, you have low currents from PV module since the regulator limits the current to avoid battery overcharge.
	PV module voltage ( $V_{PAN}$ ).
	It displays the power in watt actually delivered by the PV module.
	It displays the counter of energy that is delivered by the PV module in KWh. It is possible to reset this measure pressing simultaneously the buttons  for 2 seconds.
	It displays the charge current inside the battery ( $I_{CHARGE}$ ).
	It displays the battery temperature that is currently measured by the temperature sensor connected to WMarine10.
	It displays the current that is currently delivered to the load; even if in this screen the load icon is on, this does not mean that it is effectively power supplied; in fact the load is controlled according to the load management program that is currently set.
	It displays the power that is currently delivered to the load in watt.
	It displays the energy counter in KWh consumed by the load. It is possible to reset this counter pressing simultaneously the buttons  for 2 seconds.
	Pressing the button you go back to the main page.

Fig. 3 Display pages of measures

## System configuration

You can go to the configuration pages of WMarine10 pressing simultaneously for at least 2 seconds the buttons .

<b>Charge program configuration page</b>	
	It sets the charge voltage for the battery. We recommend to set the SEAL program for GEL or sealed batteries and the FLOOD program for the charge of flooded lead acid batteries. Charge voltages relating to each one of the programs are indicated in the following fig. 6/8 and must be chosen in accordance with the battery manufacturer indications.
<b>Low Battery voltage configuration page</b>	
	It sets the intervention voltage of Low battery protection (load detachment in case of low battery). When pressing the button  you change the setting from 10.8V to 12.2V for 12V systems and from 21.6V to 24.4V for 24V systems.
<b>Load management program configuration page</b>	
	Load always ON either during day or during night.
	Load only during day.
	Load only during night.
	Load during for 1 hour.
	Load during night for 16 hours.
<b>Voltage configuration page - Vday</b>	
	WMARINE10 detects the day when the voltage of PV module ( $V_{PAN}$ ) is $>$ than $V_{DAY}$ threshold; it detects the night when $V_{PAN}$ is $<$ than $V_{NIGHT}$ threshold. In this page it is possible to change $V_{DAY}$ threshold. $V_{NIGHT}$ threshold = $V_{DAY} - 1.3V$ .
<b>Software version display page</b>	
	It displays the software version in use on WMarine10
Pressing the left button you go back to the configuration page of the charge program	

Fig. 4 Setting pages

Once modified the settings of WMarine10 these become operative only after editing from the configuration pages pressing simultaneously the buttons for at least 2 seconds.

## Error codes

With the intervention of del WMarine10 internal protections, there are the below reported error codes.


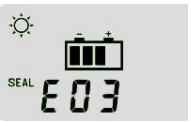



Table of Error code			
	When <i>low battery</i> symbol is flashing this indicates that there is the low battery protection - load has been disconnected to preserve battery life. This protection intervenes when the battery voltage goes under $V_{LB}$ threshold that can be set by the user (fig. 4). WMarine10 leaves this protection when the battery will be charged by the PV module at $V_{OUT-LB}$ voltage (see Fig. 8 "Table of electrical features").		Overload protection occurred. The load current exceeded the maximum allowed limit for WMarine10 ( <b>Iload</b> in the "Table of electrical features") and the regulator detached the load to prevent internal damages. If there is such a signalling, it is necessary to check if the current absorbed by the load is < than the allowed limit. After 1 minute WMarine10 tries to power supply again the load. It exits from this condition if the cause that generated the overload has been eliminated.
			
	You have this error when internal temperature of WMarine10 exceeds 80°C and deactivates the charge. You exit automatically from this protection when the internal temperature goes below the threshold of 50°C (note: the internal temperature of the regulator is not displayed on the LCD). If you see often this protection we advise to place the regulator in a cooler place.		You have this error when the battery voltage is < than 9.0V. In these conditions, the charge is disabled.

Fig. 5 Table of error codes

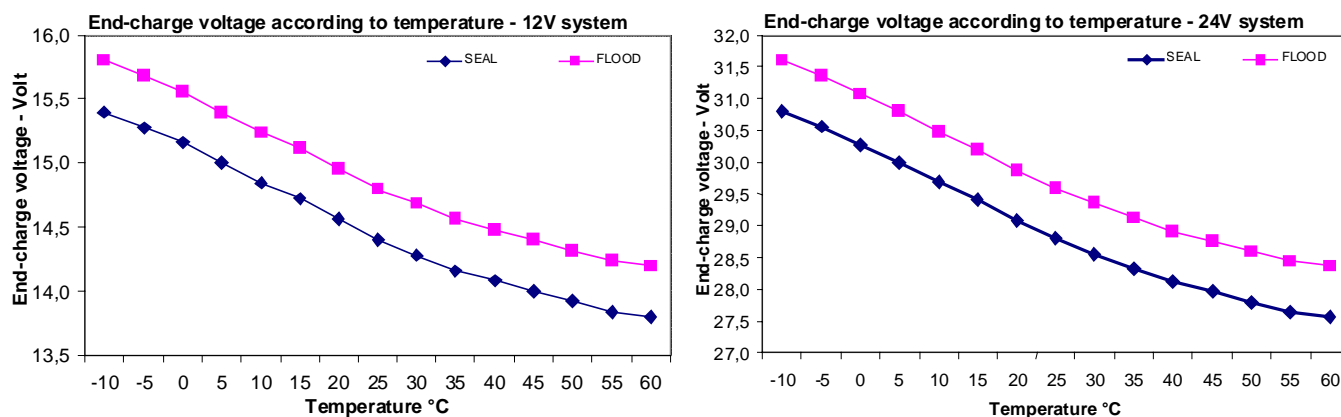


Fig. 6 Compensation curve of  $V_{ch}$  charge voltage according to battery temperature

## ELECTRICAL FEATURES

		12V battery nominal voltage			24V battery nominal voltage		
		Min	Tip	Max	Min	Tip	Max
Battery voltage	Vbatt	10V		16V	20V		32V
Open circuit voltage of PV module	Vpan	5V	-	40V	5V	-	40V
Max PV module power	Pmax	-	-	120W	-	-	220W
Load output voltage	Vload	-	Battery voltage	-	-	Battery voltage	-
Load current	Iload	-	-	15A	-	-	15A
Charge voltage at 25°C - SEAL program (default)	Vch		14.4V			28.8V	
Charge voltage at 25°C - FLOOD program	Vch		14.8V			29.6V	
Vch compensation according to battery temperature (Tbatt)	Vtadj	-	-24mV/°C	-	-	-48mV/°C	-
Low battery voltage (it can be set)	Vlb	10.8V	11.4V (default)	12.2V	21.6V	22.8V (default)	24.4V
Output voltage from low battery at 25°C - SEAL program	Vout_lb	-	13.4V	-	-	27.8V	-
Output voltage from low battery at 25°C - FLOOD program	Vout_lb	-	13.8V	-	-	28.6V	-
Solar modules threshold voltage for day detection (settable)	Vday	1.9V	4.4V (default)	9.6V	1.9V	4.4V (default)	9.6V
Solar modules threshold voltage for night detection: Vnight = Vday – 1.3V	Vnight	0.6V	-	8.3V	0.6V	-	8.3V
Self consumption	Isleep		12.7mA (Vbat 14,0V)			17,7mA (Vbat 28,0V)	
Operating Temperature	Tamb	-10°C		40°C	-10°C		40°C
Dissipated power	Pdiss			20 W			29 W
Terminals section		1mm <sup>2</sup>		10mm <sup>2</sup>	1mm <sup>2</sup>		10mm <sup>2</sup>
IP protection degree			IP20			IP20	
Weight		-	515 g	-	-	515 g	-

Fig. 8 Table of electrical features

## Dimensions

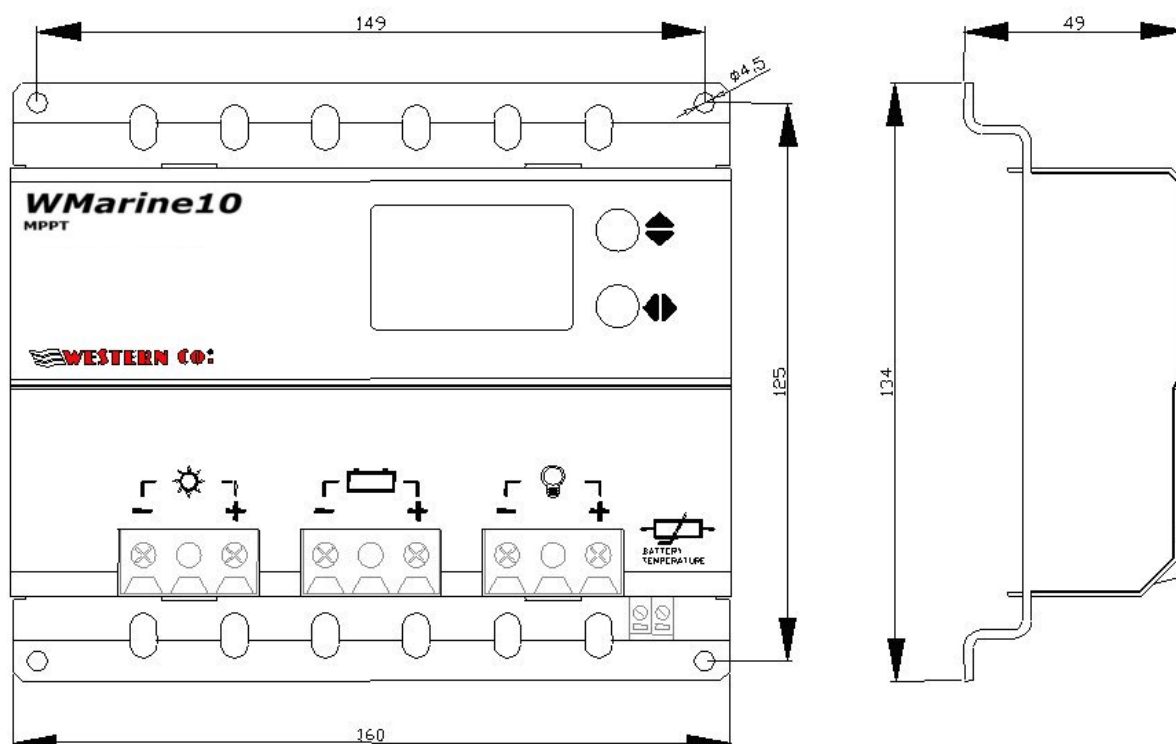


Fig. 8 Dimensions



## Warranty

Western Co. Srl guarantees the good quality and manufacturing of its products obliging itself, during the warranty period of 2 (two) years, to repair or replace at its sole discretion, for free, those parts that are defective owing to poor quality material or workmanship defect.

The defective product must be returned to Western Co Srl by a delegated company for assistance, at the expense of the customer, along with a copy of the sales invoice, both for repairing and guaranteed replacement. The costs of re-installation of the material will be borne by the customer.

Western Co srl will pay the transport expenses for the shipment of the repaired/replaced product.

### Warranty does not cover Products that, according to our discretion:

- are defective owing to natural wear,
- have failures caused by malpractice or negligence of the customer, by incorrect installation, by tampering or interventions that are different from the instructions supplied by us.

### Warranty is void if damage is also caused by:

- transport and/or bad storage of the product.
- force majeure or catastrophic events (frost for temperatures < -20°C, fire, flooding, lightning, vandalism, and so on).

All the above guarantees are the sole and exclusive agreement which supersedes any proposal or agreement whether written or oral and any other communication made between the producer and the purchaser with respect to the above. **For any dispute the jurisdiction is Ascoli Piceno (Italy).**

## Disposal of waste

Western Co., as a producer of electrical device herein described and in accordance with Law No. 151 25/07/05, informs the buyer that this product, once divested, must be delivered to an authorized recycling center or, in case of purchase of equivalent equipment, it may be returned at no cost to the distributor of the new equipment. Penalties for those who get rid of an electronic waste will be used by individual municipalities.



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