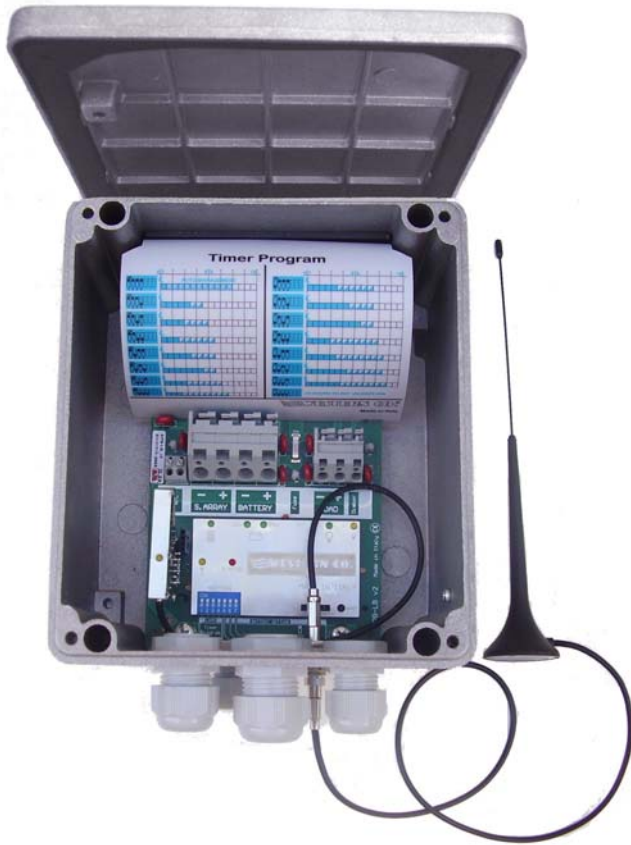




FEATURES OF SPB-LG_v2:



- **MPPT** recharge.
- Wide voltage range on PV module input (up to 100V).
- Max power of PV module: 225W at 12V and 450W at 24V.
- Integrated blocking diode.
- Suitable for systems with battery bank at 12V or 24V.
- 12/24V auto detect.
- Switch for battery selection: sealed, GEL or flooded lead acid.
- Switch for selection of battery distance: 1meter or 10 meters (in case of batteries at the bottom of the pole).
- Switch for setting depth of discharge (DoD) 30% or 70%.
- Recharge of battery compensated in temperature.
- Integrated light sensor (through PV module).
- Possible load activation with flux reduction.
- Complete check of radio interface parameters: end-charge voltage, discharge depth, light sensor sensibility, programming of load activation hours and reduced flux.
- Displaying of the following parameters: voltage, current, power, energy, temperature.
- Auto management.
- Protection for battery polarity inversion.
- Over temperature protection.
- Overload protection.
- Low battery protection.
- LEDs for the following indications; 12/24V; on/off load; on/off flux reduction; current from PV; protections.
- SMT PCB with microcontroller.
- IP65 metal box for outdoor application.
- Easy installation.
- Remote control via GSM modem.

General Description:

SPB-LG charge regulator has been planned to be used in off-grid PV lighting systems; in fact, thanks to its IP65 metal case, it is indicated for use in environments exposed to the elements. SPB-LG has got a very efficient recharge circuit with an algorithm of search of the maximum PV modules' power (MPPT); it has got a wide input range (up to 100V) so to adapt the different types of photovoltaic modules. It is suitable for 12V and 24V systems (auto detect) both for sealed and flooded lead acid batteries and it can manage a max PV power of respectively 225W and 450W. The recharge is compensated in temperature (external sensor). SPB-LG manages intelligently an installation with remote battery (at the bottom of the pole ~10mt) without using additional connections and it has got many protections: battery polarity inversion, overload, overvoltage, over temperature, low battery. The latter threshold is selectable for a use of the battery bank with depth of discharge (DoD) of 30% or 70%.

SPB-LG manages an output for a load with currents up to 8A able to drive our SOX-E ballasts (for LPS lamps) and the drivers for LED lamps. Another output called DIMMER is also dedicated for our products in order to handle even the lamp flux reduction. This feature allows to reduce consumptions during the hours where there is not a need for maximum lighting. You can program Load activation and Flux reduction through your GSM interface.

Day/night detection is executed according to the PV module voltage; therefore it is not necessary to connect further sensors to the regulator. The choice to use terminals for quick connection (no screws model "cage clamp") for connections is dictated by the simplicity and reliability of the contact that no longer depends on screw tightening. The wide box assures an easy cabling thanks also to the protective barriers for the most delicate electronic components.

Status LED, switches and screen printing indications facilitate the system configuration, the working analysis and diagnostics.

The parameters' setting and the system monitoring occur through a GSM modem interface mounted on each SPB-LG and that receives commands via SMS messages sent from a PC workstation equipped with GSM modem and a dedicated software (CCLS Western Co). On each SPB-LG you must install a sim card of any telephone operator authorized to receive and send SMS.

Working:

SPB-LB is a charge regulator from PV modules for sealed (SEAL) or flooded lead acid (FLOOD) electrochemical leaden batteries.

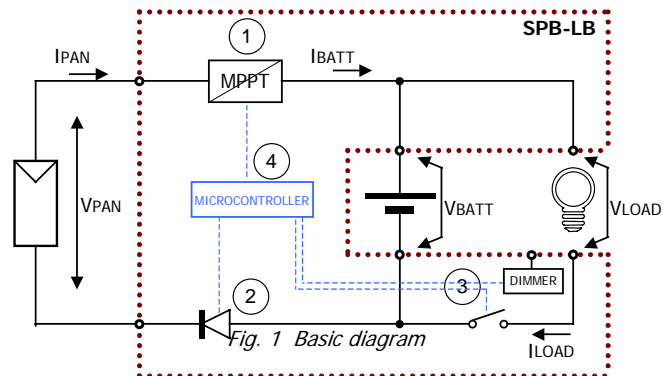
Fig. 1 shows a diagram of principle:

(1)-*Recharge circuit*: it adapts V_{PAN} and I_{PAN} (respectively PV module voltage and current) so to search the condition with the maximum power from the PV module (MPPT -Maximum Power Point Tracking). In addition it manages the battery recharge by reducing the output current to the battery when V_{BATT} exceeds the charging voltage (V_{CH}).

(2)-*Blocking diode*: it is necessary to avoid that during night, when the PV module is not lighted, it can absorb current from the battery.

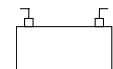
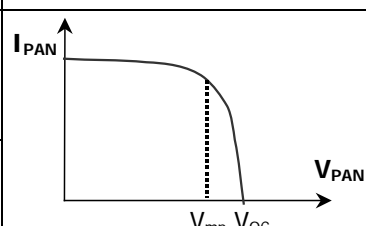
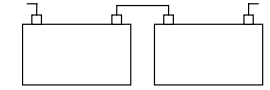
(3)-*Circuit for load control*: it turns ON / OFF the load according to the program set by the user, it commands Dimmer signalling, and makes the load to detach in case of low battery or overload.

(4)-*Microcontroller*: it controls the whole circuit, it measures currents and voltages of PV module, battery and load, it executes MPPT algorithm.



Choice of the PV module:

SPB-LG charge regulator, thanks to MPPT recharge, allows to use a wide range of PV modules ensuring the optimum exploitation of the power. The PV module has to be chosen according to the battery nominal voltage and respecting the constraints of PV module input of SPB-LG: max open circuit voltage: 100V and max PV module power 225W with 12V battery and 450W with 24V battery.

Battery nominal voltage		PV modules features
 12V battery nominal voltage		V_{mp} : voltage at max power at $T=25^{\circ}C > 15,0V$ V_{OC} : open circuit voltage at $T=-10^{\circ}C < 100V$ P_{MAX} : max power at $25^{\circ}C < 225W$ We recommend mono or polycrystalline PV modules with a number of cells from minimum 36 to max 144.
 24V battery nominal voltage		V_{mp} : voltage at max power at $T=25^{\circ}C > 30,0V$ V_{OC} : open circuit voltage at $T=-10^{\circ}C < 100V$ P_{MAX} : max power at $25^{\circ}C < 450W$ We recommend mono or polycrystalline PV modules with a number of cells from minimum 72 to max 144.

Installation:

The product installation must be performed very carefully in all its phases since from it depends the long term reliability of the system; the major cause of the malfunctions is due to a lack of thoroughness during installation (ex. inappropriate cable section or cabling mistakes can generate overheating, imperfect closures create water infiltrations that damage electronics, and so on). Here below the steps to follow:

- Fix the SPB-LG on an adequate surface not exposed to sunrays by using the 4 holes of the box (WESTERN CO. PV street-lamps have got some holes on the top-of-pole mounting structure). The side with cable-glands is always downward in order to facilitate water drainage. The cover has a gasket that ensures the IP protection degree; therefore be sure to place it perfectly and then gradually tighten the 4 closing screws. Always recheck that the cable-glands are properly tightened.
- Fix the GSM antenna and connect it to BNC connector on SPB-LG box. The antenna base is magnetic, therefore it can be fixed without any screw or glue.
- Insert the SIM card in dedicated slot (fig. 2). To operate the SPB-LG correctly on the SIM card must operate same setting and for help you to do this is created a procedure on CCLS Western Co software end its GSM modem. Consult the on line help software for a detailed description of setting SIM procedure.
- Following the diagram in Fig. 2, connect with the right polarities respectively: load; sensor for battery temperature measure (supplied); PV module and lastly the battery. When connecting the battery the charge regulator turns on and starts working (it is normal that with the contact of the last pole there is a spark of light, it is due to charge of the internal capacitor). Use the appropriate sections of the cable as shown in Fig. 2.
- SPB-LG automatically recognizes the nominal voltage battery and accordingly adapt its operating thresholds. When starting on immediately check that the LED lightens - 12V o 24V according to the nominal voltage of the battery bank.
- You must set the configuration for batteries:
- move switch n°5 to ON position if batteries are near the regulator, while move switch n°5 to OFF position if the batteries are far from the regulator (batteries at the bottom of the pole and charge regulator on the top of the pole).
- Using remote workstation and CCLS Western Co software, set the battery in use to adapt the right charge voltage (V_{ch}). We recommend the curve of Graph 1 (13,76Vch) if you use VRLM sealed or GEL batteries, while if you use flooded lead acid batteries we recommend the curve (14,24Vch).
- Using remote workstation and CCLS Western Co software, set the discharge depth of the battery bank. This causes the system autonomy in case of NO SUN – with a greater discharge depth we have a greater autonomy but the expected life of the battery bank is reduced. Generally we recommend a DoD of 30% that corresponds to V_{lb} voltage of 12,00V.



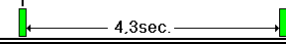
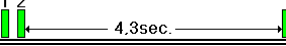
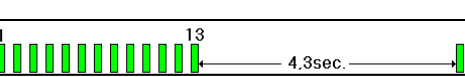

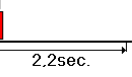
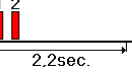

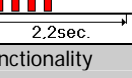

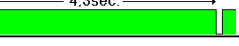

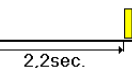
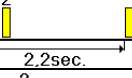
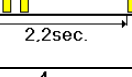
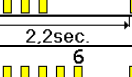
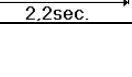
- Using remote workstation and CCLS Western Co software, set the management program of the load proper to your own application. For further details see the manual of the radio interface.

System Test:

Once activated the system, it is necessary to proceed with the testing:

- With the PV module exposed to sunrays, verify that SPB-LB is charging the battery by observing the LED (1) that indicates the current intensity from the PV module. It will make some flashes as reported in the table.
- Verify the 12/24V LED does not indicate the NTC probe disconnection (see following table).
- Verify the right load (using your radio interface, by setting temporarily DARK on "----" and 1^ hour at ON); otherwise it is possible to simulate the night by disconnecting temporarily one of the wires of the PV module or even obscuring the PV module with an opaque panel.

Displayings and protections:

PV LED: Green	Functionality	The number of flashes indicates the intensity of current from the PV module
 		1 flash with a pause of 4,3 sec.: 0,5A < PV current < 1,5A
		2 flashes with a pause of 4,3 sec.: 1,5A < PV current < 2,5A and so on ...
		... intermediate values ... 13 flashes with a pause of 4,3 sec.: 12,5A < PV current < 13,5A
Status LED: Red	Functionality	It indicates the system status
 STATUS		If always ON it indicates a system anomaly – a reset is needed.
		1 flash every 2,2 seconds: the Low-Battery protection is ON; the load is deactivated; you have to wait that the PV module recharges the battery and, after that, the protections deactivates (condition of normal working)
		2 flashes every 2,2 seconds: the overload protection is ON; the load is deactivated; after about 2 minutes the load is resetting, it makes 3 attempts in sequence , then it will wait the following night to try again.
		3 flashes every 2,2 seconds: over temperature protection; load OFF and deactivated recharge circuit; wait that the temperature inside the box decreases, then the protection will deactivate.
	4 flashes every 2,2 seconds: overvoltage protection; deactivated recharge circuit; the protection deactivates when the battery voltage goes back within the operative range.	
Led 12/24 Green	Functionality	It indicates the working nominal voltage of the system
		Besides the indication of the working nominal voltage of the system, if every 4,3sec the LED turns OFF for a moment, this means that NTC probe is disconnected. Vch becomes the same of Vch at 60°C
Led GSM Yellow	Functionality	Indicate GSM modem state.
		1 flash every 2,2 seconds: SPB-LG is initializing GSM modem. The initialization take about 1-2 minutes and if there is no errors the LED turns off and the SPB-LG is ready to receive commands from remote workstation.
		2 flashes every 2,2 seconds: SIM not installed. Remote controll are not working.
		3 flashes every 2,2 seconds: field level too low for GSM communication. You must check antenna connection and antenna location and test is you are in coverage area of your telephone operator.
		4 flashes every 2,2 seconds: the SIM card are not setting and the remote control are not working. You must execute setting SIM procedure on remote workstation.
		6 flashes every 2,2 seconds: communication error from SPB-LG and GSM modem. In this case, the SPB-LG resets and re-initializes the GSM modem.

LOAD Programming:

The load programming can be set by remote workstation (see on line help of CCLS Western Co software) . Each small box represents an hour (from 1 to 16) from twilight to sunrise: if is fully or partially coloured "LOAD" output is ON; "Dimmer" output is ON only if the small box is partially coloured (to represent the flux reduction). If all 16 small boxes are all completely coloured you have a 24/24h ON configuration. In fact, LOAD output is active independently from the twilight event. The "AUTOMANAGEMENT" configuration can be set from "Setup" - Menu – LOAD. It automatically changes the hours of reduced flux according to the available energy stored in batteries.

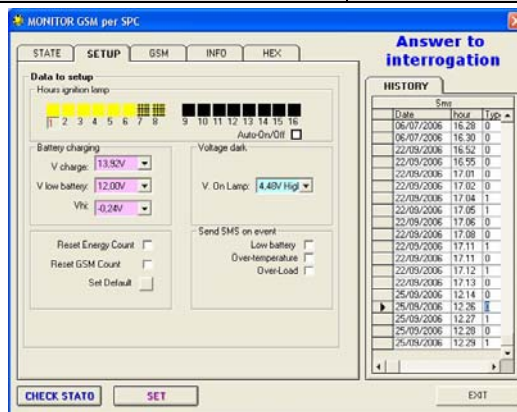
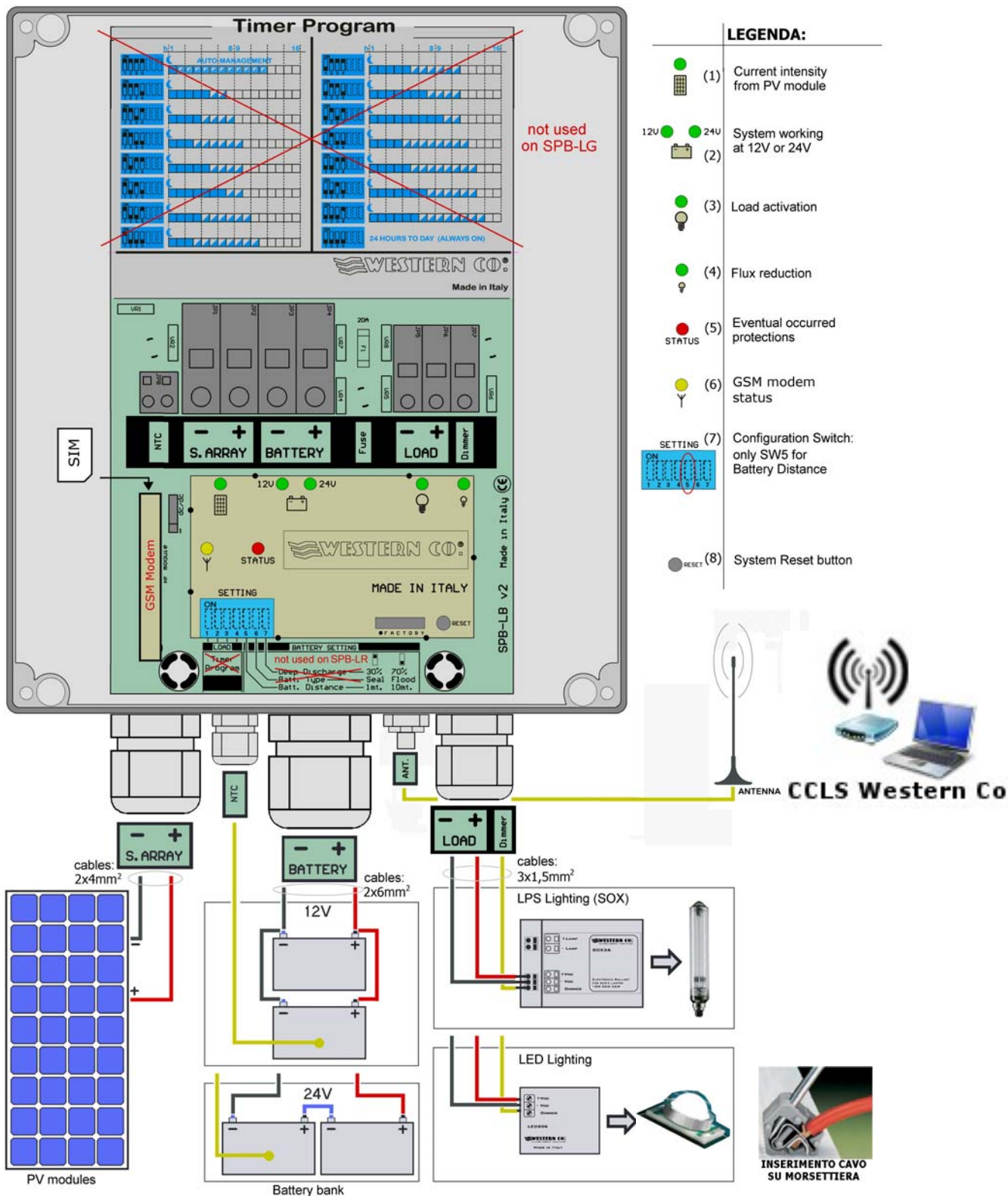
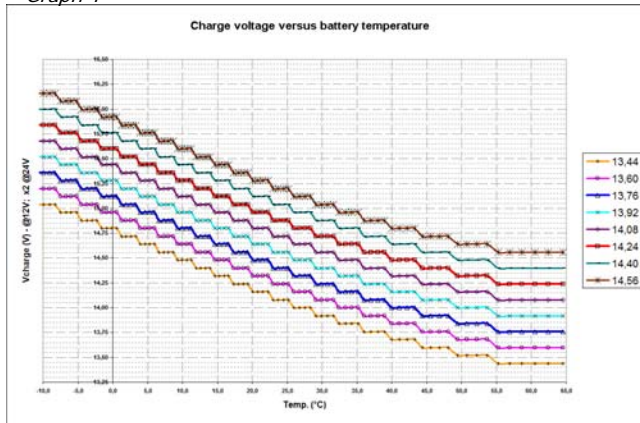


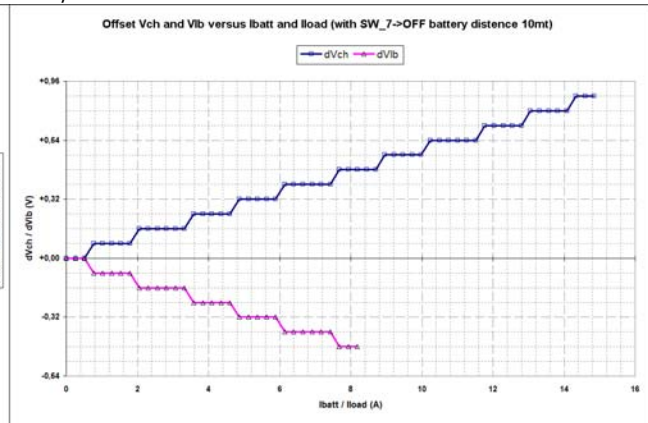
Fig. 2 Wiring scheme



Graph 1



Graph 2



Electric features:

		12V battery nominal voltage			24V battery nominal voltage		
		Min	Typ	Max	Min	Typ	Max
Battery voltage	Vbatt	10V	12V	17V	20V	24V	34V
Open circuit voltage	Vpan	20V		100V	40V		100V
Panel Current	Ipan			13,5A			13,5A
Max panel current	Pmax			225W			450W
Load output voltage	Vload	-	Vbatt	-	-	Vbatt	-
Load current	Iload	-	-	8A	-	-	8A
Recharge voltage at 25°C	SW_6->SEAL SW_6->FLOOD	Vch	14.44V 14.88V			28.88V 29.76V	
Vch compensation according to battery temperature (Tbatt) (see Graph 1)		Vtadj	-	24mV/°C	-	-	48mV/°C
Low battery voltage SW_5->ON	SW_7->ON SW_7->OFF	Vlb	-	12.00V 11.52V	-	-	24.00V 23.04V
Vch compensation with SW_5->OFF (see Graph 2)		Vremch		+58mV/A		+58mV/A	
Low battery output voltage at 25°C		Vout_lb	-	Vch-0,24V	-	-	Vch-0,48V
Vlb compensation with SW_5->OFF (see Graph 2)		Vremlb		-58mV/A		-58mV/A	
Voltage detection of day (settable)		Vday	-	6.88V	-	-	11.36V
Voltage detection of night: Vnight = Vday -0.8V		Vnight	-	4.48V	-	-	8.96V
Auto -consumption		Iqsc		12.7mA			17,7mA
Ambient Operating Temperature		Tamb	-10°C		40°C	-10°C	
Protection degree				IP65			IP65
Weight			-	1500 g	-	-	1500 g
Case/box dimensions (mm)				190x165 H100			
Dimensions with cables (mm)				250x165 H100			