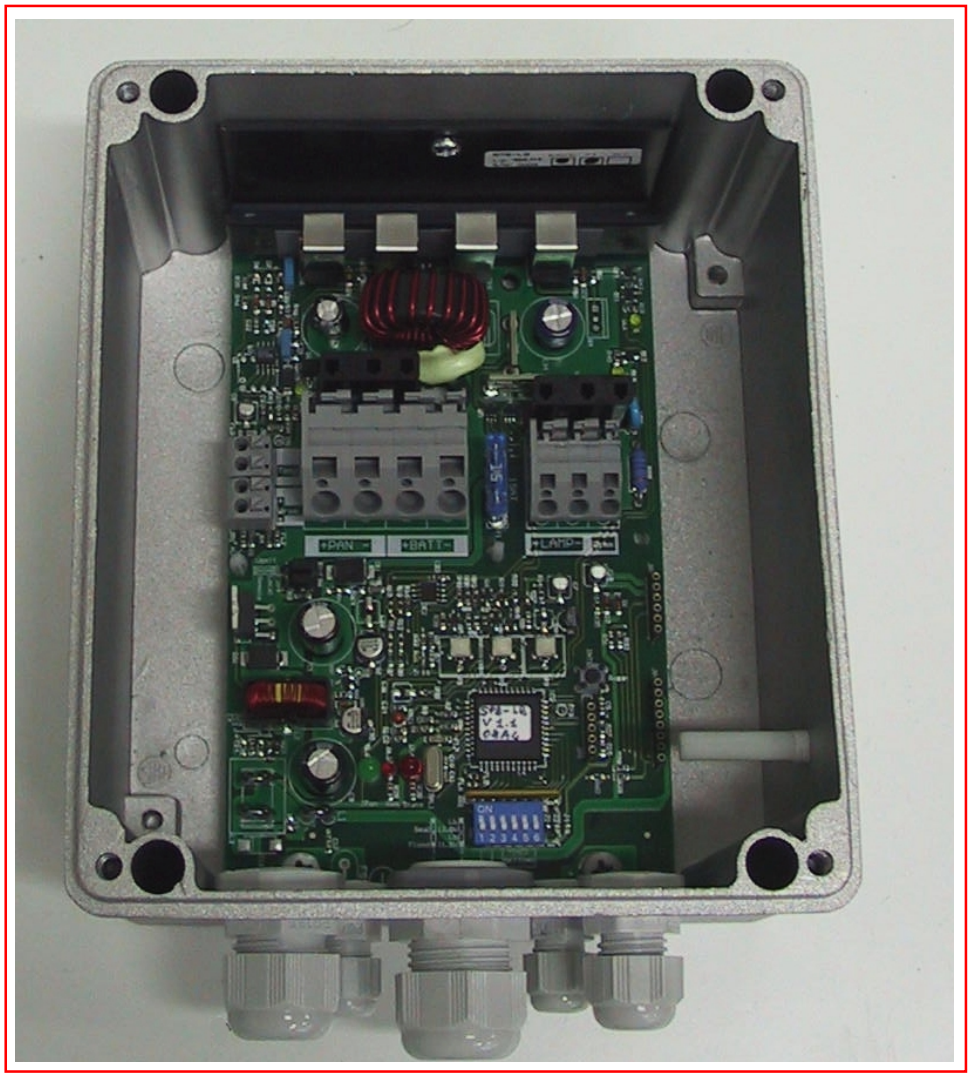
# SPB-LB



## Solar equipment for public lighting

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**How to use the Serial Number**

SPB-LB is identified by a Serial Number (SN) which is put on the label in the external side of the metallic box.
In the main offices of Western CO. snc Serial Numbers are registered in proper files.
In case of communications concerning SPB-LB or in case of coming back to the seller/distributor or at Western CO. snc for any reason, always take note of the Serial Numbers of each SPB-LB and communicate them together with explanation of the case; write the serial number in the delivery notes and in warranty documents which have always go with the products.

SPB-LB is produced in two different version of nominal DC battery voltage: 12Vdc and 24Vdc. The writing "12Vdc" or "24Vdc" is put on the external label, in order to distinguish the different nominal tensions. In this handbook we will indicate SPB-LB12 and SPB-LB24 the two produced different, while we will indicate SPB-LB when we want to refer to both the versions.

**fig. 1: SPB-LB box**

**SPB-LB features:**

- Recharge system for 12v (SPB-LB12) or 24v (SPB-LB24) Pb batteries.
- **Flooded lead acid/sealed** Pb battery selectable type.
- Microcontroller system.
- Mosfet components.
- **MPPT** recharge.
- SMT technology.
- Max recharge current: **10A** continuous.
- Max current from panels: **10A**.
- Integrated blocking-diode.
- Integrated light sensor (with photovoltaic module).
- Activation: **light sensor + timer + time-table programming**
- Time-table programming can be set through switch.
- Load activation in "reduced flux" mode to save energy.
- Battery recharge with compensation in temperature.
- Control of remote battery voltage.
- Low battery control.
- Double voltage threshold of low battery and end of low battery condition, set through switch.
- Western Enhanced switching recharge system which improves modules' performances.
- Kind of battery (sealed or ad flooded lead acid) can be set through switch.
- LED for state indication of charge/batteries.
- Control LED for charge current.
- Over-temperature protection.
- Overload protection.
- PV module working nominal voltage: 12Vdc (SPB-LB12) or 24Vdc (SPB-LB24).
- IP67 waterproof metal box for outdoor application.
- Easy cabling

**General Description**

SPB-LB charge regulator has been planned to be used PV stand alone systems with batteries for use in lighting field.
The circuit has got a switching system with microcontroller for recharge of **sealed or flooded lead acid** 12Volt/24Volt (according to the version SPB-LB12 or SPB-LB24) Pb batteries and search of the MPPT maximum power point of PV modules (switching Western Enhanced for a maximum exploitation of efficiency during recharge phase). A temperature sensor (which must be installed as near as possible to the battery) allows to adapt the recharge voltage to the variations of environment temperature as reported in the graphic at he end of this manual. This guarantees the best use of battery even in conditions of large thermal excursions and make SPB-LB charge regulator suitable for outdoor applications. The recharge circuit needs to measure the battery voltage but, owing to the voltage drop on cables that connect regulator and battery, such measure is as more distorted as longer are the cables. For this reason there is an auxiliary input for the revelation of remote battery voltage that we advise to connect id the cables' length between SPB-LB and battery is > of 1.5 metres. All these expedients guarantee an optimum recharge and, therefore, a maximum life duration of the battery.
SPB-LB controls a 12V (SPB-LB12) / 24V (SPB-LB24) output to which you can connect a lamp. We advise to use high efficiency lamps as, for instance, the sodium low pressure lamps (models SOX- E XX ): we remember that such lamps cannot be connected directly to the 12V/24V output of SPB-LB but that they need an electronic ballast that is usually put inside the lamp-holder (see model SOX 18-36 produced by Western CO. snc). The output that power supplies the lamp is on at dusk (the light sensor is through the PV module, there is not the need of external light sensors) for a programmable time through a proper dip-switch. The load is automatically deactivated in low battery condition; The voltage threshold for recognizing of low battery is double and it can be set as well as the threshold for output from low battery state.
SPB-LB regulator can turn on the lamp with reduced luminosity; this occurs by Dimm output that on activation signals to the external ballast circuit to reduce the lamp luminosity. This function allows to preserve energy which is stored inside the batteries during the hours when a lesser lighting in requested.

Easy connection terminal block (no screws model "cage clamp") make an easy cabling with cables having section until 6mm$^2$ while the waterproof box make the system extremely resistant to bad weather.
The regulator is protected from over-temperatures and from overload on output.

## Cabling scheme:

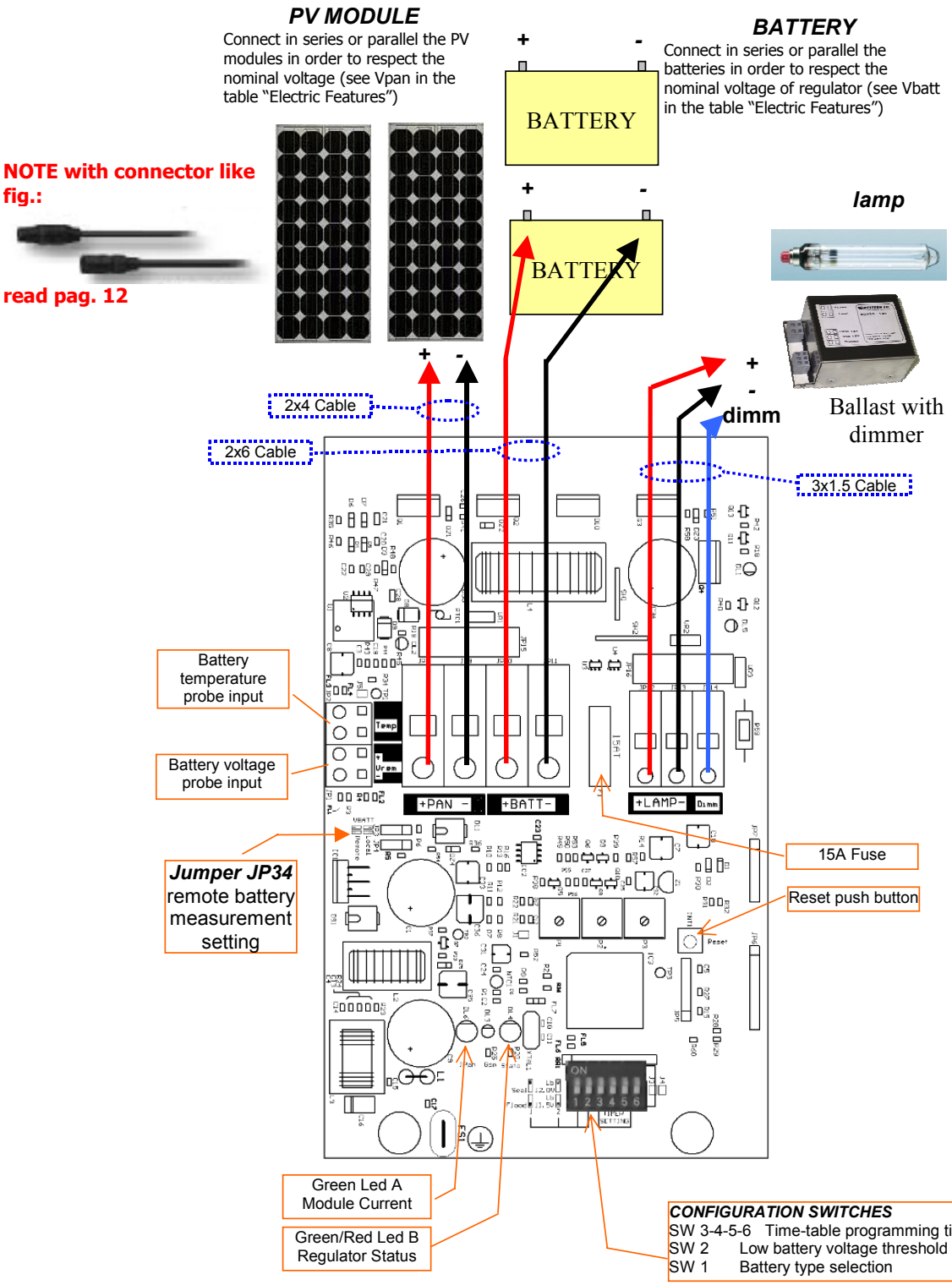
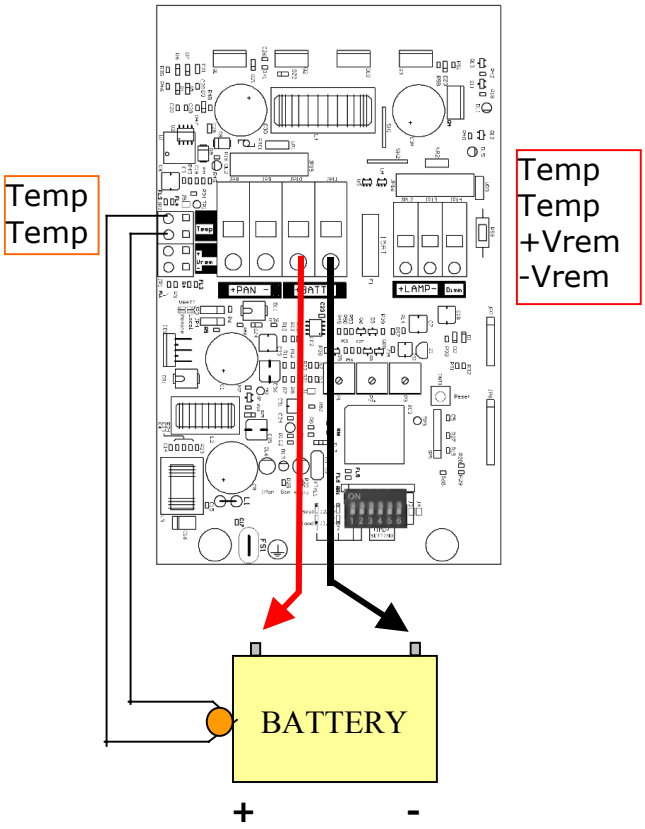



**Fig. 1**

**Fig. 2- Cable inserting into the terminal block**

**Battery cabling scheme:**

**Battery placed at a distance < of 1.5mt**




**Battery placed at a distance > of 1.5mt**

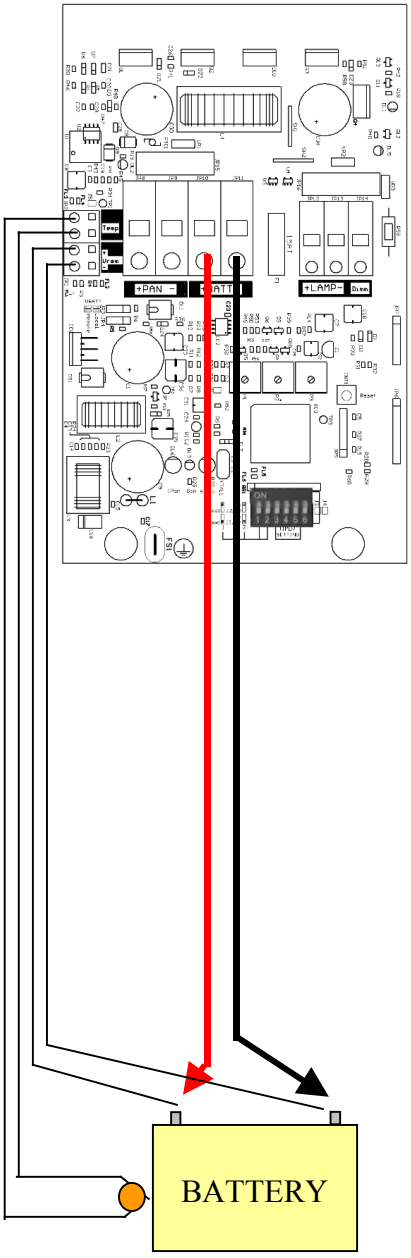
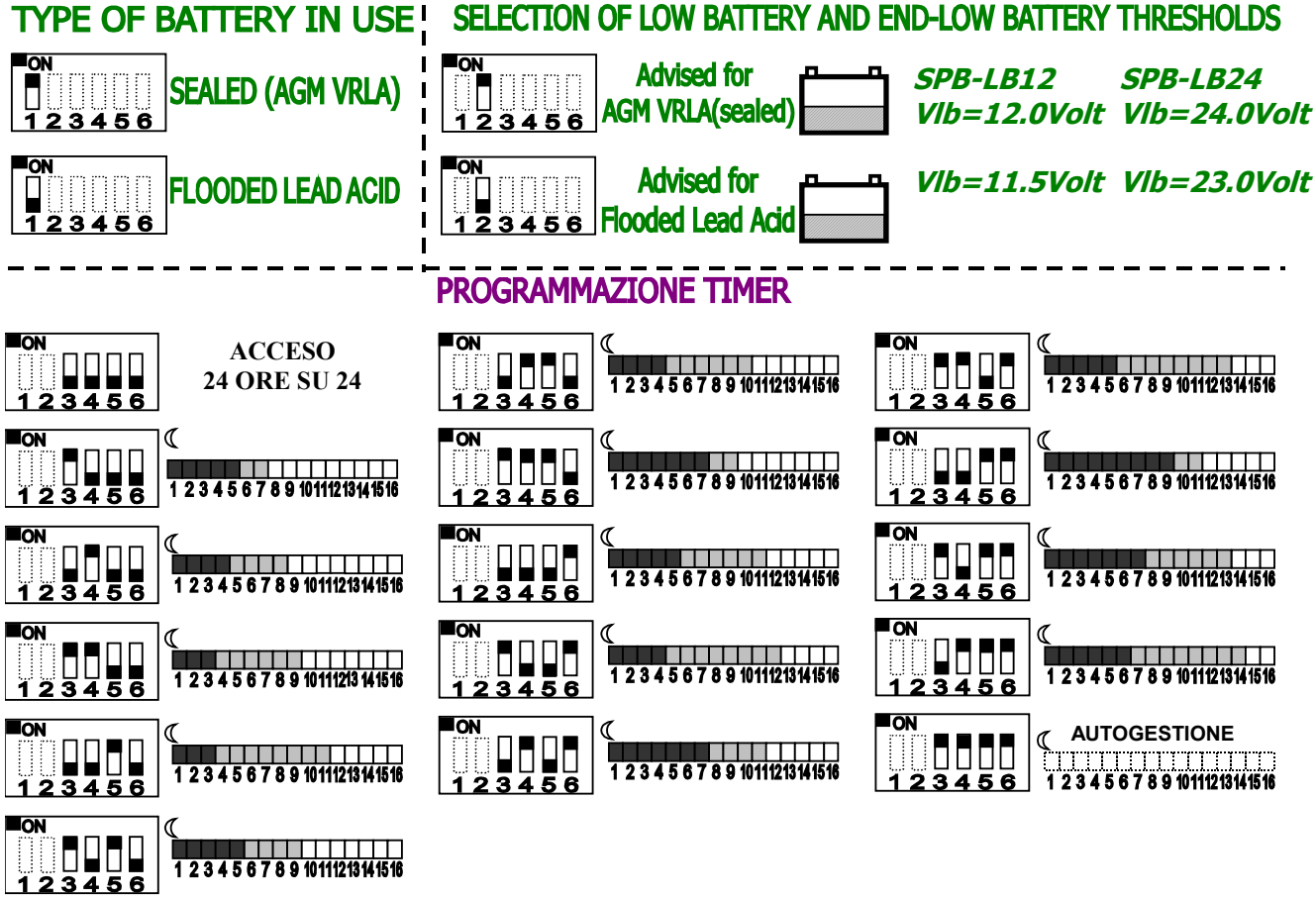



**Fig. 3- Scheme of cabling remote batteries.**

## Programming:

Follow the indications of page 4 for dip-switch setting.

**Fig. 4: Programming (with the dark timer time-table programming the lamp turns on, in the white ones the lamp turns off, in the ones with shading the lamp has got flux reduction).**




With auto-management configuration, SPB-LB regulator will set 12 hours, related to the average energy which is daily stored inside the battery same hours flux reduction e other at maximul flux; in summer increses the number of hours at maximum flux and in winter reduce the number of hours at maximum flux.

**Table 1: Timer advised setting for timer with particular configuration: PV module-lamp-battery with the best orientation**

| | NORTHERN Italy | CENTRAL Italy | SOUTHERN Italy |
|---|---|---|---|
| **ADVISED TIMER with:**<br>**- 150Wp PV module**<br>**- SOX-E 26W lamp**<br>**- 12V 200Ah battery** | ⩽ 7h | ⩽8h | ⩽ 9h |
| **ADVISED TIMER with:**<br>**- 150Wp PV module**<br>**- SOX-E 26W lamp**<br>**- 24V 100Ah battery** | ⩽ 7h | ⩽8h | ⩽ 9h |

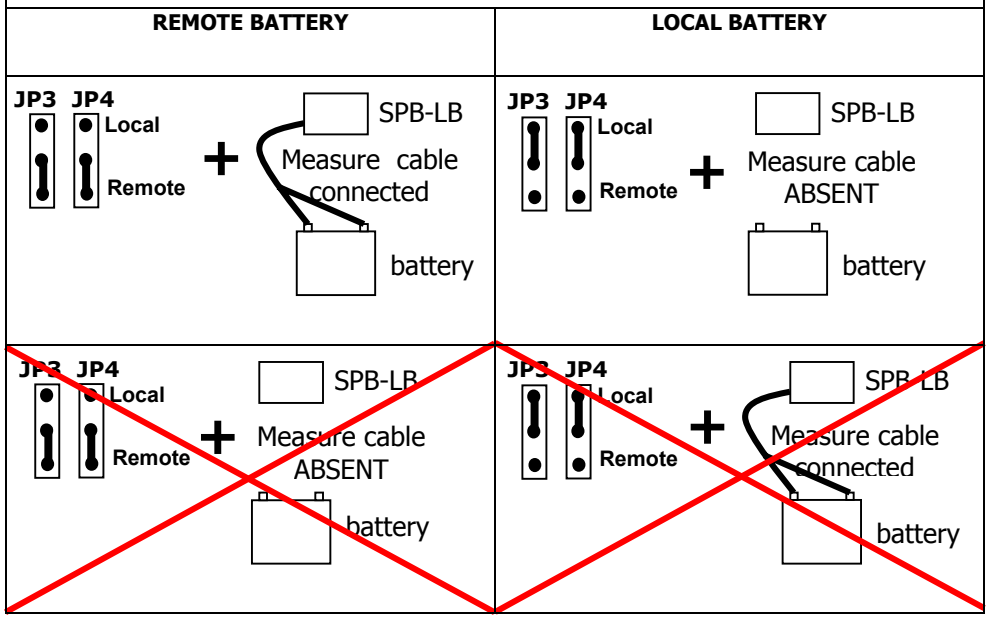
## Remote battery:

If the battery is at the bottom of the pole or at a distance > of1.5m from the regulator there is a distorted reading of its voltage owing to drops on the power supply cables. The circuit allows to solve this problem by measuring the battery voltage with a proper additional signal cable (Optional – not standard supplied - code NTCBAT10). To work with remote battery follow the following steps:

- **Place JP 3 and 4 jumpers in "Remote" position** (as shown in fig. 5)
- (Caution to polarities!) Connect the signal cable to the +Vrem - Vrem terminal block of battery voltage remote measure (see fig. 3) and bring the other end until the battery terminal blocks.
- NOTE: if the cable of remote battery measure is ABSENT, JP 3 and 4 jumpers must be in "Local" position!

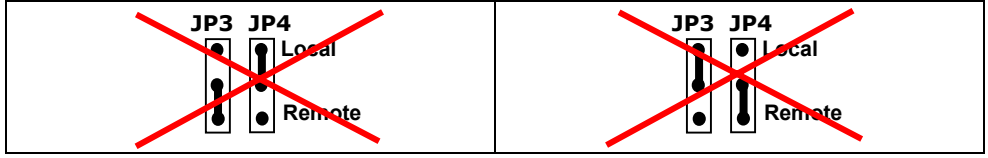
NOTE: if you do not actuate the measure of remote battery you have a lesser battery discharge owing to the distorted measure of voltage in the discharge phase. There is the risk to reach before the low battery state and the lamp activation is shorter. Another consequence is a slowing in the reaching of end-charge voltage.

**Fig. 5: Remote battery setting**




WARNING: if you DON'T connect the remote battery cable and JP3 - JP4 jumpers are on "Remote" the circuit risks of being DAMAGED (left cross in fig. 5); if you connect the remote battery cable and JP3 - JP4 jumpers are on "Local" the circuit risks of being DAMAGED (right cross in fig. 5).
If the terminals of the remote battery cable go in short-circuit the circuit risks of being DAMAGED.

**Fig. 6: WRONG SWITCH CONFIGURATIONS REMOTE/LOCAL BATTERY**




## Circuit mounting procedure:

- Assemble the mechanic part (cement basement, pole, support of panels, photovoltaic modules, lamp-bracket, lamp-holder, batteries in underground basement or windy and sunrays-protected cabinet on the base of the pole).
- Fix SPB-LB box to the structure of the PV street-lamp by using the regulator's holes (WESTERN CO. PV street-lamps have got predisposed holes inside the top-of-pole mounting structure). Note: the holes which are already on the corner of SPB-LB box are waterproof when the cover is properly closed with the original packing. **DO NOR PERFORATE** the box for any reason!
- Set on the ***CONFIGURATION SWITCH*** (see fig. 1 and 4) the kind of battery in use; if you use a AGM/VRLA SEALED battery put lever 1 in ON position; if you use a FLOODED LEAD ACID battery put level 1 in OFF position; eventual **modifications** during the apparatus working become **operative only after RESET**.
- Set on the ***CONFIGURATION SWITCH*** (see fig. 1 and 4) the low battery threshold and the threshold of output from low battery that you want to use:
  **Lever 2 in ON** position if you prefer to extend the life of battery which will be discharged maximum of about 40% if AGM VRLA SEALED and of about 20% if FLOODED LEAD ACID; the end of the low battery state will occur when the battery will be recharged almost completely; this configuration is advised for AGM VRLA SEALED batteries.
  **Lever 2 in OFF** if you prefer to discharge more the battery to increase the number of days of lamp activation in case of unfavourable climate at a loss of the useful life of battery which will be discharged maximum of about 70% if AGM VRLA SEALED and of about 50% if FLOODED LEAD ACID; the end of the low battery state will occur when the battery will not be yet completely charged; this configuration is advised for FLOODED LEAD ACID batteries.

- Before deciding which thresholds you want to use please evaluate well the possible consequences on the useful life of battery; **modifications** during the apparatus working become **operative only after RESET**.
- Program on the **CONFIGURATION *SWITCH*** (see fig. 1 and 4) the hours of lamp activation after the moment of light sensor activation following prospect of fig. 4 where the dark time-table programming are for turning on and the white ones are for lamp turning off, the grey ones are instead for turning on with flux reduction; a too long lamp turning on brings a swift degradation of the battery. We strongly **advise to set** one of the configurations of **table 1**. The modifications of switches for lamp turning on hours are immediately operative (you DON'T need to RESET).
- Extract the 15A fuse (car's kind - see fig. 1).
- The equipment box is electrically connected to the negative terminal block but **IT CANNOT be used to close the circuit**. So **AVOID ABSOLUTELY** the contact of battery cables and PV modules with the metallic structure of the PV street-lamp (otherwise the circuit is **HEAVILY DAMAGED**). We advise **to isolate the ends** of the cables. (Caution to polarities!)
- With cable having section of 6mm$^2$ (**never go under this section**) cable the battery poles to the correspondent +BATT e -BATT terminal block of the equipment. If you use two batteries of 12V nominal voltage, you have to connect in series with SPB-LB24 or in parallel with SPB-LB12 regulator. **It is obligatory to respect the nominal battery voltage of regulator reported in the table "Electric Features" of this handbook.**
- Insert 3 and 4 jumpers in "local" position if you work with LOCAL battery (distance regulator-battery **< 1.5m**); Insert i 3 and 4 jumpers in "remote" position if you work with REMOTE battery (distance regulator-battery **> 1.5m**).
- (Caution to polarities! Avoid absolutely short-circuits between terminals!) if you work with remote battery (at the bottom of the pole) connect the signal cable for the measure of remote battery voltage from the +Vrem -Vrem terminal block of the circuit to the battery. Note: the signal cable for remote battery is quadruple with two poles for the battery temperature (NTC) and other two poles for the remote measure of battery voltage (optional cable not standard supplied code NTCBAT10).
- Connect **ALWAYS** the temperature sensor (NTC) to Temp terminal block (see fig. 3).
- Bring the temperature sensor (NTC) to the battery and make it adhere to the battery by assuring an efficient thermal exchange.
- Connect the power supply cables from the lamp to the ballast inside the lamp-holder (see fig. 1)(Caution to polarities!).
- Connect the PV modules to the +PANN –PANN terminal blocks( see fig. 1); if you have more than one single module, you have to connect them in series or parallel in order to respect the module nominal voltage of SPB-LB (see Vpan on table "Electric Features"). We advise to connect the modules in series or parallel directly on the junction box of module and use a single bipolar cable for external use 4 mm$^2$ to connect the +PANN -PANN terminal block of SPB-LB; **DO NOT USE** blocking diodes because it is integrated in SPB-LB circuit.

## System activation:

In the circuit predisposition, power on didn't yet occur. To activate the system follow scrupulously the following procedure:

- Control again the cables polarities!
- Control again that levers 1 and 2 of CONFIGURATION SWITCH have been set per for the kind of battery in use.
- (CAUTION IN MANOEUVRES! Avoid casual contacts on other parts of the circuit); Insert the fuse (15A car's kind) in its housing (see fig. 1); The circuits activates.
- On power on the B LED will have a short red lightning – then it turns off. If PV modules are in the darkness and load activation has been set in the first hour of dusk, output activates and if all is connected properly the lamp will turn on. If PV modules are not in the darkness, but you want to check the lamp activation it is possible to detach temporarily a wire of the module and the lamp will turn on. When you re-connect the module's wire the lamp turns off automatically, after a short delay.
- If PV modules are exposed to sunrays the recharge battery phase begins (you can see it from the LED A power on). The LED A will be as more luminous as more current is recharging the battery.
- **If you do not respect all above mentioned, you risk to DAMAGE the circuit (see fig. 5).**
- Usually the timer will begin the computation with the light-sensor signal and the lamp will be activated according to the time-table programming which have been set on the CONFIGURATION SWITCHES of the timer, or until dawn or until the reaching of low battery threshold.
- Close well the waterproof box putting in the proper way the packing of the cover and closing/fixing the cable; control periodically the state. **Eventual damages caused by humidity penetration inside the box will not be repaired in warranty**.

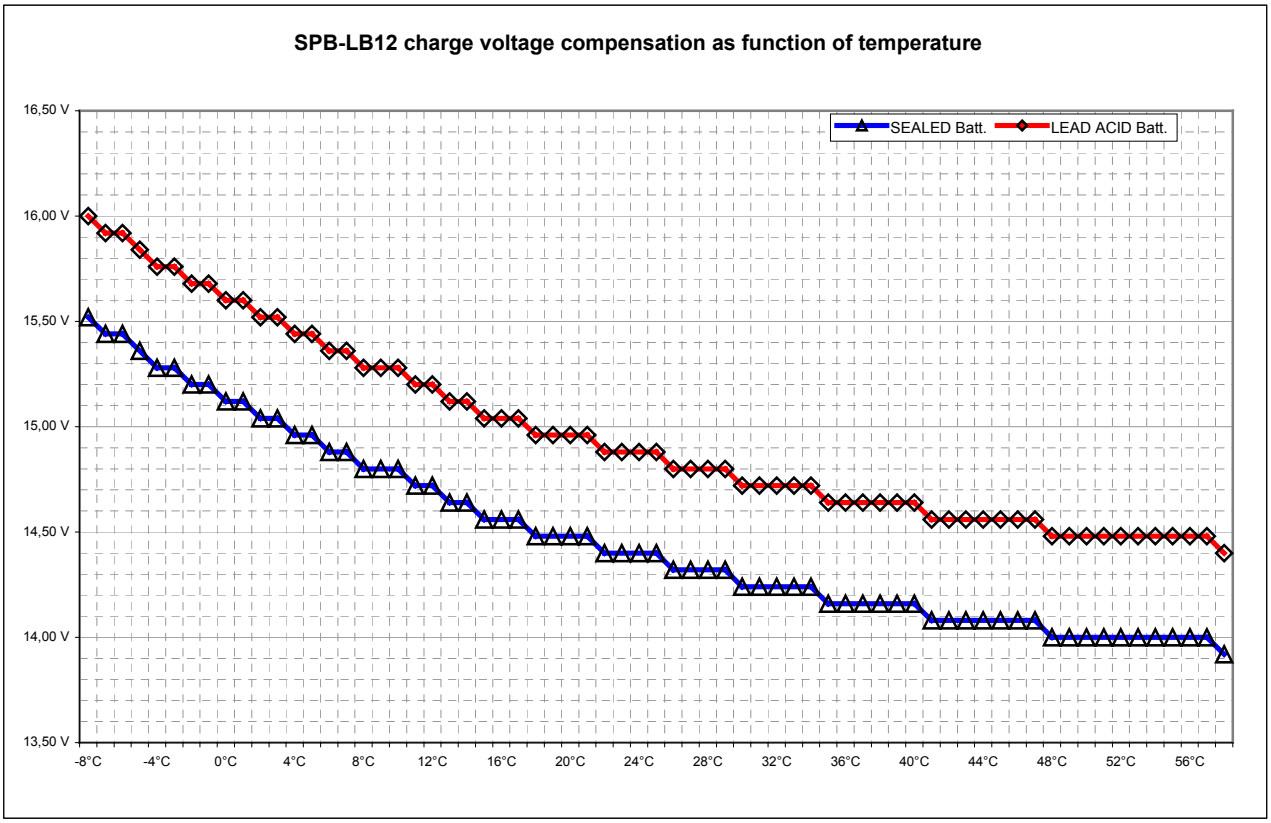
Lamp deactivation occurs with the following priority: Discharged battery (priority above all) – Dawn – Timer

**Anomalous behaviours:**

**Signalling of B LED – Condition of the charge regulator**

| Noticed behaviour | Interpretation | Remedy |
|---|---|---|
| On activation the B LED (red) "Status" lightens to the bitter end ONCE every 2 seconds. | Low battery condition; the battery is discharged and all outputs are de-activated | Wait the battery recharging. |
| On activation the B LED (red) "Status" lightens to the bitter end TWICE every 2 seconds. | Overload condition; outputs are deactivated for 2 minutes – after 2 minutes you can try to reactivate the load. If overload condition continues, every 2 minutes you have an attempt of reactivation until a maximum of 3 attempts. After that, the next attempt of power on will happen the next night. | Control the output (cables, lamps, and so on) and remove possible cause of overload. An end-life lamp can cause overload. |
| On activation the B LED (red) "Status" lightens to the bitter end THREE TIMES every 2 seconds. | Over-temperature condition. | Place the charge regulator in another place which is fresher. |
| At dusk the lamp does not turn on. | If the battery is new, the PV module could be particular and give signal in input to the regulator even in darkness condition. | Modify the dark revelation voltage of twilight. |
| At dusk the lamp does not turn on. | The battery is discharged for a long period without sun. | Wait the sun to recharge the batteries. |
| At dusk the lamp does not turn on. | The lamp is exhausted or the cable is interrupted. | Control cable and lamp and replace the degraded component . |
| At dusk the lamp does not turn on. | After some working years the battery is naturally exhausted and not recharge anymore. | Replace the battery. |
| The lamp lighting time in shorter than the programmed. | The battery is discharged. | Wait the sun to recharge the batteries. |
| The lamp lighting time in shorter than the programmed. | The battery is not charged enough. | Control if the cabling of PV modules has been interrupted somewhere. |
| The lamp lighting time in shorter than the programmed. | After some working years the battery is naturally exhausted and it lost its capacity. | Replace the battery. |
| The system does not reactivate after a long period of storage and/or inactivity. | The battery suffered auto-discharge and/or it has been stored in discharged condition for long time; as a consequence it exhausted. | Try to recharge the batteries with battery charger from grid; in negative case replace the battery. |

## Curve of charge voltage:



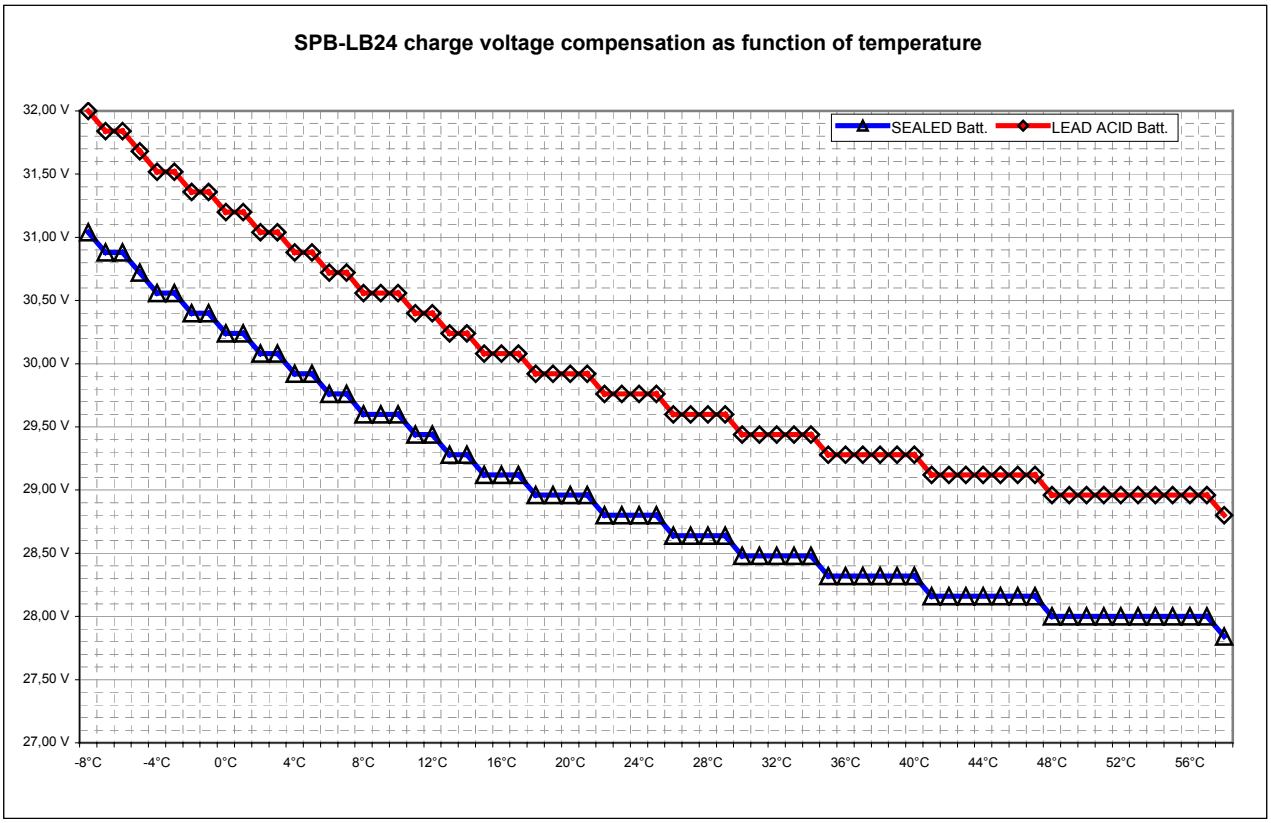




**Fig. 8: Curve of battery charge voltage compensation as function of temperature.**

## Electric features:

| | | | SPB-LB12 | | | SPB-LB24 | | | |
|---|---|---|---|---|---|---|---|---|---|
| **FEATURES** | **SYM.** | **CONDITION** | **MIN.** | **TYP.** | **MAX.** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| DC power supply (Battery)<br>Working voltage<br>Working current | <br>VDD<br>IDD | no load, no modules | <br>7.5<br>12 | <br>12<br>20 | <br>15<br>25 | <br>15<br>12 | <br>24<br>20 | <br>30<br>25 | <br>V<br>mA |
| Voltage of PV modules | VPAN | | 0 | 17.2 | 21 | 0 | 34.4 | 42 | V |
| Current of PV modules | IPAN | | 0 | 10 | 12[1] | 0 | 10 | 12[1] | A |
| Nominal Battery Voltage | Vbatt | | | 12 | | | 24 | | V |
| Low Battery threshold | VLB | For at least 5sec. with SW 2 ON<br>For at least 5sec. with SW 2 OFF | <11.8<br><11.3 | <12.0<br><11.5 | <12.2<br><11.7 | <23.6<br><22.6 | <24.0<br><23.0 | <24.4<br><23.4 | V<br>V |
| End-Low Battery threshold | VELB | with SW 2 ON<br>with SW 2 OFF | Vch-0.31<br>Vch-1.15 | Vch-0.36<br>Vch-1.2 | Vch-0.41<br>Vch-1.25 | Vch-0.62<br>Vch-2.30 | Vch-0.72<br>Vch-2.40 | Vch-0.82<br>Vch-2.50 | V<br>V |
| Recharge voltage for AGM/VRLA SEALED batteries | VCH | Battery temperature 25°C ±2°C | 14.30 | 14.40 | 14.50 | 28.60 | 28.80 | 29.10 | V |
| Recharge voltage for FLOODED LEAD ACID batteries | VCH | Battery temperature 25°C ±2°C | 14.78 | 14.88 | 14.98 | 29.66 | 29.76 | 29.96 | V |
| Efficiency | η | | 86 | 95 | 98 | 86 | 95 | 98 | % |
| Voltage compensation in temperature | VTadj | [2] TBATT>=-8°C<=60°C | - | -22 | - | - | -44 | - | mV/°C |
| Light-sensor threshold (for ON load) | Vlsoff | | 4.4 | 4.5 | 4.6 | 8.8 | 9.0 | 9.2 | V |
| Light-sensor threshold (for OFF load) | Vlsoff | | 6.7 | 6.9 | 7.0 | 13.6 | 13.8 | 14.0 | V |
| Working environment temperature | TA | | -10 | - | 60 | -10 | - | 60 | °C |
| Section of cables from PV modules | - | | 2.5 | 4 | 6 | 2.5 | 4 | 6 | $mm^2$ |
| Section of cables towards batteries | - | | - | 6 | - | - | 6 | - | $mm^2$ |
| Section of cables towards load | - | | - | 1.5 | 4 | - | 1.5 | - | $mm^2$ |
| Peak current on lamp output | Ilpk | <2s | - | - | 10 | - | - | 10 | A |
| Maximum current on lamp output | Ilamp | | - | - | 7 | - | - | 7 | A |
| Current protection threshold | Iprot | | - | 8.0 | - | - | 8.0 | - | A |
| Voltage on lamp output[3] | Vlamp | | - | Battery voltage | - | - | Battery voltage | - | V |
| Re-activation time after overload | ΔTol | | | 2 | | | 2 | | minutes |
| Minimum duration external lighting to turn off the lamp | ΔT | | | 5 | | | 5 | | seconds |
| Software version | sw | | | 1.1 | | | 1.1 | | |

[1] – Internal temperature <50°C.
[2] – Regulation effected at steps of 6°C.
[3] – It is the battery voltage, so it has got the same excursion than the battery voltage.

## Mechanic dimensions:

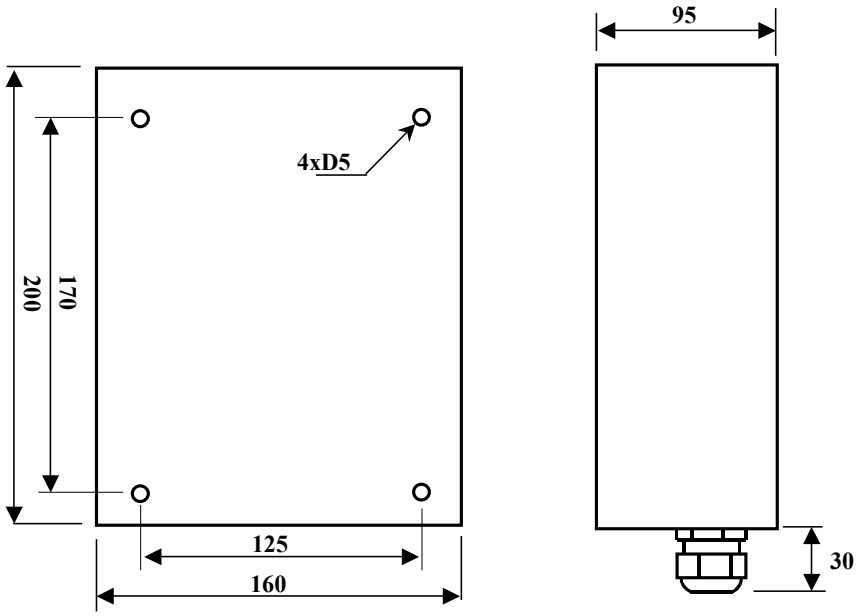



**Fig. 9: Dimensions**

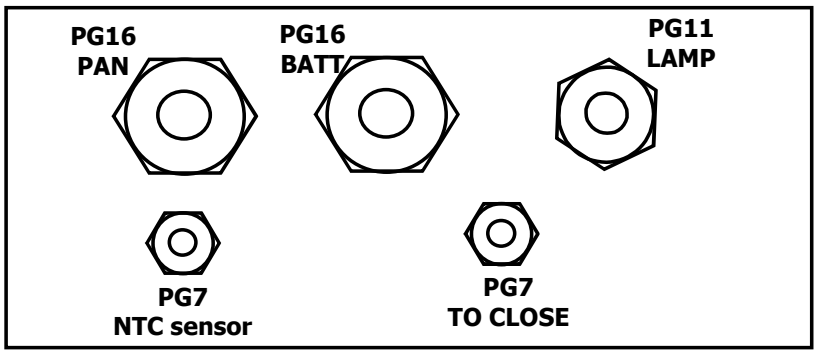



**Fig. 9: Cables passage**

**NOTA: If pannel connecto are like this:**

**We suggest to cut this connector and enter to SPBL-B through PG13.5 and PG7, see to figure on the left.**

## Accessories:

**NTC**

Standard supplied

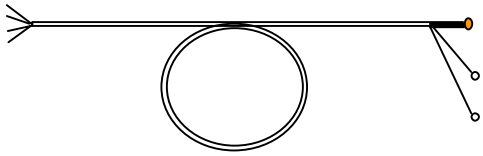
1.5m bipolar signal cable with temperature sensor at the end.



**NTCBAT10**

NOT standard supplied. To be ordered as accessory code NTCBAT10

10m quadripolar cable with temperature sensor and connections to measure the battery voltage at one end.



## Maintenance:

For a right working:

- Program the timer properly to avoid deep discharges of battery.
- Avoid that battery reaches high temperatures; ventilate the batteries' box and avoid direct contact with sunrays.
- Control periodically the health of battery; for flooded lead acid batteries control at least every 6 months and, if necessary, refill with distilled water the batteries electrolyte to cover plates of min. 1cm (NOTE: in a discharged battery the electrolyte has got a lesser volume; please avoid to fill too much to avoid that expansion after charge causes exit of electrolyte).
- Control periodically the health of cables avoiding wear on cutting or abrasive surfaces and also avoiding direct contact with sunrays.
- Keep this manual for future consultations.

**Anomalous behaviours:**
Beyond the particular cases at page 5, the following conditions can occur:

| Noticed behaviour | Interpretation | Remedy |
|---|---|---|
| At sunset the lamp doesn't turn on. | The battery is discharged owing to a too long period of NO sun. | Wait for the sun to recharge the battery. |
| At sunset the lamp doesn't turn on. | The lamp is exhausted or cable has been interrupted. | Control cable and lamp and replace the broken component. |
| At sunset the lamp doesn't turn on. | After some years of working the battery is naturally exhausted and it doesn't recharge any more. | Replace the battery. |
| The lamp's turning on is shorter than the programmed time. | The battery is discharged. | Wait for the sun to recharge the battery. |
| The lamp's turning on is shorter than the programmed time. | The battery is at very low temperature and it reduces partially its capacity. | Wait for a higher temperature and capacity will increase. |
| The lamp's turning on is shorter than the programmed time. | Remote battery's voltage is not measured in the right way. | Use the accessory NTCBAT10 cable to measure the battery voltage. |
| The lamp's turning on is shorter than the programmed time. | The battery does not recharge enough. | Control if the modules' cabling has been interrupted somewhere. |
| The lamp's turning on is shorter than the programmed time. | After some years of working the battery is naturally exhausted and it doesn't recharge any more. | Replace the battery. |
| The system does not reactivate after long period of storing and/or of inactivity. | The battery suffered for self discharge and/or it has been stored in discharged condition for a long time; consequently it damaged itself. | Try to recharge the battery with a grid charger; in case of negative result the battery must be replaced. |
| The sealed battery (AGM VRLA) exhales gas or it emits liquid or it swells; the flooded lead acid battery consumes a big quantity of liquid and it exhales gas. | There is not the NTC temperature sensor.<br>The NTC temperature sensor has been damaged.<br>The NTC temperature sensor is not connected in the right way. | Restore the NTC temperature sensor and replace the batteries if they have been damaged. |

## Delivery:

WESTERN CO. snc Via Pasubio 1 63037 San Benedetto del Tronto (AP) - ITALY
tel 0735 751248 fax 0735 751254 e-mail: info@western.it web: www.western.it
Updated version of this manual is at the point "Technical manuals" on web site www.western.it

**Exhausted batteries are highly polluting**
**DO NOT leave them in the environment.**
**Bring them in an authorized collecting centre.**