



# PL system design

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## Introduction

The following system design concepts show a number of typical configurations using PL energy system controllers. There are a lot more possible configurations which cannot all be described here.

It is necessary to follow the instructions for the basic settings of the PL regulator described in the user guide (Time, system voltage, program, and battery capacity).

Detailed instructions for adjusting the settings of the PL controller are described in the PL Reference Manual.

### NOTE

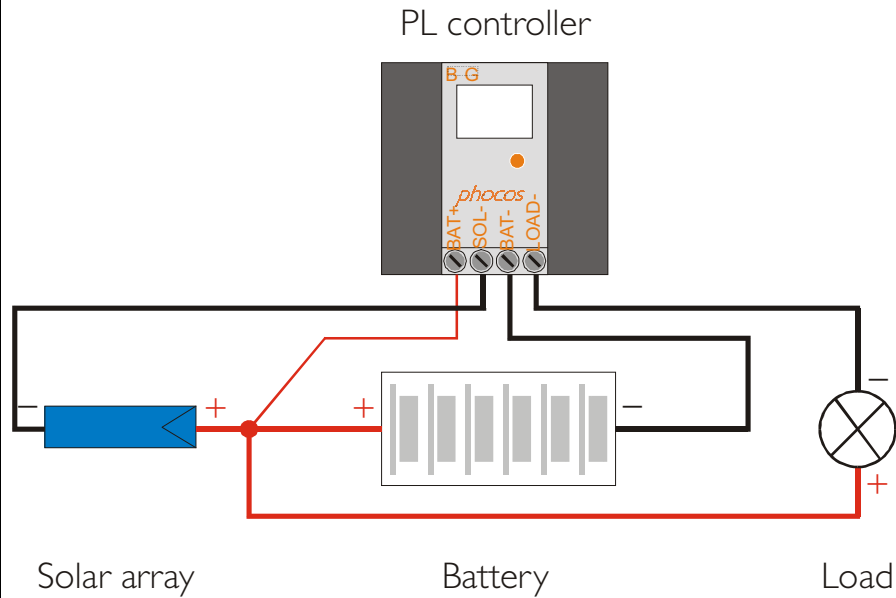
The schematic diagrams are general suggestions and do not necessarily comply with any local safety regulations. Always check these regulations prior to designing a power system.

# I. Standard Solar System

## Description

Standard application for PL regulators in solar systems. Loads will be disconnected by the PL controller to protect the battery from over discharge.

## Schematic diagram



## Special settings

None

## Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

## 2. Solar System with external load current measurement (negative wire)

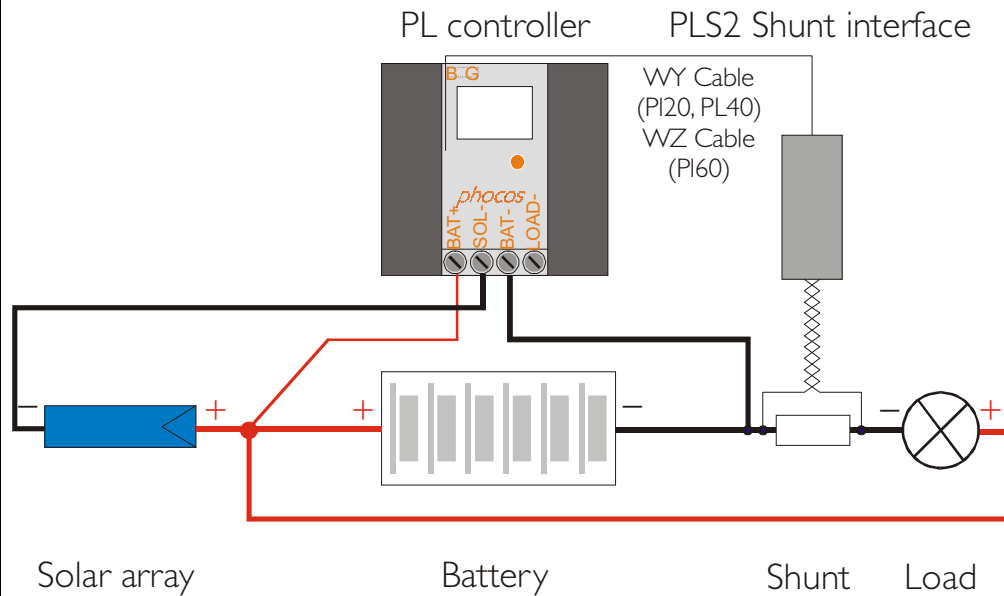
### Description

Standard application for PL regulators in solar systems with inverters. Load is connected directly to the battery. Current is measured by an external shunt and the PLS2 interface.

Deep discharge protection must be handled by the load (inverter).

It is possible to connect other DC loads to the PL controller for deep discharge protection.

### Schematic diagram



### Special settings

None

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Keep sense wires from shunt to PLS2 interface as short as possible.

### 3. Solar System with external load current measurement (positive wire)

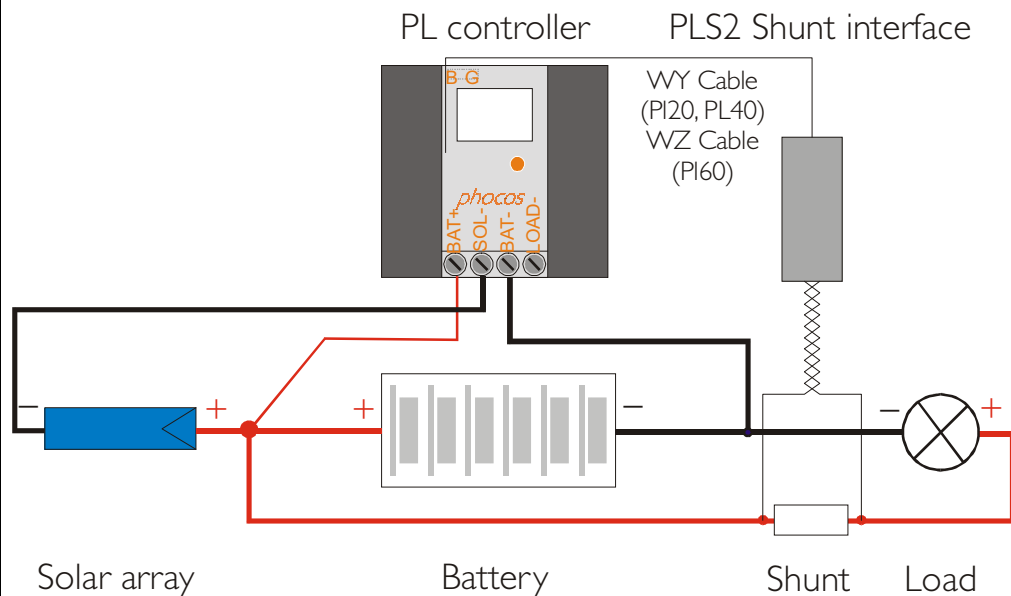
#### Description

Standard application for PL regulators in solar systems with inverters. Load is connected directly to the battery. Current is measured by an external shunt and the PLS2 interface.

Deep discharge protection must be handled by the load (inverter).

It is possible to connect other DC loads to the PL controller for deep discharge protection.

#### Schematic diagram



#### Special settings

None

#### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Keep sense wires from shunt to PLS2 interface as short as possible.

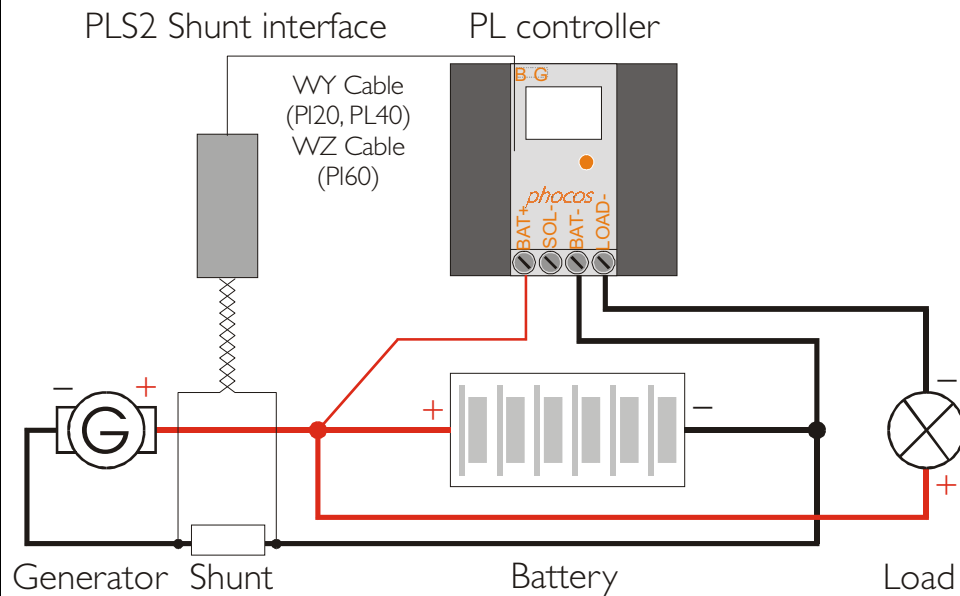
## 4. Power System with external charge current measurement (negative wire)

### Description

Application for PL regulators with power generators that cannot be connected to the SOL terminal (e.g. because of too high current) but should be measured. Current is measured by an external shunt and the PLS2 interface.

Charge control of the generator is done by the generator itself (e.g. generator is a mains battery charger).

### Schematic diagram



### Special settings

None

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Keep sense wires from shunt to PLS2 interface as short as possible.

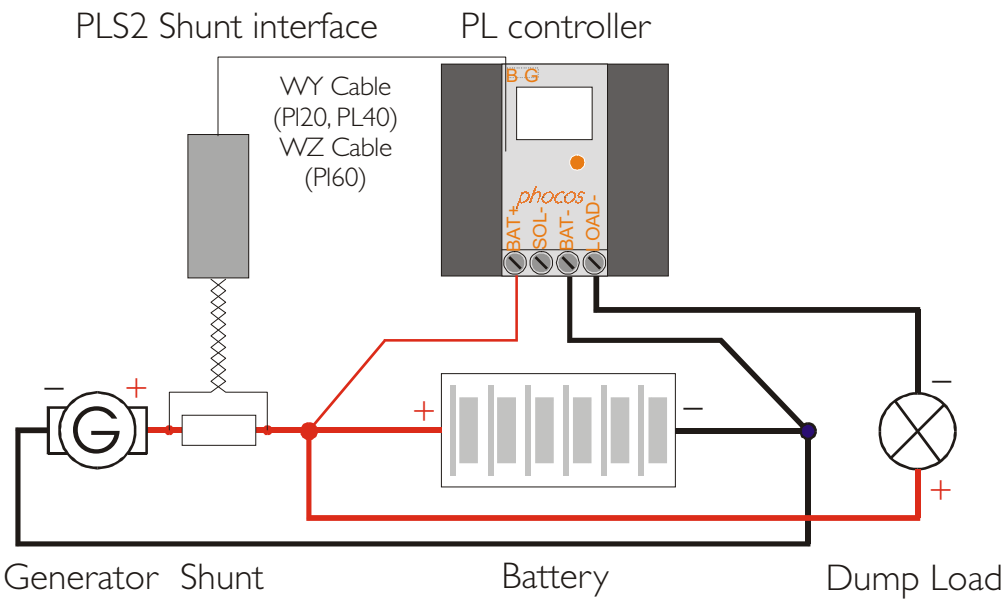
## 5. Power System with external charge current measurement (positive wire)

### Description

Application for PL regulators with power generators that cannot be connected to the SOL terminal (e.g. because of too high current) but should be measured. Current is measured by an external shunt and the PLS2 interface.

Charge control of the generator is done by the generator itself (e.g. generator is a mains battery charger).

### Schematic diagram



### Special settings

None

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Keep sense wires from shunt to PLS2 interface as short as possible.

## 6. Power System with external load and charge current measurement

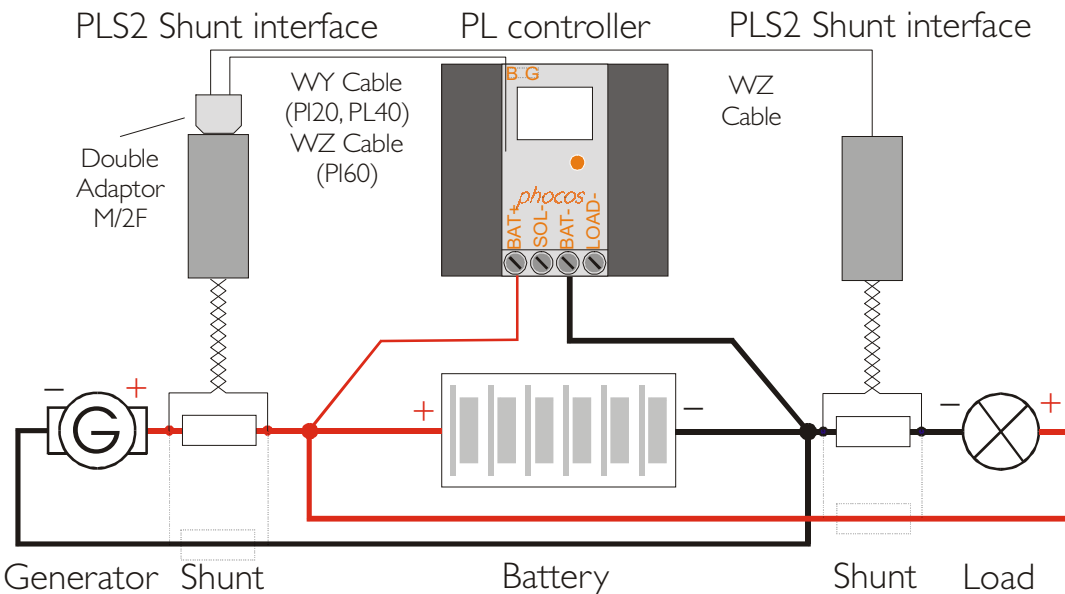
### Description

Application, if both load and charge current needs to be measured externally (both generator and load exceed current limits of the PL controller).

The charge control is done by the generator itself (e.g. generator is a mains battery charger).

Deep discharge protection must be handled by the load (inverter).

### Schematic diagram



### Special settings

Remove jumper from green terminal block of one PLS2 to set it as a slave.

### Additional wiring instructions

Wire from battery+ to BAT+ terminal of the PL controller just supplies the regulator. There is no high current on this wire.

Keep sense wires from shunt to PLS2 interface as short as possible.

Shunts may be connected both to positive and negative wire.

For additional information about connecting two PLS2 interfaces to a PL controller, see PLS2 reference manual.

You may use one PLS2 and one shunt to measure charge and load current together. The reading on the PL will be exactly the same as each PLS2 is bi-directional and sends both charge and load information.

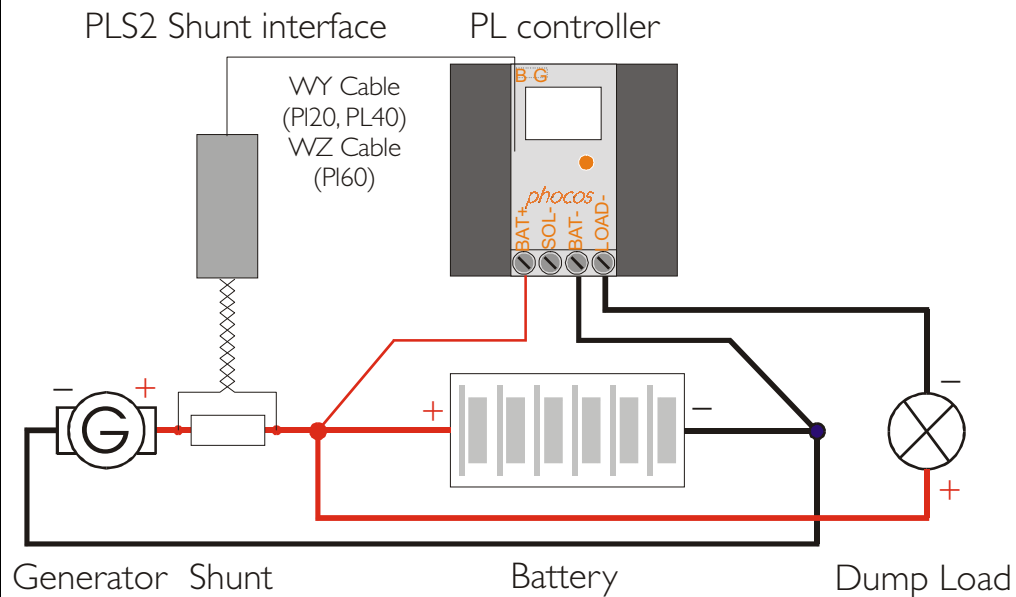
## 7. Power System with PWM Shunt load regulation

### Description

For power generators that do not accept being disconnected from the battery like hydro turbines or wind turbines. Battery regulation is done by the PL controller with the help of a dump load.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

### Schematic diagram



### Special settings

Select program 4: (SET > PROG: 4)

Select Shunt control on LOAD-terminal (SET > MODE > LSET: 10)

Select PWM on LOAD-terminal (SET > PWM: 2 or 3)

Set appropriate charge control parameters (SET > REG > BMAX .... TCMP), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Dump load current must exceed charge current of generator for proper charging control.

**WARNING:** If dump load fails, no charge regulation is possible. Always use extremely reliable dump loads (e.g. a resistor made from mechanically tough resistance wire).

Keep sense wires from shunt to PLS2 interface as short as possible.



## 8. Power System with PWM Shunt load regulation and load disconnect

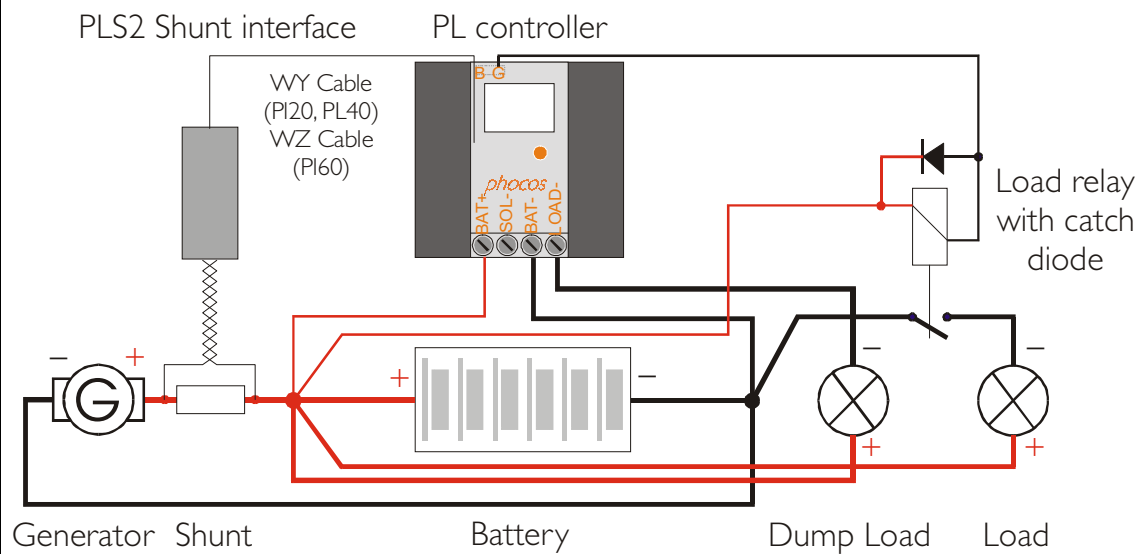
### Description

For power generators that do not accept being disconnected from the battery like hydro turbines or wind turbines. Battery regulation is done by the PL controller with the help of a dump load.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

The load must be switched by a relay, because the LOAD terminal is used for shunt regulation. We choose the load terminal for the regulation task as it is able to use PWM, "G" is not.

### Schematic diagram



### Special settings

Select program 4: (SET > PROG: 4)

Select Shunt control on LOAD-terminal (SET > MODE > LSET: 10)

Select Load disconnect on G-terminal (SET > MODE > GSET: 1)

Select PWM on LOAD-terminal (SET > PWM: 2 or 3)

Set appropriate charge control parameters (SET > REG > BMAX .... TCMP), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Dump load current must exceed charge current of generator for proper charging control.

**WARNING:** If dump load fails, no charge regulation is possible. Always use extremely reliable dump loads (e.g. a resistor made from mechanically tough resistance wire).

Max. relay coil current is 120mA for PL20 and PL40, 300mA for PL60. PL60 has a solid state relay, therefore an additional wire from G- to Bat- is required. Relay must switch system voltage and load current. Catch diode must be fitted.

Keep sense wires from shunt to PLS2 interface as short as possible. A second shunt and a PLS2 interface may be used to measure load current.

## 9. Power System with on/off Shunt load regulation and load disconnect

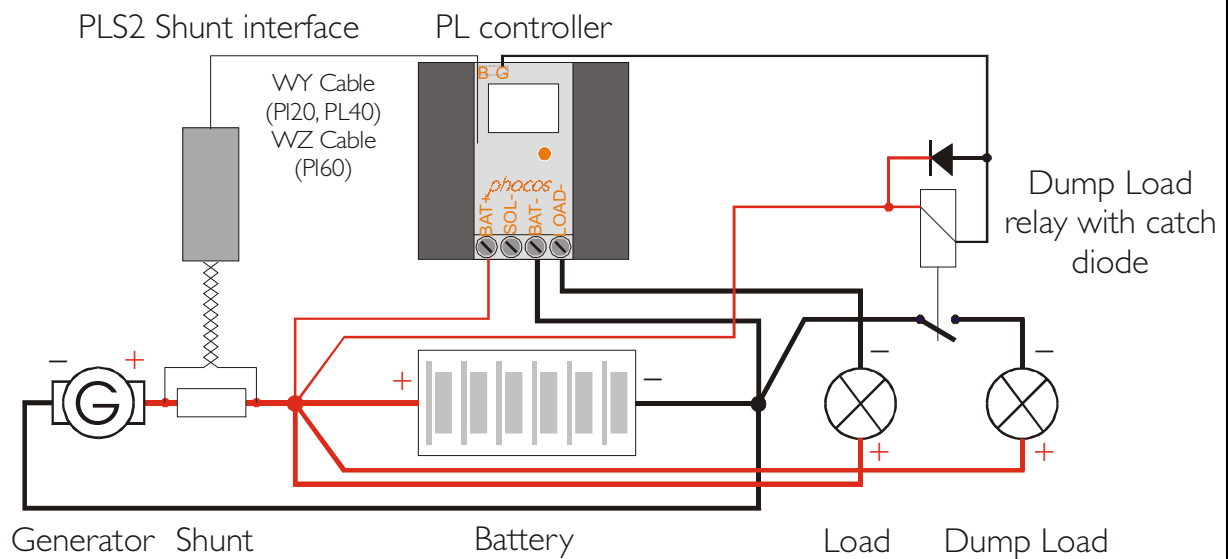
### Description

For power generators that do not accept being disconnected from the battery like hydro turbines or wind turbines. Battery regulation is done by the PL controller with the help of a dump load.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

The dump load must be switched by a relay, because the LOAD terminal is used for load disconnect. We choose the G terminal for the regulation task as we use a shunt load that cannot accept PWM.

### Schematic diagram



### Special settings

Select program 4: (SET > PROG: 4)

Select Shunt control on G-terminal (SET > MODE > GSET: I0)

Select Load disconnect on LOAD-terminal (SET > MODE > LSET: I)

Select PWM on SOL-terminal (SET > PWM: I)

Set appropriate charge control parameters (SET > REG > BMAX .... TCMP), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Dump load current must exceed charge current of generator for proper charging control.

**WARNING:** If dump load fails, no charge regulation is possible. Always use extremely reliable dump loads (e.g. a resistor made from mechanically tough resistance wire).

Max. relay coil current is 120mA for PL20 and PL40, 300mA for PL60. PL60 has a solid state relay, therefore an additional wire from G- to Bat- is required. Relay must switch system voltage and dump load current. Catch diode must be fitted.

Keep sense wires from shunt to PLS2 interface as short as possible. A second shunt and a PLS2 interface may be used to measure load current.

## 10. Hybrid Solar/Wind/Hydro Power System (PWM regulation)

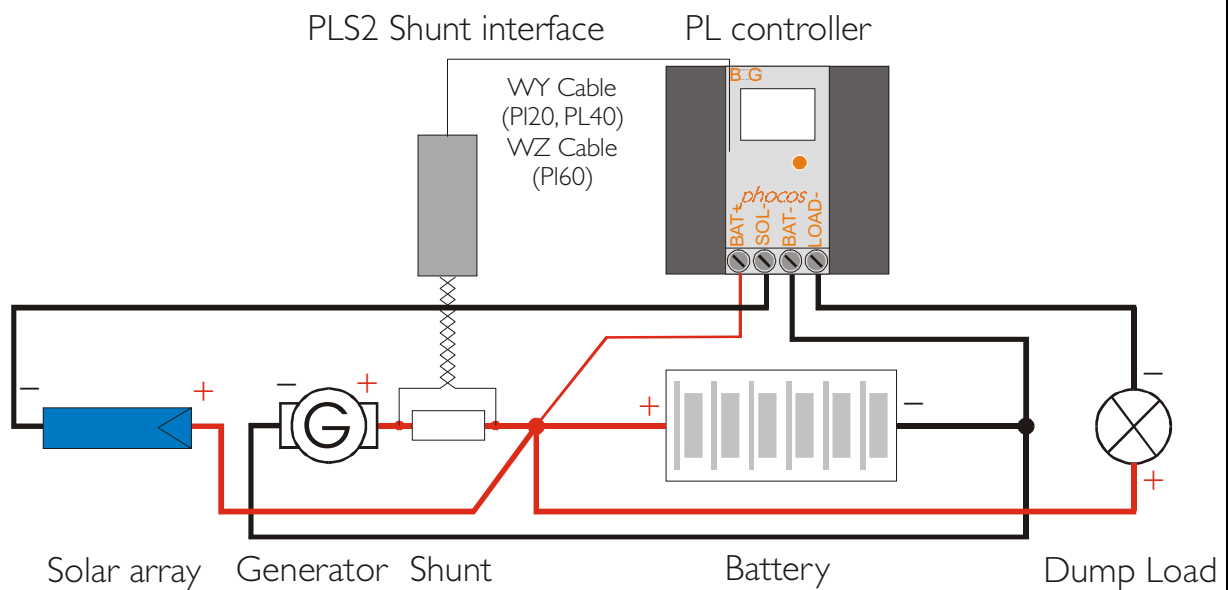
### Description

Hybrid solar system with power generators that do not accept being disconnected from the battery like hydro turbines or wind turbines.

Battery regulation of the generator is done with the help of a dump load.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

### Schematic diagram



### Special settings

Select program 4: (SET > PROG: 4)

Select Shunt control on LOAD-terminal (SET > MODE > LSET: 10)

Select PWM on SOL- and LOAD-terminal (SET > PWM: 3)

Set appropriate charge control parameters (SET > REG > BMAX .... TCMP), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire. Dump load current must exceed charge current of generator for proper charging control.

**WARNING:** If dump load fails, no charge regulation is possible. Always use extremely reliable dump loads (e.g. a resistor made from mechanically tough resistance wire).

Keep sense wires from shunt to PLS2 interface as short as possible. A second shunt and a PLS2 interface may be used to measure load current.

## 11. Hybrid Solar/Wind/Hydro Power System with load disconnect (PWM regulation)

### Description

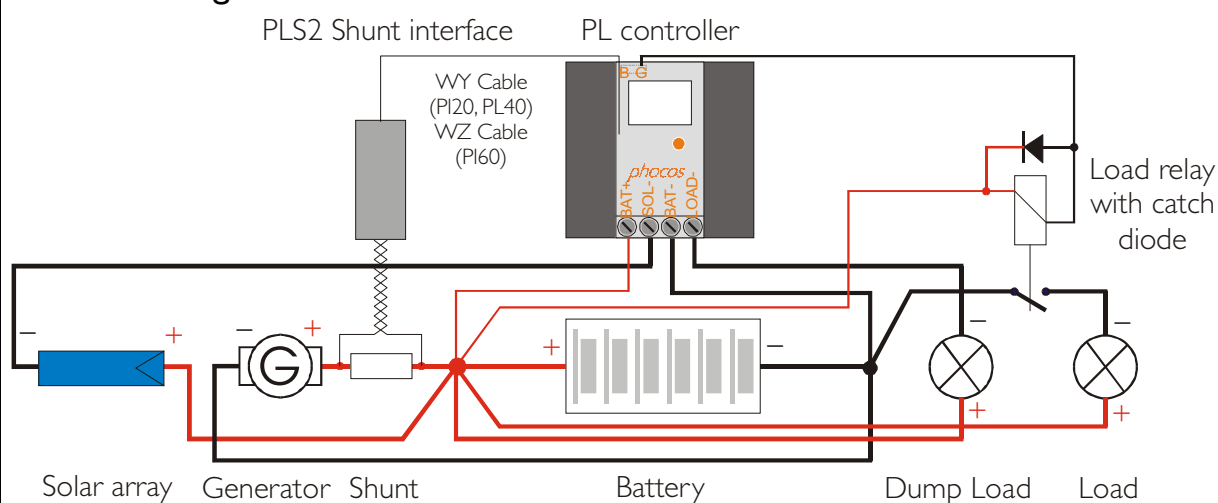
Hybrid solar system with power generators that do not accept being disconnected from the battery like hydro turbines or wind turbines.

Battery regulation of the generator is done with the help of a dump load.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

The load must be switched by a relay, because the LOAD- terminal is used for shunt regulation.

### Schematic diagram



### Special settings

Select program 4: (SET > PROG: 4)

Select Shunt control on LOAD-terminal (SET > MODE > LSET: 10)

Select PWM on SOL- and LOAD-terminal (SET > PWM: 3)

Select Load disconnect on G-terminal (SET > MODE > GSET: 1)

Set appropriate charge control parameters (SET > REG > BMAX .... TCMP), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Dump load current must exceed charge current of generator for proper charging.

**WARNING:** If dump load fails, no charge regulation is possible. Always use extremely reliable dump loads (e.g. a resistor made from mechanically tough resistance wire).

Max. relay coil current is 120mA for PL20 and PL40, 300mA for PL60. PL60 has a solid state relay, therefore an additional wire from G- to Bat- is required. Relay must switch system voltage and load current. Catch diode must be fitted.

Keep sense wires from shunt to PLS2 interface as short as possible.

A second shunt and a PLS2 interface may be used to measure load current.

## 12. Hybrid Solar/Wind/Hydro Power System with load disconnect (on/off regulation)

### Description

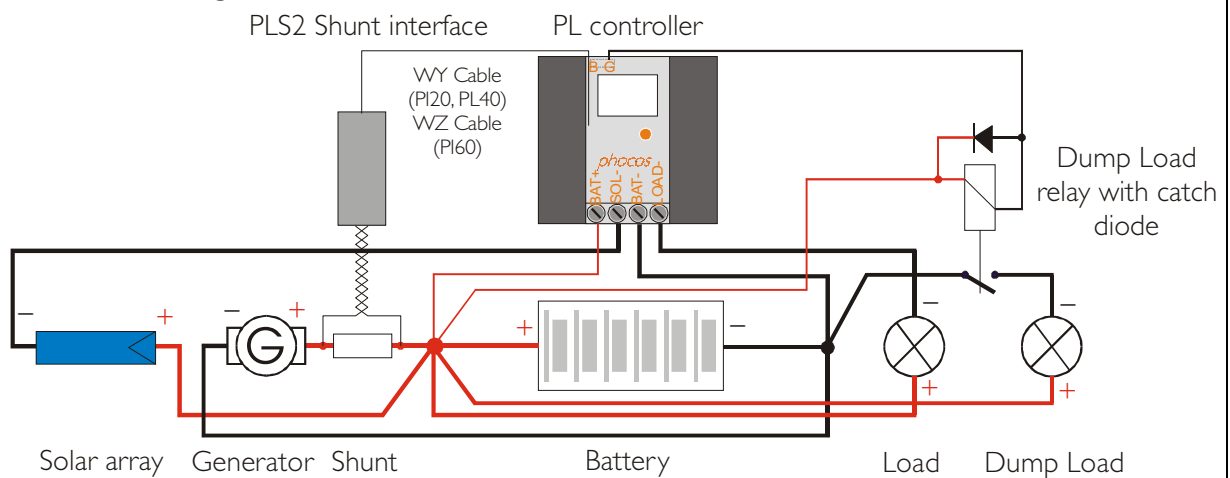
Hybrid solar system with power generators that do not accept being disconnected from the battery like hydro turbines or wind turbines.

Battery regulation of the generator is done with the help of a dump load.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

The dump load must be switched by a relay, because the LOAD terminal is used for load disconnect. We choose the G terminal for the regulation task as we use a shunt load that cannot accept PWM.

### Schematic diagram



### Special settings

Select program 4: (SET > PROG: 4)

Select Shunt control on G-terminal (SET > MODE > GSET: 10)

Select PWM on SOL-terminal (SET > PWM: 1)

Set appropriate charge control parameters (SET > REG > BMAX .... TCMP), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Dump load current must exceed charge current of generator for proper charging.

**WARNING:** If dump load fails, no charge regulation is possible. Always use extremely reliable dump loads (e.g. a resistor made from mechanically tough resistance wire).

Max. relay coil current is 120mA for PL20 and PL40, 300mA for PL60. PL60 has a solid state relay, therefore an additional wire from G- to Bat- is required. Relay must switch system voltage and dump load current. Catch diode must be fitted.

Keep sense wires from shunt to PLS2 interface as short as possible.

## 13. Hybrid Solar and Diesel/Gas Generator System

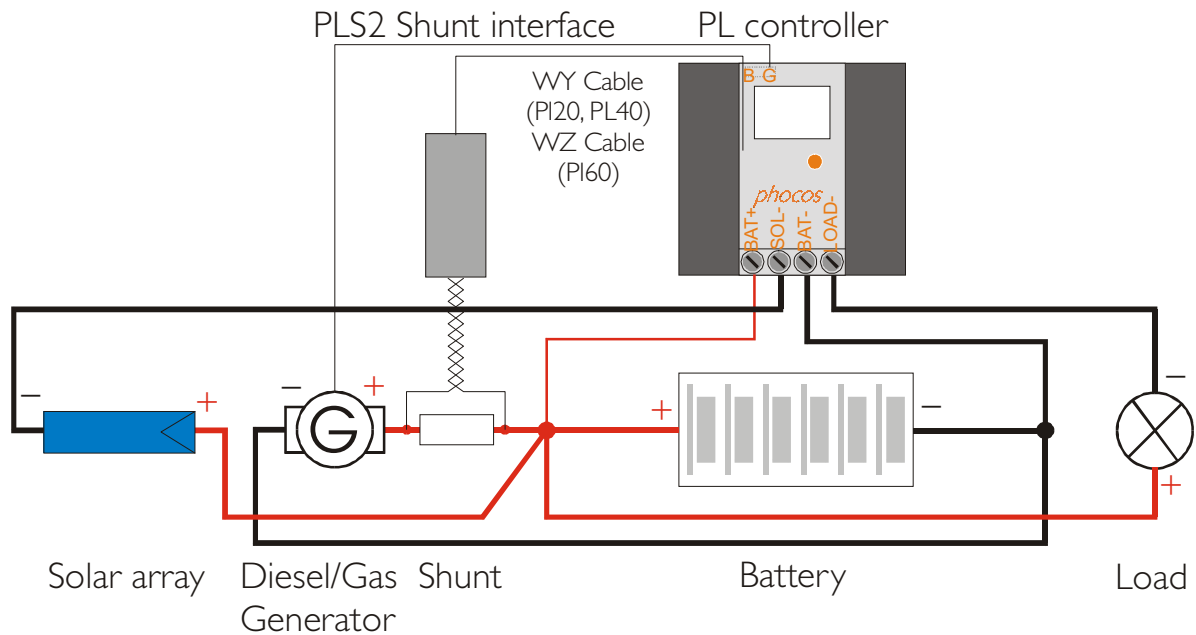
### Description

Hybrid solar system with diesel or gas generators that can be switched by the PL controller.

Battery regulation of the generator is done with the help of the G-terminal of the controller. Solar regulation is done by the PWM SOL- input of the controller.

The generator is connected directly to the battery. The Shunt interface provides current measurement and is optional.

### Schematic diagram



### Special settings

Adjust generator control settings according to generator requirements (CHRG > CINT > GMOD ... GDAY), see Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Max. current on G terminal is 120mA for PL20 and PL40, 300mA for PL60. PL60 has a solid state relay, therefore an additional wire to Bat- or Bat+ is required. Refer to generator manual for control input functions. A relay between the G-terminal and the generator may be necessary.

Keep sense wires from shunt to PLS2 interface as short as possible.

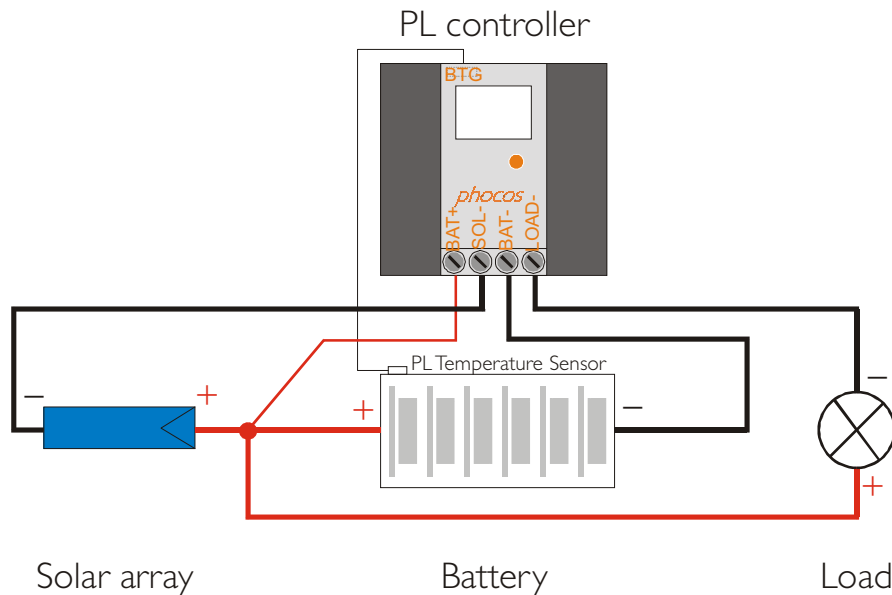
## I4. Standard Solar System with temperature controlled battery regulation

### Description

Standard application for PL regulators in solar systems. Loads are disconnected by the built-in battery deep-discharge protection circuit.

Battery charging process is temperature compensated. Recommended if battery temperature varies or is far below or above 25°C.

### Schematic diagram



### Special settings

If standard temperature compensation profile does not match battery requirements, select program 4: (SET > PROG: 4)

Select correct temperature compensation profile (SET > REG > TCMP > 1...7). See Reference Manual for details.

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

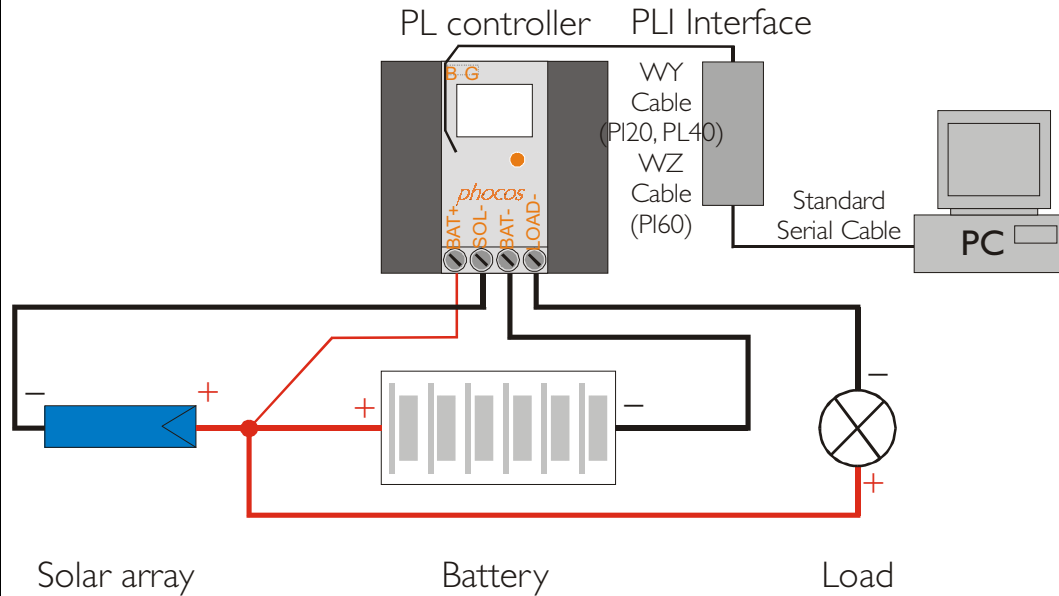
Connect temperature sensor to the terminal block under the lid. The stripe on the sensor wire goes to the T- side. Wires may be extended.

## 15. System with local Computer interconnection

### Description

Application with a data connection between the PL controller and a local Personal Computer via a PLI Interface. The PLI Interface connection can be added to all other system configurations.

### Schematic diagram



### Special settings

All PL settings can be accessed and changed with the PLCOM software supplied.

### Additional wiring instructions

The connection between the PLI interface and the Personal Computer is done via a standard computer serial interface cable, available at any computer shop.

For detailed instructions see PLI and PLCOM reference manuals.

For RS232 cable details see PLI cable connections sheet.



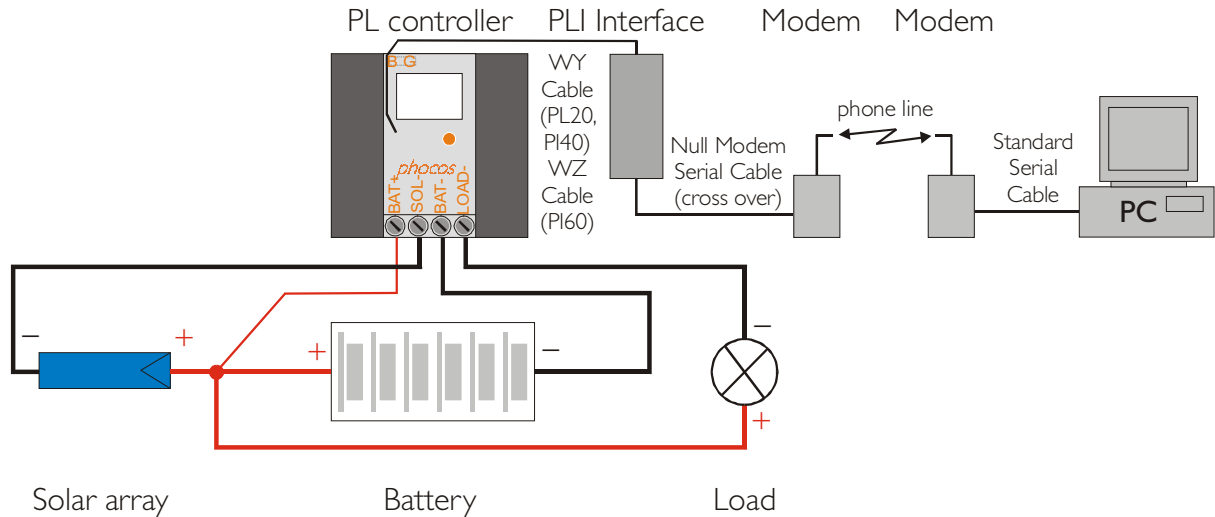
## 16. System with remote computer interconnection

### Description

Application with a data connection between the PL controller and a remote Personal Computer via a PLI Interface and two modems.

The PLI Interface connection can be added to all other system configurations.

### Schematic diagram



### Special settings

The PL side modem has to be programmed according to the PLCOM manual.

All PL settings can be accessed and changed remotely with the PLCOM software supplied.

### Additional wiring instructions

The connection between the PLI interface and the modem needs a Null Modem Style cable, available at any computer shop.

The connection between the modem and the Personal Computer is done via a standard computer serial interface cable, usually supplied with the modem.

For detailed instructions see PLI and PLCOM reference manuals.

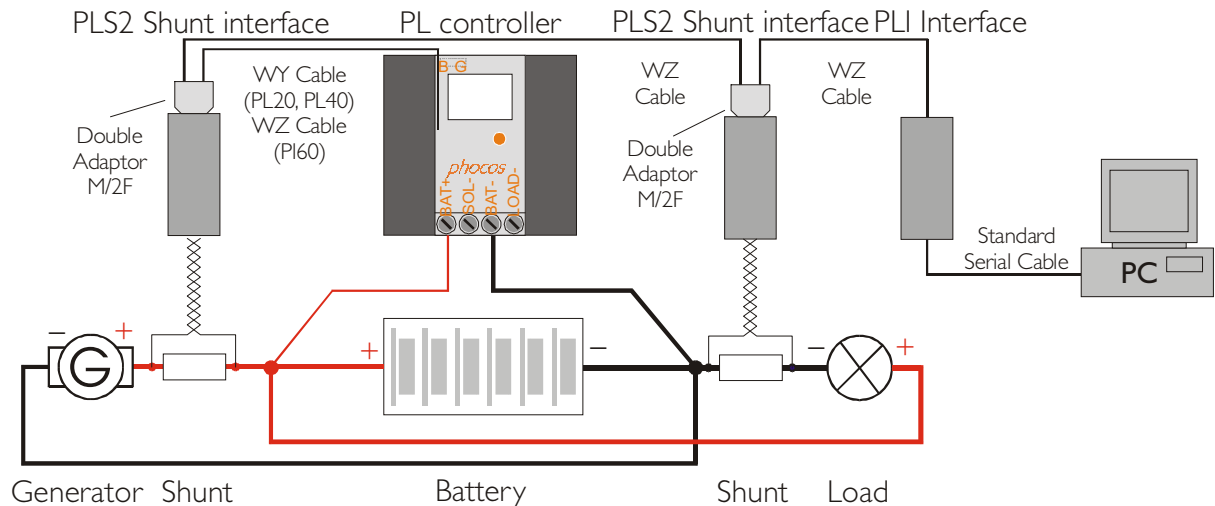
For RS232 cable details see PLI cable connections sheet.

## 17. System with computer interconnection and external load and charge current measurement

### Description

Application with a data connection between the PL controller and a Personal Computer via a PLI Interface together with two PLS2 Shunt interfaces.

### Schematic diagram



### Special settings

All PL settings can be accessed and changed with the PLCOM software supplied.

Remove jumper from green terminal block of one PLS2 to set it as a slave.

### Additional wiring instructions

Both PLS2 Interfaces need to be connected to a standard telephone double adaptor. One female plug of the first PLS2's double adaptor is connected to the PL controller with a WY wire (PL20, P40) or a WZ wire (PL60) (optional supplied). The other female plug is connected to the second PLS2's double adaptor with a WZ cable. The free female PLS2's double adaptor is connected to the PLI Interface with a WZ cable.

If just one PLS2 interface is used, connect one double adaptor plug to the PL controller with a WY/WZ cable and the other to the PLI Interface with a WZ cable.

The connection between the PLI interface and the Personal Computer is done via a standard computer serial interface cable, available at any computer shop.

For detailed instructions see PLS2, PLI and PLCOM reference manuals.

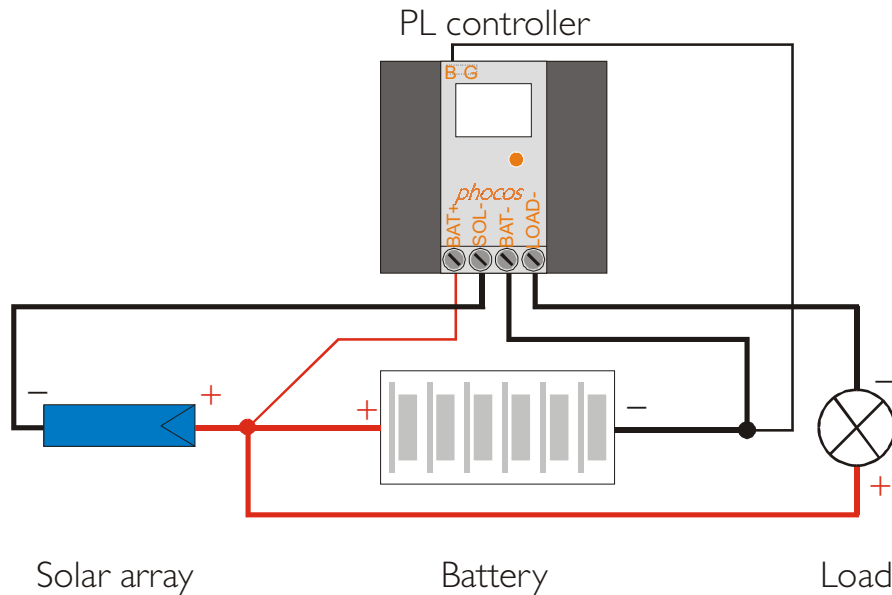
For RS232 cable details see PLI cable connections sheet.

## 18. System with long wires between battery and PL

### Description

Application where the battery voltage needs to be sensed because of high voltage drop on battery wires.

### Schematic diagram



### Special settings

If program 2,3 or 4 is selected, set B-input to sense battery voltage (SET > MODE > BSET: 0)

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire, so no voltage drop occurs on the positive side.

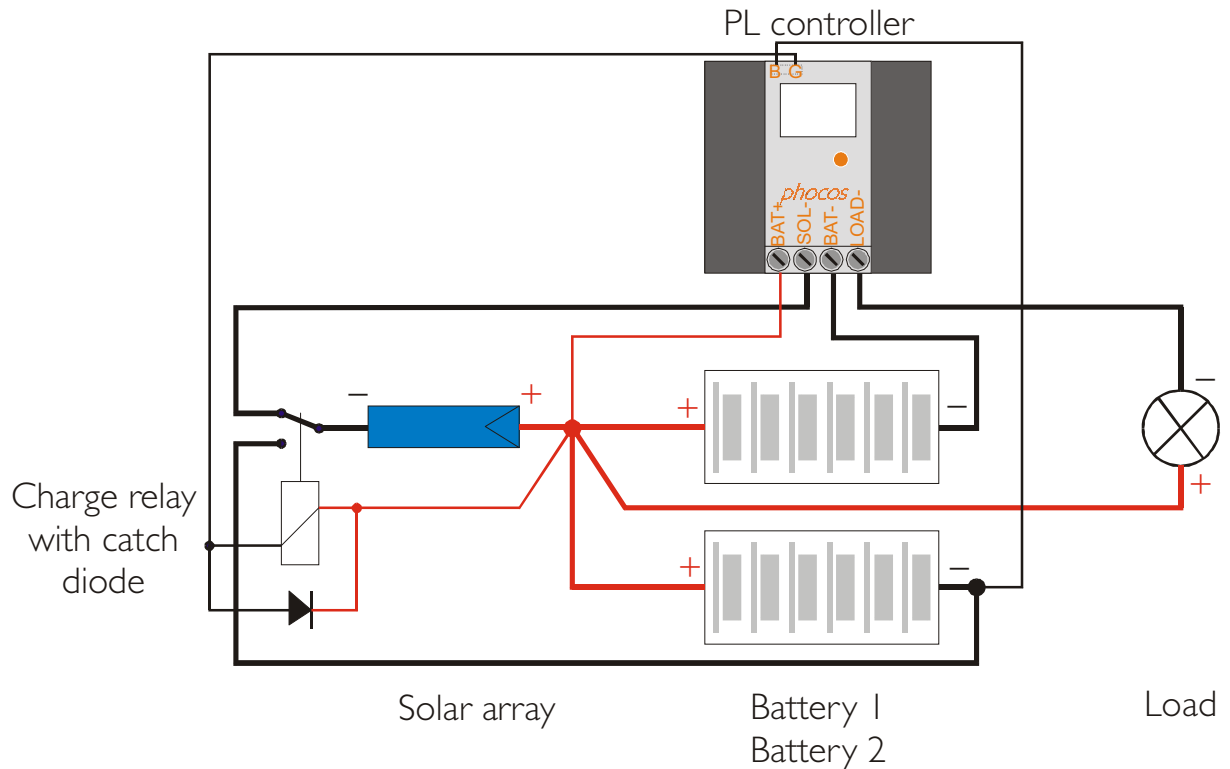
The wire from battery- to the B-terminal senses the battery voltage. There is no current in this wire, so no voltage drop occurs. The PL controller measures the true battery voltage. The sense wire may be fused.

## 19. Dual Battery System

### Description

Application with second battery that is charged by the excess energy of the Solar array.

### Schematic diagram



### Special settings

Set B-input to sense second battery voltage (SET > MODE > BSET: 1)

Set regulation voltage for second battery control (SET > MODE > BAT2: xx Volt)

Set G-terminal to switch second battery control (SET > MODE > GSET: 6)

### Additional wiring instructions

The wire from battery+ to the BAT+ terminal of the PL controller only supplies the regulator. There is very little current in this wire.

Max. relay coil current is 120mA for PL20 and PL40, 300mA for PL60. PL60 has a solid state relay, therefore an additional wire from G- to Bat- is required. Relay must switch system voltage and charge current. Catch diode must be fitted.

It is possible to connect relay to LOAD-terminal if load disconnect is not used (in this case set LOAD terminal to control 2<sup>nd</sup> battery: SET > MODE > LSET: 6).

The sense wire may be fused.