PL2020N

Advanced Solar Charge Controller

User Guide

Read this before installing

Display

27.8 ᵛ

𝐵𝐴𝑇𝑉

BOOST

PL2020N
Charge Controller

Alarm led — ○

— Button

High current connections

Test terminal

Serial port

Mounting holes

Low level connections
(plug in terminal block)

Cable tie
posts
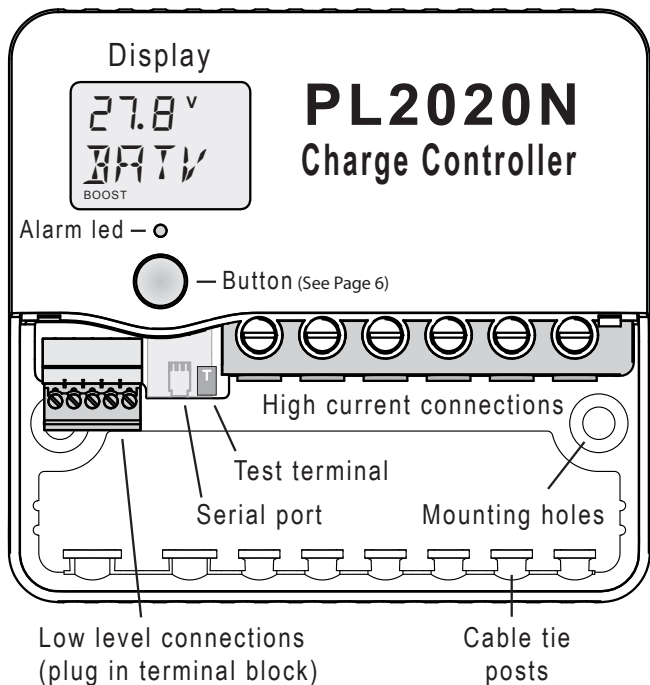
Screw wires into the high current terminals *tightly*
as described on page 4.

Warning: The PL regulator is for DC current ONLY

Where to set up your PL

Make sure you set up your PL:

- Vertically, where air can circulate around it;
- In a dry environment out of direct sunlight;
- Away from flammable gases or liquids;
- Away from spiders, wasps or other insects which might make nests in it.

Wiring instructions

For safety and to avoid damage, connection of wires must be done in the following order:

a. Connect the battery first. Positive to B+, Negative to B-. If the display comes on, then connection is correct. If not, reverse the connection. (see diagram opposite)

b. Connect the negative (-) wire from the solar panel(s) to the S- terminal.

c. Test the solar panel connection by touching the positive(+) wire from the solar panel onto the Test terminal (T).

• If the alarm led does not flash then it is OK. Connect the wire to the S+ terminal.

• If the alarm led flashes quickly then it is *not* OK. Reverse the solar panel connection and test again. *(There must be some light on the solar panels for this test to work)*

d. Connect the negative (-) wire from any DC load circuit to the L- terminal. Then connect the positive wire from the load to the L+ terminal. Test that the load circuit works. The PL is protected against load short circuits, but cannot protect your load devices if you reverse the connection to them.

WARNING:

The PL can be damaged quickly by reverse connection of the solar array in 32,36 and 48V systems. Test first to avoid damage.

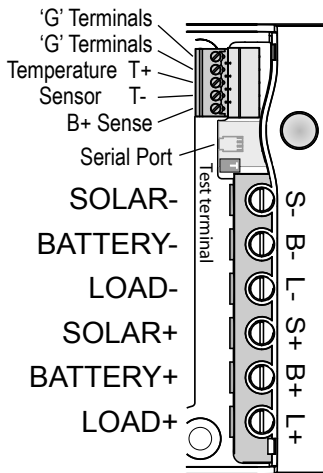**Note:** The PL is protected against charge side short circuits.
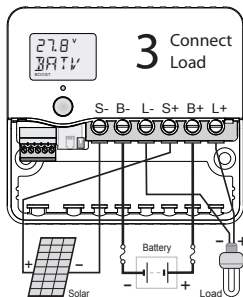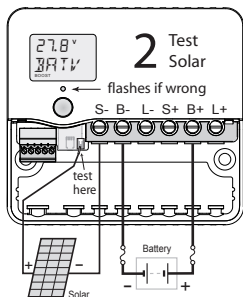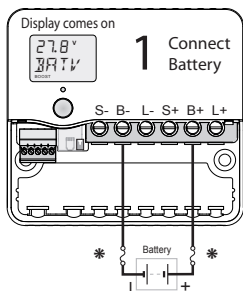
Basic Connection

1. Connect Battery
2. Test Solar Polarity
3. Connect Load

*For safety, most installation standards require fuses or circuit breakers on both sides of the battery.

For other connections, see the reference manual.

Display comes on

27.8ᵛ
BATV
BOOST

1 Connect Battery

S- B- L- S+ B+ L+

* Battery *
– | + +

27.8ᵛ
BATV
BOOST

← flashes if wrong

2 Test Solar

S- B- L- S+ B+ L+

test here

Solar
– | + +

Battery
– | + +

27.8ᵛ
BATV
BOOST

3 Connect Load

S- B- L- S+ B+ L+

Solar
– | +

Battery
– | + +

Load
– +

'G' Terminals
'G' Terminals
Temperature T+
Sensor T-
B+ Sense
Serial Port

Test terminal

SOLAR− S−
BATTERY− B−
LOAD− L−
SOLAR+ S+
BATTERY+ B+
LOAD+ L+

Using the Menus

You can move around the menu system and change settings using the button on the front of the PL.

There are seven top-level menu items in the PL's menu system (BATV, CHRG, LOAD etc - see diagram opposite). Each menu item provides access to a sub-menu, and some of these sub-menus lead again to further sub-menus.
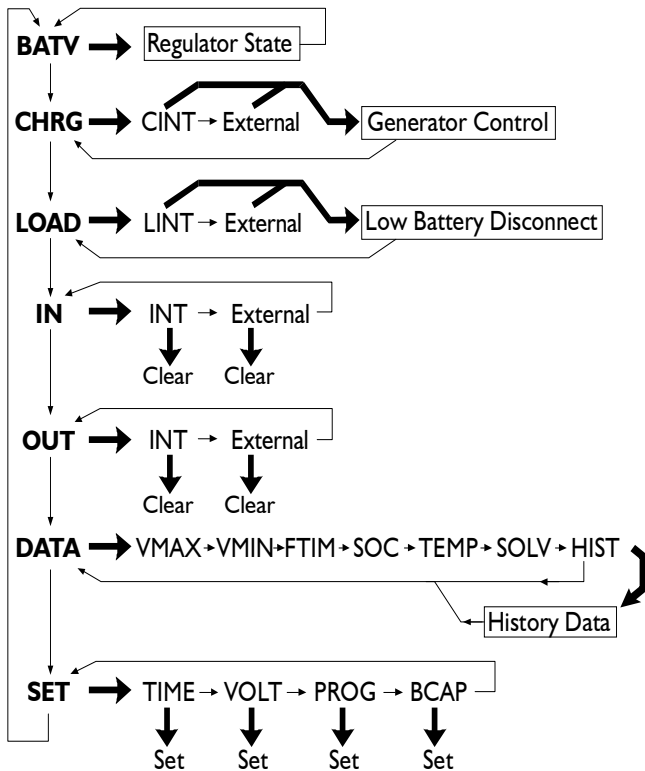
A **short push** tells the PL to advance to the next menu or setting. To do a short push, press on the button on the front of the PL, and release it immediately.

A **long push** "selects", moving into a sub-menu or allowing you to change settings. To do a long push, press the button, holding it down until the menu changes (about one second).

Getting back
Wherever you are in the menu system, a series of short-pushes will bring you back to the top-level menus without changing any settings. There are two exceptions: when a number is flashing (you are already changing a setting - see page 8); and when you see the word "EXIT" (you're in "History" mode - see page 11).

⟶ Thin arrow = short push

⟹ Thick arrow = long push

BATV ⟹ Regulator State

CHRG ⟹ CINT → External ⟹ Generator Control

LOAD ⟹ LINT → External ⟹ Low Battery Disconnect

IN ⟹ INT → External

Clear   Clear

OUT ⟹ INT → External

Clear   Clear

DATA ⟹ VMAX → VMIN → FTIM → SOC → TEMP → SOLV → HIST

History Data

SET ⟹ TIME → VOLT → PROG → BCAP

Set   Set   Set   Set

Choosing your settings

You must follow the procedure below to ensure that your PL will regulate correctly.

1. Set the Time
   a. Short-push until the display shows "SET".
   b. Long-push once and the display will show "TIME".
   c. Long-push again, and the time will start flashing.
      (Note that the time is displayed in hours and tenths of hours. For example, "6.5" means 6:30am, and "13.1" means 1:06pm.)
   d. Short-push until the time shown is correct. If you reach 23.9, it will cycle back to 0.0 (midnight).
   e. When the time shown is correct, long-push to set it.

2. Set the System Voltage
   a. After setting the time, short-push to move from "TIME" to "VOLT".
   b. Long-push and the voltage will start flashing.
   c. Short-push until the voltage is correct for your battery. If you reach 48V, it will cycle back to 12V.
   d. When battery voltage is correct, long-push to set it.

3. Set your program
   The PL comes with a number of pre-set programs, to make configuration easy for most installations.
   a. Short-push to move from "VOLT" to "PROG".
   b. Long-push and the program number will start flashing.
   c. Short-push to set your program:

Programs

0: Liquid Electrolyte Batteries, with Low Battery
   Disconnect option (see page 16).
1: Gel batteries, with Low Battery Disconnect option.
2: Liquid Electrolyte with Light Controller option (see p17)
3: Gel batteries with Light Controller option.
4: Customised setup. Choosing this program will require
   you to set a number of additional parameters. (see p18)

d. When the program shown is correct, long-push to set it.

4. Set the Battery Capacity

a. Short-push to move from "PROG" to "BCAP".
b. Long-push and the battery capacity will start flashing.
c. Short-push to choose the correct battery capacity for
   your system in Ampere hours (Ah). (Large settings
   display in thousands - e.g. 1600 Ah shows as "1.6".) If
   you are unsure, check your battery manual or consult
   your battery supplier.
d. Long-push to keep the chosen value.

REVERSE GEAR

If you overshoot the setting or want to go down instead of
up, there is a way to reverse the direction of change.
Do a long push. The number stops flashing. Do another
long push. The number starts flashing again but this time
short pushes will change the number in the opposite way.
(When you first enter a screen, the short pushes are set to
increment the number.)

Monitoring your system

The PL's advanced monitoring functions provide you with unparalleled information about your system. Here are some of the questions your PL can answer:

How full is the battery?

The voltage level of your battery is a good measure of how full it is, and is shown on the top-level "BATV" screen. Alternatively, SOC in the DATA sub-menu (long-push on DATA, then three short-pushes) uses the amp-hour data to provide an educated guess of the state of charge. (Warning: SOC will be useless if the PL is not measuring all the charge and discharge from the battery. For example, if an inverter is connected directly to the battery, an external shunt is needed so that the PL can include the inverter in its calculations. There will also be errors due to temperature and the age of the battery)

How much energy have I collected today?

The top-level IN screen shows how many Amp hours have been collected today.

How much energy have I used today?

The top-level OUT screen shows how many Amp hours the load has used today.

What voltage did the battery reach?

VMAX shows today's maximum voltage since midnight; VMIN shows today's minimum voltage. Both are in the DATA sub- menu.

What time did the battery finish charging today?

The FTIM screen in the DATA sub-menu shows the time the PL finished charging and entered the "float" state (see page 14). If the controller did not get to float, then this will show 0.0.

Are components working correctly?

A temperature sensor can be connected to your PL to improve regulation. If this sensor is installed, the battery temperature is shown on the TEMP screen in the DATA sub- menu. (Its blank if no temperature sensor is attached)

To test your solar array, the SOLV screen in the DATA menu shows the open-circuit voltage of the solar array.

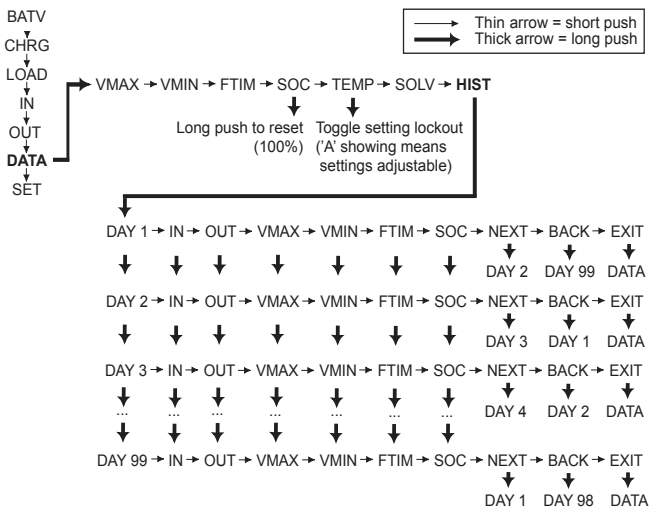(Note: charging is interupted while this screen is displayed)

Retrieving historical data

In addition to storing today's performance data, the PL keeps information about the last 30 days of operation.

Historical performance information can be accessed from the DATA screen (see diagram below).

After a long-push on DATA, short-push until you see HIST. A long-push on HIST will put you in "history mode", where you can cycle through each day's data.

(Note: the day numbers go backwards - i.e. DAY 1 means yesterday, and DAY 99 is 99 days ago.)

BATV
CHRG
LOAD
IN
OUT
DATA
SET

VMAX → VMIN → FTIM → SOC → TEMP → SOLV → **HIST**

Long push to reset (100%)
Toggle setting lockout ('A' showing means settings adjustable)

Thin arrow = short push
Thick arrow = long push

DAY 1 → IN → OUT → VMAX → VMIN → FTIM → SOC → NEXT → BACK → EXIT
DAY 2   DAY 99   DATA

DAY 2 → IN → OUT → VMAX → VMIN → FTIM → SOC → NEXT → BACK → EXIT
DAY 3   DAY 1   DATA

DAY 3 → IN → OUT → VMAX → VMIN → FTIM → SOC → NEXT → BACK → EXIT
DAY 4   DAY 2   DATA

DAY 99 → IN → OUT → VMAX → VMIN → FTIM → SOC → NEXT → BACK → EXIT
DAY 1   DAY 98   DATA

Quick Summary

This is a quick summary of the screens in the data submenu which are reached by a long push on the DATA screen and the values stored each day by the history function.

IN   The amount of energy collected in Amp hours

OUT   The amount of energy used in Amp hours

VMAX   Maximum battery voltage since midnight.

VMIN   Minimum battery voltage since midnight.

FTIM   Time of day the regulator entered the Float state 0.0 if it didn't get to float (see page 14).

SOC   Percentage estimate of the state of charge of the battery based on amp hours. A very rough 'fuel gauge'.

TEMP   Temperature being sensed by the battery temperature sensor (if attached).

SOLV   Solar panel open circuit voltage.
            NB: charging stops while displaying this screen.

HIST   Entry point for history data display.

At midnight, IN, OUT, VMAX, VMIN, FTIM and SOC are stored in the history data and reset.

VMAX and VMIN respond very slowly to changes in battery voltage. This allows them to ignore short term voltage fluctuations.

The Battery Charging Process

When charging your battery, the PL moves automatically through the following charging sequence:

Boost phase - In this phase, all available charge is used to charge the battery as quickly as possible. When the battery is charging in the Boost phase, the "Boost" indicator appears on the PL's screen.

Absorption phase - The battery is nearly full. To avoid excess gassing, the charge current is now adjusted to keep the battery voltage constant.

Float phase - The battery is fully charged, so the PL now monitors the battery and keeps it full. If the battery voltage drops below a pre-set point, the battery will move back to the Boost phase automatically.

To increase battery life, the PL will occasionally move into an additional phase called the Equalisation phase. This phase levels the charge between the different cells inside the battery by overcharging the battery for a short period.

The PL moves through these phases automatically, but it is also possible to change the phase manually.

A long-push on the BATV menu will show the current charging phase. Subsequent long-pushes will move the PL into the next phase in the cycle.

The diagram opposite shows how the voltage of the battery varies during the charging process. The regulation

settings shown in the diagram (BMAX, ETIM etc) can all be set individually in Program 4. This means the PL can be adjusted to regulate well even in unusual installations. For more information see reference manual. The pre-set values provided by choosing Programs 0, 1, 2 or 3 will mostly ensure good regulation without a complex setup process.
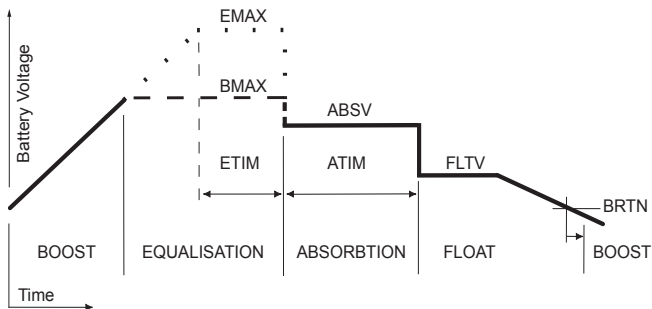
Low Battery Disconnect Option

Low Battery Load Disconnect is a feature of the PL which helps avoid battery damage by preventing the load from excessively draining the battery. You do not have to use this feature - the PL will still regulate effectively without it. Low Battery Disconnect works by turning the load off when the voltage falls below a pre-set point for a period of time. This feature is designed not to trigger if the battery voltage drops for just a few moments (for example, because a motor has just been turned on).
Once the battery has recharged to a safe level, the load will automatically switch on again.

To use Low Battery Disconnect, you need to connect your load to the regulator as described on page 4, and you should also ensure that you have chosen a program where the Low Battery Disconnect feature is activated - see p9.
Note - NEVER connect batteries or inverters to the LOAD terminal of the PL. They will cause heavy current flow which will damage the regulator.

Light Controller Option

The PL can act as a light controller which can switch lights on at night. When the voltage from the solar array drops, the Light Controller function will switch on power to the PL's LOAD terminal. If you have connected lights to the LOAD terminal, they will switch on at dusk and switch off at dawn. The low battery disconnect function will turn the lights off if the battery voltage drops too low.

To use the Light Controller option, choose a PL program which enables this function, as described on page 9.

Further information

The PL can be used to control external switches to expand the capacity of the system. There are also accessories to connect to a computer and a remote control.

For information on how to customise your regulation setup and use the many additional features, consult the Reference Manual. This is available from your dealer or from
www.plasmatronics.com.au

More information on the accessories can also be found on the website