A COMPLETE GUIDE ABOUT SOLAR PANEL INSTALLATION. STEP BY STEP PROCEDURE WITH CALCULATION & DIAGRAMS

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Complete Solar Panel Installation Design & Calculations with Solved Examples – Step by Step Procedure

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Below is a Complete Note on **Solar Panel design installation**, calculation about No of solar panels, batteries rating / backup time, inverter/UPS rating, load and required power in Watts. with Circuit, wiring diagrams and solved examples.

If you pick this article related to solar panel installation, You will be able to;

- ✔ To calculate the no of solar panel (with rating)
- ✔ To calculate the rating of Solar panel
- ✔ To calculate the rating of batteries for Solar panel system
- ✔ To calculate the back up time of batteries
- ✔ To calculate the charging current for batteries

- To calculate Charging time for batteries
- To calculate the rating of charge controller
- How much watt solar panel we need
- How to select the proper solar panel for home
- UPS / Inverter Rating for load requirement and much more…

Solar Panel Installation: Step by Step Procedure with calculation and examples

Before we start , its recommended to read the article about proper selection & different types of solar panels and photovoltaic panel for home & commercial use as well.

Now lets begin,

Suppose, we are going to install a solar power system in our home for a total load of 800W where the required backup time of battery is 3 hours (You may use it your own as it is just for sample calculation)

Load = 800 Watts

Required Backup time for batteries = 3 Hours

What we need to know?

1. Inverter / UPS Rating =?

2. No of batteries for backup power =?

3. Backup Hours of batteries =?

4. Series or Parallel Connection of Batteries = ?

5. Charging Current for Batteries = ?

6. Charging Time for batteries = ?

7. Required No of Solar Panel =?

8. Rating of Charge Controller = ?

Solution:

Inverter / UPS Rating:

Inverter / UPS rating should be greater than 25% of the total load (for the future load as well as taking losses in consideration)

800 x (25/100) = **200W**

Our Load + 25% Extra Power = 800+200 = **1000 Watts**

This is the rating of the UPS (Inverter) i.e. We need 1000W UPS / Inverter for solar panel installation according to our need (based on calculations)

Required No of Batteries

Now the required Back up Time of batteries in Hours = 3 Hours

Suppose we are going to install **100Ah, 12 V batteries**,

12V x 100Ah = 1200 Wh

Now for One Battery (i.e. the Backup time of one battery)

1200 Wh / 800 W = 1.5 Hours

But our required Backup time is 3 Hours.

Therefore, 3/1.5 = 2 → i.e. we will have to connect two (2) batteries each of 100Ah, 12V.

Backup Hours of Batteries

If the number of batteries are given, and you want to know the Backup Time for these given batteries, then use this formula to calculate the backup hours of batteries.

1200 Wh x 2 Batteries = **2400 Wh**

2400 Wh / 800 W = **3 hours.**

In the first scenario, we will use 12V inverter system, therefore, we will have to connect two (2) batteries (each of 12V, 100 Ah) in Parallel. But a question raised below:

Battrey Charging Time

Series or Parallel Connection for Batteries

Why Batteries in Parallel, not in Series?

Because this is a 12V inverter System, so if we connect these batteries in series instead of parallel, then the rating of batteries become $V_1 + V_2$ = 12V + 12V = 24V while the current rating would be same i.e.100Ah.

Good to Know: In Series Circuits, Current is same in each wire or section while voltage is different i.e. Voltage are additive e.g. V1+V2+V3….Vn.

That's why we will connect the batteries in parallel, because the Voltage of batteries (12 V) remains same, while its Ah (Ampere Hour) rating will be increased. i.e. the system would become = 12V and 100Ah +100Ah = 200Ah.

Good to Know: In parallel Connection, Voltage will be same in each wire or section, while current will be different i.e current is additive e.g. I1+I2+I3…+In

We will now connect 2 batteries in parallel (each of 100Ah, 12V)

i.e. 2 12V, 100Ah batteries will be connected in Parallel

= 12V, 100Ah + 100Ah = 12V, 200 Ah (parallel)

Charging Current for Batteries

Now the **Required Charging Current** for these two **batteries**.

(Charging current should be 1/10 of batteries Ah)

200Ah x (1/10) = **20A**

Charging Time required for Battery

Here is the formula of Charging Time of a Lead acid battery.

Charging Time of battery = Battery Ah / Charging Current

T = Ah / A

For example, for a single 12V, 100Ah battery, The charging time would be:

T = Ah / A = 100Ah / 10A = 10 Hrs (Ideal Case)

due to some losses, (it has been noted that 40% of losses occurred during the battery charging), this way, we take 10-12 A charging current instead of 10 A, this way, the charging time required for a 12V, 100Ah battery would be:

100Ah x (40/100) = 40 (100Ah x 40% of losses)

the battery rating would be 100Ah + 40 Ah = 140 Ah (100Ah + losses)

Now the **required charging current for the battery** would be:

140Ah / 12A = 11.6 Hours.

Required No of Solar Panel

Now the required No of Solar Panels we need for the above system as below.

Scenario 1: DC Load is Not Connected = Only Battery Charging

We know the famous power formula (DC)

P = VI …… (Power = Voltage x Current)

Putting the values of batteries and charging current.

P = 12V x 20 A

P = **240 Watts**

these are the required wattage of solar panel (only for battery charging, and then battery will supply power to the load i.e. direct load is not connected to the solar panels)

Now

240W/60W = 4 Solar panels

Therefore, we will connect 4 Solar Panels (each of 60W,12V,5A) in parallel.

Click image to enlarge

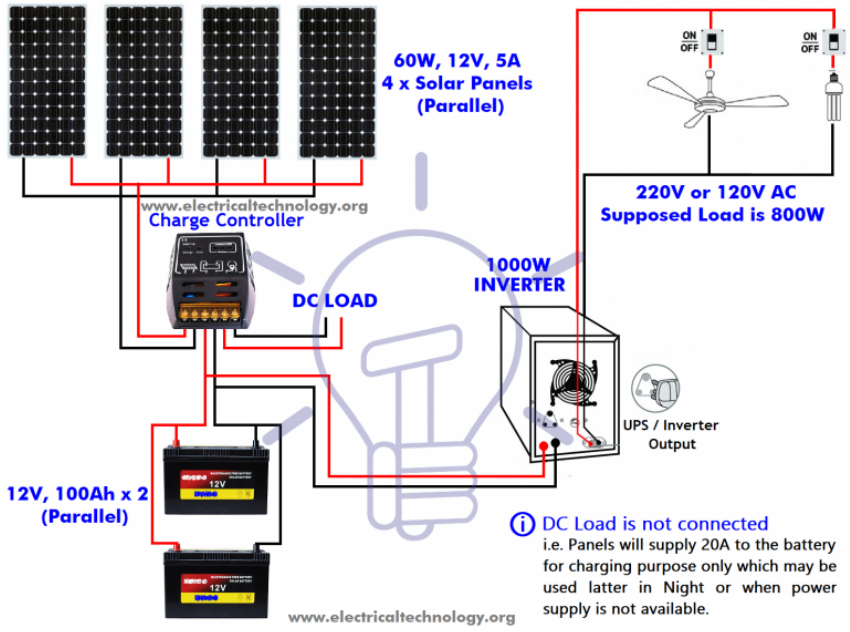

fig: Circuit Diagram for the above Calculation for Solar Panel Installation (Solar Panels only for battery charging)

The above calculations and system was only for battery charging (and then battery will supply power to the desired Load) to AC electrical appliances, which will get power through inverter and DC loads via Charge controller (via charged batteries)

Scenario 2: DC Load is Connected as well as Battery Charging

Now suppose there is a 10A directly connected load to the panels through inverter(or may be DC load via Charge Controller). During the sunshine, the solar panel provide 10A to the directly connected load + 20A to the battery charging i.e. solar panels charge the battery as well as provide 10A to the the load as well.

In this case, the total required current (20 A for Batteries Charging and 10 A for directly connected load)

In this case above, total required current in Amperes,

20A + 10 A = 30A

Now, I = 30 A, then required Power

P = V x I = 12V x 30A = 360Watts

I.e. we need 360 W system for the above explained system (This is for both Direct Load and Batteries Charging)

Now, the number of solar panels we need

360/60W = **6**

Therefore, we will Connect **6** No of **Solar panels (each of 60W, 12V,5A)**

Click image to enlarge

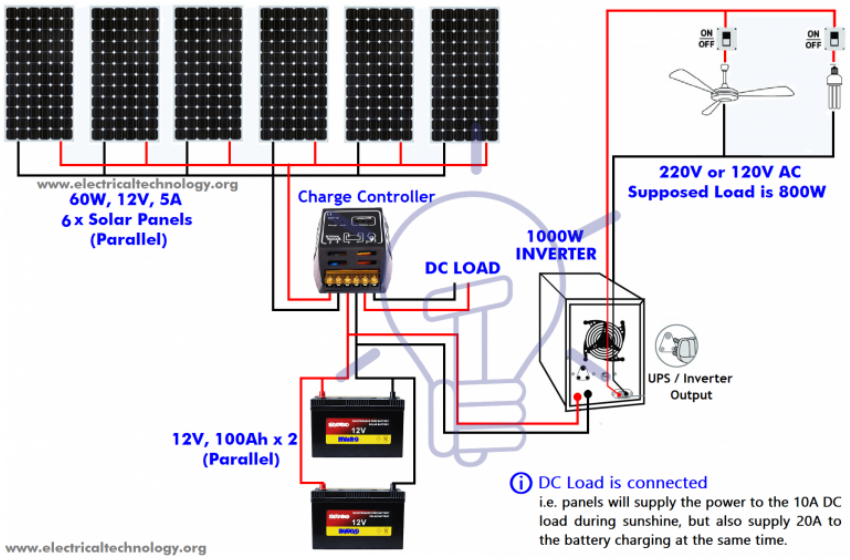

fig: Circuit Diagram for the above Calculation for Solar Panel Installation (Solar Panels only for battery charging + Direct connected load)

Rating of Charge Controller

As we have calculated above that the charging current for 200Ah battery is 20-22 Amperes (22A For Battery Charging+10A for direct DC Load), therefore we can use a charge controller about **30-32 Amp.**

Note: The above calculation is based on ideal case, so it is recommended to always choose a solar panel some bigger then we need, because, there are some losses occurs during battery charging via solar panel as well as the sunshine is not always in ideal mood.

By: Engr Khan

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Easy Charging Time and Charging Current formula for Batteries (With Example of 120Ah Battery)

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