TEESING

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TECHNICAL NOTE:

How to solar power the Dust Sentry

Many customers choose to power their Dust Sentry using solar photovoltaic (PV) panels. Constructing an efficient solar PV system requires careful planning throughout the process from selecting components, to placing the solar array. In this technical note, we describe some important considerations and provide guidelines for constructing an off-grid PV power source for the Dust Sentry. On Page 2 you can see a worked example for a typical Dust Sentry.

Key PV system elements include:

- Solar panels - convert sunlight into electric energy
- Deep cycle batteries - store power produced by solar panels and provide power to instruments
- Charge controllers - protect batteries from overcharging and optimize the battery charging function
- Wires and cables - connect the electrical components

Supporting structures include:

- Panel mounting - supporting framework for the solar panels
- Battery enclosure - protects batteries and charging circuitry from environmental elements

Optional system components include:

- Combiner box - combines the output of each individual solar panel into one circuit
- Disconnects - circuit breakers that protect the various system components; one disconnect is placed between the solar panels and the batteries and another is placed between the batteries and the instruments.

Designing a PV system

The main challenge for the off-grid PV system is to ensure that it can keep up with regular power demands and can provide enough power during infrequent peak periods. Keys to the design of such a system are: (1) computing power demands of the instruments, (2) evaluating how many batteries are needed to ensure operation at night and on overcast days, and (3) determining the number of solar panels that are required to satisfy power demands.

Power requirements

The first thing to know before designing a PV system is the power requirement of your system. You need to consider the following points:

- Bypass the 110/240VAC power supply – connect directly to the 12VDC input.
- Usage of a single Dust Sentry including a modem and one third party sensor (e.g. wind speed and direction) is 15W (~10W of this is used by the heated inlet).
- Regulated 12VDC input (+/- 2.5%) with <150mV (pk-pk) ripple. The main system sampling pump is connected directly to the 12VDC supply – therefore any fluctuation in supply voltage will cause a change in the sample pump speed, affecting the measurement.
- Due to the regulated 12VDC input requirement, a DC/DC converter should be installed between the solar system battery and the Dust Sentry input.
- Efficiency of the DC/DC converter may only be 72%, which means the power requirement will be 21W in to get 15W out.

Compute amp-hours per day

To compute amp-hours per day, multiply the total system wattage by 24 hours/day. It is also necessary to apply a loss factor for the batteries (20% is a conservative guide).

Determine the size of the battery bank

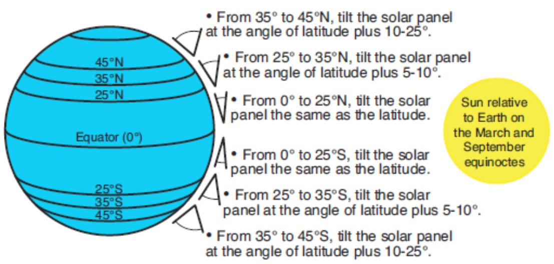
Batteries are needed to provide power to the system during the night and through periods with overcast skies. The size of the bank will vary with latitude and according to your climate. For this reason alone engaging a local expert is strongly advisable. You also need to consider that the batteries should never be fully discharged, as they can be damaged.

Determine the number of solar panels

Solar panels are the elements in a PV system that actually produce electricity, and the must be sized according to the amp-hours per day for your system. The number of average sun hours per day is important to determine the number of panels, and depends on the geographic location. To find out the solar insolation (given in kWh/m2/day) for a given part of the world you can use reference websites such as: http://www.apricus.com/html/solar_collector_insolation.htm#.Ughu1pJgdqU. The number of panels required will also depend on the efficiency of each panel.

System output and charge controller
A charge controller regulates the power transfer from the PV array to the batteries, which prevents overcharging. In addition, it prevents the batteries from discharging into the solar array. Some charge controllers also monitor the temperature of the batteries to prevent overheating. Charge controllers may offer remote power monitoring and can show the overall operating efficiency of the system.

Solar panel orientation
Solar panels should generally face toward the solar south in the northern hemisphere and toward solar north in the southern hemisphere. The angle of inclination of the panels should be similar to the latitude of the study site near equatorial regions, but increase at latitudes that are closer to the poles (see below diagram).



You also may wish to adjust the tilt closer to horizontal in summer and closer to vertical in winter. Please note that build-up of material (e.g. dust or bird droppings), or shading (e.g. from trees or buildings) will have an impact on the power output of the panels.

Worked example of a PV system

Step 1:
Dust Sentry system load is 15W including modem and Gill Windsonic sensor.

Step 2:
W use a Meanwell SD-25A-12 DC/DC converter which is 72% efficient, i.e. 15W / 72% = 21W

Step 3:
The Dust Sentry will run 24 hrs a day. 21W x 24 hours = 504 Watt-hours.

Step 4:
We are running off 12V. 504 Watt-hours / 12 V = 42 Amp-Hours per day.

Step 5:
The system will need to run for max 2 days without sun. 42 Amp-hours x 2 days = 84 Amp-hours.

Step 6:
We will use lead acid batteries. Lead acid charge should not go below 50%. 84 Amp-hours / 50% = 168 Amp-hours battery capacity needed e.g. 3 x PVX-560T batteries from Concorde Battery Corp (http://www.sunxtender.com/solarbattery.php?id=4).

Step 7:
To charge the battery fully in one day of full sun: 504 Watt-Hours per day / 4 hours of peak sunshine = 126 Watts.

Step 8:
The charging system is not 100% efficient; a good rule of thumb is to allow for 20% charging losses i.e. 126 Watts + 20% = 151 Watts.

Step 9:
For contingency it would be wise to add another 20% i.e. 151 Watts + 20% = 181 Watts.

Step 10:
Solar panels typically available in 60W or 90W. 181 Watts / 60 Watts = 3.01 panels (3 will be sufficient).

Step 11:
Current rating of solar charge controller required. 3 panels x 60 Watts / 12 Volts = 15 Amps. E.g. Morningstar SS20 20 Amp controller:
(http://www.morningstarcorp.com/en/sun-saver).