Application Note

# Solar Powering SignalFire Equipment
## 12V Systems

## OVERVIEW

SignalFire's "Stick" nodes as well as modules (like the Wireless I/O Module or MIOM) are powered from an external power supply between 6 and 36 Volts DC. Typically, these units are powered with a 12V sealed lead acid battery charged by a solar panel. Also somewhat common are 24 Volt systems.

This application note will guide you in the design and sizing of the elements of this solar power sub-system.

## BACKGROUND

The power system must be chosen to allow for continued operation for some amount of time when no light is present (like on very cloudy days and at night). The term for this is autonomy and it is a measure of how long the battery will last without any charging. The solar panel much also be chosen so that it will charge the battery at a reasonable rate. The following is a list of rules we use for designing a charging system like this:

- 10 Days of Autonomy
- Only allow ½ of the battery to be discharged over the autonomy period
- Want to charge the battery from ½ discharged to full charge in 6 hours of full sunlight

## BATTERY SIZING

Let's look at the battery "size" first. We will assume that you are using a 12 Volt system. Battery "size" is expressed in Amp-Hours and is a measure of how much total power a battery can put out. This is often called **capacity**.

The required battery capacity will depend on the amount of (average) current drawn out of the battery and the length of autonomy you want. In our case, we want 10 days of autonomy to use up ½ of the battery capacity.

Current draws will vary depending on what load you have. For SignalFire's equipment, refer to the table at the end of this note. For now, let's say that we want to power an RSD Stick (Modbus Stick with RSD Module) and that a single relay will be almost always energized. The current draw for this (at 12 Volts) is 34 mA.

Calculating the amount of capacity used in a day:

**0.034 Amps * 24 Hours/Day = 0.816 Amp-Hours/Day**

We wanted 10 days of autonomy so:

**10 Days * 0.816 Amp-Hours/Day = 8.16 Amp-Hours**

Now, that was for only half the battery capacity, so we need a battery with 2X this capacity or 16.3 Amp-Hours.

Batteries come in capacities with round numbers like 5, 10, 12, 15, 20,… so we could use a 20 Amp-Hour battery and have a little extra capacity or 15 Amp-hour and have a little less than we want. I would go with 15 if long periods of no sun is rare and 20 if in an area where there might be dark for extended periods. The more capacity a battery has, the larger it physically is.

Now, let's looks the solar panel needed to charge this system. We want to charge the battery (starting at half charge) in 6 hours to full charge. Let's say we went with the 20 Amp-hour battery – this means that we want to charge 10 Amp-Hours of capacity in 6 hours. First, we calculate the charging current needed to do this:

**10 Amp-Hours / 6 Hours = 1.67 Amps of charging current needed**

Next, we calculate the size of the solar panel. Solar panels are measured in Watts which is a measure of how much power they can put out. Watts equals current times voltage:

**1.67 Amps * 12 Volts = 20 Watts**

So, a 20 Watt solar panel will be what you need to charge you battery from half charge in about 6 hours.

Now you know the battery size (12 Volt, 20 Amp-Hour) and solar panel size (20 Watt) you need for this system. You just need a charger that can put out at least 2 amps (5-10 Amps is common so this is no problem).

Here is a recommended charger:
https://www.morningstarcorp.com/products/productssunsaver-gen-3/

Here is the current draw for some standard configurations of SignalFire equipment. Contact the factory for other configurations.

| Device | Configuration | Average Current (mA) |
|---|---|---|
| Modbus Stick | None | 18 |
| RSD System (Stick and Module) | 12V, both relays off | 18 |
| RSD System (Stick and Module) | 12V, one relay on | 34 |
| RSD System (Stick and Module) | 12V, both relays on | 50 |
| RSD System (Stick and Module) | 24V, both relays off | 12 |
| RSD System (Stick and Module) | 24V, one relay on | 22 |
| RSD System (Stick and Module) | 24V, both relays on | 30 |
| Gateway Stick | 12V | 25 |
| Gateway Stick | 24V | 17 |
| GW Stick with Enet Module | 12V | 85 |
| GW Stick with Enet Module | 24V | 57 |
| MIOM (module only) | 12V, No relays on | 2.0 |
| MIOM (module only) | 12V, 1 relay on | 9.6 |
| MIOM (module only) | 12V, 2 relays on | 16.7 |
| MIOM (module only) | 12V, 3 relays on | 24.3 |
| MIOM (module only) | 12V, 4 relays on | 31.1 |
| MIOM (module only) | 24V, No relays on | 1.3 |
| MIOM (module only) | 24V, 1 relay on | 5.8 |
| MIOM (module only) | 24V, 2 relays on | 9.6 |
| MIOM (module only) | 24V, 3 relays on | 13.6 |
| MIOM (module only) | 24V, 4 relays on | 17.0 |
| Modbus IO1 Module (module only) | 12VDC supply Relay off | 3 |
| Modbus IO1 Module (module only) | 12VDC supply Relay on | 10 |
| Wireless-IO Module | 15sec check-in. 12V, no relays | 21.1 |
| Wireless-IO Module | 15sec check-in. 12V, 1 relay | 36.5 |
| Wireless-IO Module | 15sec check-in. 12V, 2 relays | 51.5 |