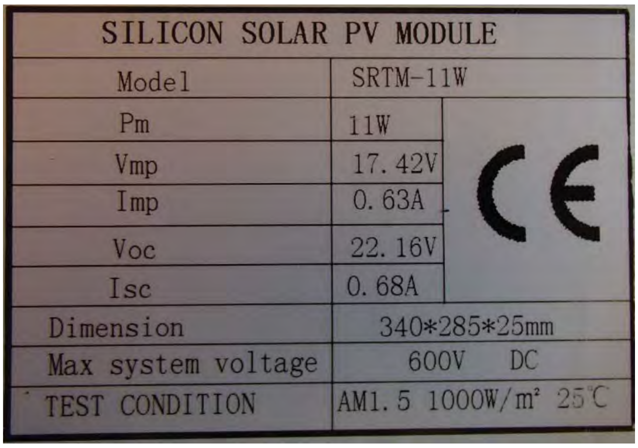
10 Solar Panels

The SFM1 is designed for long term field deployments, typically in remote locations. The sophisticated power circuit of the instrument is intended to operate independently utilizing a standard 12V, 22W solar panel connected direct to the instrument. These solar panels can either be purchased direct from ICT to provide a complete solution at the time of purchase or sourced locally by the end user.

With a solar panel attached, the SFM1 will regulate the charging current from the external source and dynamically trickle charge the internal 4.2 V battery. The output voltage of solar panels varies a great deal depending on the amount of solar radiation striking the surface of the panel. For example, in full sunlight a 12V solar panel will typically supply up to 21V, even when the sun is at a low angle. This will result in the SFM1 charging at a maximum rate of 200mA. Where partial sun light or diffuse light (shade) strikes the solar panel the output voltage will drop significantly to around 5 to 7 Volts. The internal battery of the SFM1 will still charge, but at a reduced rate, down to as low as only 60 mA. The dynamic charging circuit is designed to maximise any and all available light, either direct or diffuse solar radiation, at any time of the day or conditions to ensure maximum possible charge of the battery is achieved.

10.1 Solar Panel Specifications

If sourcing a solar panel locally ICT International recommends the following specifications be matched or exceeded by your local supplier.



SILICON SOLAR PV MODULE	
Model	SRTM-11W
Pm	11W
Vmp	17.42V
Imp	0.63A
Voc	22.16V
Isc	0.68A
Dimension	340*285*25mm
Max system voltage	600V DC
TEST CONDITION	AM1.5 1000W/m² 25℃

Figure 11: Recommended Solar Panel Specifications

Where:

Pm = Power Maximum
Vmp = Voltage maximum power - what the Voltage would be under ideal conditions with the maximum output current
Imp = Amps maximum power. "I" refers to Intensity and is a legacy term used prior to the adoption of the SI unit, Ampere. Imp * Vmp = Solar panel Watts.
Voc = Voltage Open Circuit or nothing is attached to the panel
Isc = Current under short-circuit conditions. The Peak current a solar panel can produce with its output shorted. It is used for calculating wire size and circuit protection ratings.

NOTE 18: ICT recommends the use of Poly-crystalline photovoltaic cells or Blue Coloured solar panels only. Mono-crystalline Photovoltaic cells or Black Coloured solar panels are less expensive, but have lower efficiencies in direct sunlight and poor to zero output in diffuse light conditions

10.2 Solar Panel Calculator

Depending upon the scientific question being asked, the experimental design will inevitably involve a custom configuration of the instrumentation. Typically, the independent operation of the SFM1 with its own solar panel and no extension cables provides greatest flexibility in experimental design and is the optimal configuration. However, in some cases it may be desirable to have a single external power supply servicing a large number of SFM1 Sap Flow Meters or a range of ICT Instruments such as Heat Field Deformation Multipoint Radial Profiling Sap Flow Meter (HFD8), Stem Psychrometers (PSY1), Dendrometers (DEN1) or (DEN5), Soil Moisture (SMM1) and Weather Station (AWS1) all located at a single site or individual tree.

To assist the decision making process about what size solar panel to purchase and what capacity and number of external batteries are necessary to provide power and a redundant safety margin, a web based calculator is available from the ICT web site: www.ictcommunity.org/focus/powercalculator.html

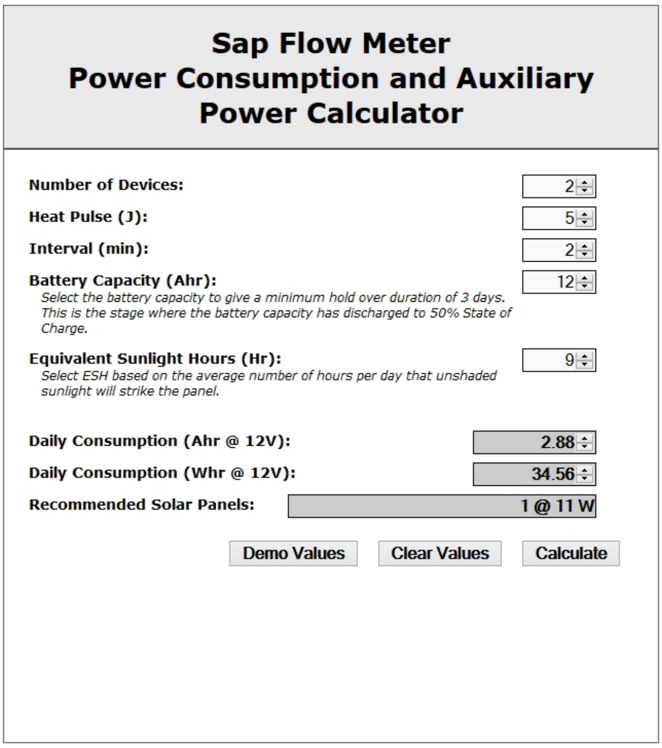


Figure 12: ICT Sap Flow Power Calculator for calculating SFM1 power consumption and auxiliary solar power requirements.

Customers are encouraged to use this calculator to aid in better understanding the power requirements of their field campaign. The calculator provides a convenient facility to simulate power requirements and how these might change under differing situations. Utilising this service during the design stage of an experiment is recommended.

10.3 Solar Panel Mounting

ICT offers a convenient multipurpose Solar Panel Post Mount (SPPM) for mounting of solar panels. The SPPM is specifically designed for mounting the SP22 solar panels. The panels are set at a default 45° angle, but can be fully adjusted on the mounting pivot to ensure that the best possible zenith angle to the sun can be achieved to maximise the Equivalent Sun Hours (ESH) for optimum charging.

10.3.1 Mounting on a Star Picket

The Solar Panel is supplied with a mounting kit designed to fit the solar panel onto a standard star picket or steel post. At the base of the mount a locking screw is fitted to prevent the panel rotating on the post.

Photo 5: SP22 Solar Panel mounted to star picket.

Photo 6: locking screw on base.

The angle of the panel is adjusted to suit the angle of the sun using the wing nut and pivot, as shown below. An optional battery pack and solar regulator can be installed just below the solar panel to provide some protection from weather.

Photo 7: Angle Adjustment.

Photo 8: Optional Battery Pack & Regulator fitted.

NOTE 19: Solar Panels should always be pointed North in the Southern Hemisphere or South in the Northern Hemisphere.

10.3.2 Mounting Options

The SPPM is designed for mounting on a steel fence post or Star Picket, but can also be attached to larger diameter wooden posts such as Vineyard trellis posts. Alternatively, the upright of the SPPM can simply be dug straight into the soil for autonomous operation. The SPPM can also be attached to a branch of the tree within the canopy to securely install the solar panel at a preferred angle within a well-lit portion of the canopy.

Photo 9: SPPM installed directly in the soil to mount and position a SP 22W solar panel.

Photo 10: SPPM Solar Panel Post Mount used on the branch of a tree

10.4 Connection of Solar Panel to the SFM1

The solar panel connects directly into the power-bus ports of the SFM1. No regulator is required!

The first step in connection of a panel is to strip the wires to the required length. Remove the outer sheath of the cable from the panel to a length of 100mm. Then strip the individual conductors (wires) and expose the bare copper wires to a length of approx. 20mm.

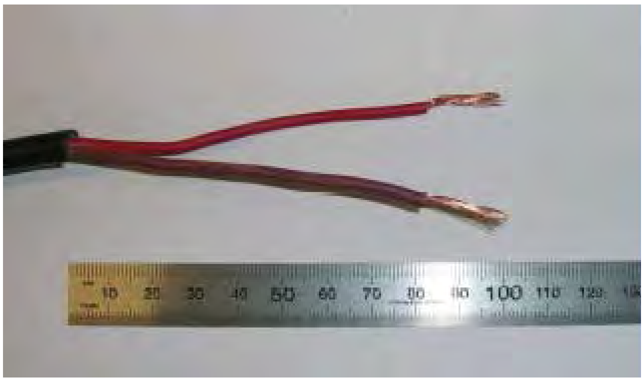


Photo 11: Solar panel cable with the insulating sheaths stripped back to expose the required wire lengths for correct installation in the SFM1

WARNING 5 - If connecting up the solar panel outdoors in sunlight do not short (touch the positive and negative) wires together, as this will damage the solar panel.

Remove both power-bus plugs from one end the SFM1 and loosen or unscrew the locking caps, as shown below. A second set of plugs are located at the opposite end of the SFM1 so that multiple sap flow meters can be connected together in a daisy chain fashion, running from one solar panel.

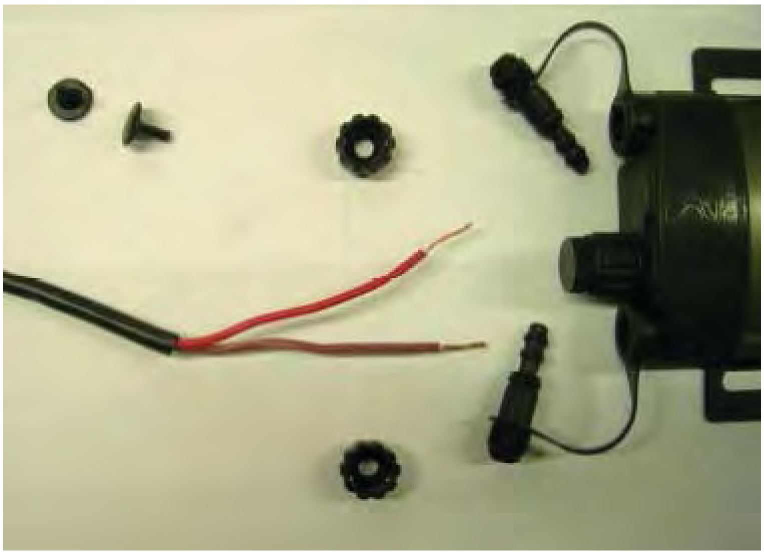


Photo 12: Inserting the prepared, stripped solar panel cable into the power-bus plugs at one end of the SFM1.

Insert the wires through the bus-plugs, taking care to firstly fit the locking collar over the wire. Draw the wire through the plug to allow the bare cable to protrude out the end of the plug. Fold the bare ends back onto the bus-plugs. The plugs are ready to insert into the logger to connect the solar panel.

The plugs are a deliberately tight or compression fit. The two small O-rings on the tips of each bus-plug are not intended for water proofing. Instead they are to ensure the cable is pressed against the gold plated copper power-bus pipes that run the entirety of the instrument, to ensure good electrical coupling or connection of the cable to the internal charging circuit.

Finally, tighten the locking collar of the bus-plug until the rubber olives are compressed tight against the insulating sheath of the cable. This provides a strain relief that will minimise the risk of the cable being pulled out if placed under a sharp pulling force or tension. Then push the bus plugs into place ensuring that an audible click is heard as the bus-plugs are fully inserted.

NOTE 20: No attempt is made to prevent water ingress into the power-bus tubes. As the gold plated copper pipes run the entirety of the instrument, no water that will ultimately ingress along the cable entry will be able to access the electronics, nor will it conduct across between the positive and negative inputs as they are also physically separated on either side of the instrument. Therefore no electrical short can occur. The gold plating of the copper pipe will also prevent corrosion of the pipes and therefore ensure a good electrical connection is maintained throughout the life of the installation.

Photo 13: Inserting the power-bus plugs with stripped cable into the power bus ports on either side of the SFM1

NOTE 21: The small protective Bus-Plug caps are not used when wires are inserted.