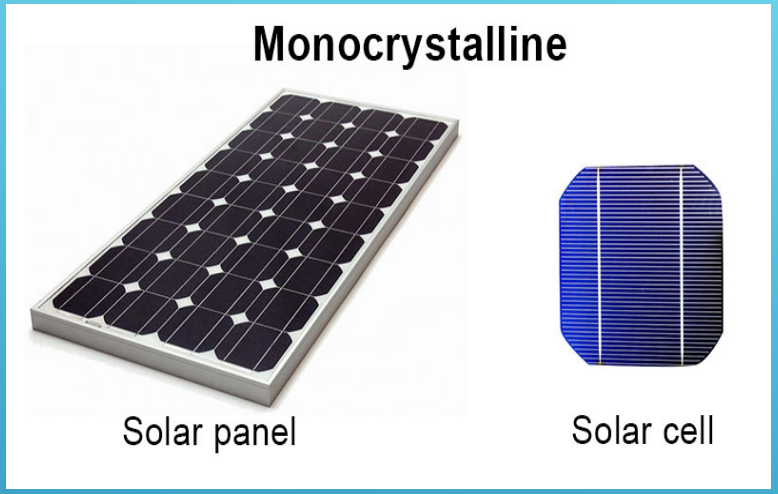
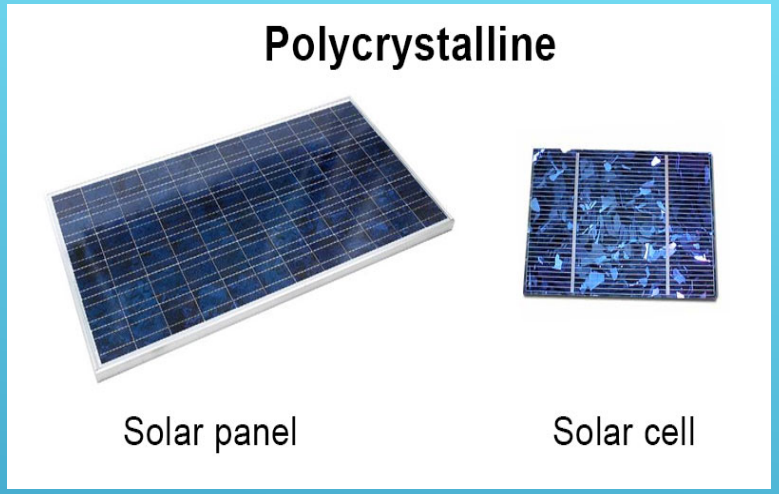
SOLAR PANEL CELL TYPES

Monocrystalline Cells ☑



- 15-21% efficient
- Slightly higher cost (eg Renogy 100w $140)
- Smallest area
- Perform better in low light
- Rounded edges
- Solid dark blue/black
- Sunpower cells most popular

Polycrystalline Cells



- Slightly less expensive (eg Renogy 100w $120)
- 13-16% efficient
- Larger area
- Exact rectangular shape
- Speckled blue

RIGID

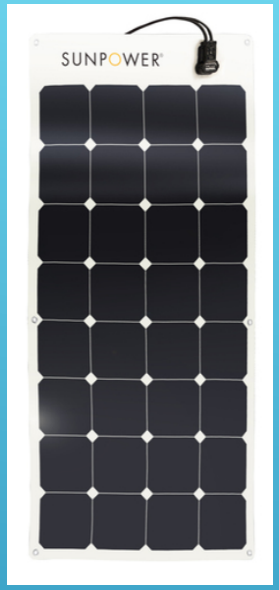
12 Volt Monocrystalline Solar Panel

Example:
- Renogy 100 Watt
- 100W, 16V, 6.25A
- Dimensions 47”x20”x 1¼”
- 16.5 lbs
- $140

- Less expensive
- Heavier requiring more complex, permanent and visible mounting
- Best for davit or rail installations
- Slightly more efficient per given area

FLEXIBLE

12 Volt Monocrystalline Solar Panel



Example:
- Renogy 100 Watt
- 100W, 17.5V , 5.8A
- Dimensions 47”x21”x 1/16”
- 4.4 lbs
- $300

- More expensive
- Much lighter
- Simpler mounting (Velcro or snaps on canvas)
- More stealthy less visibile
- Can be setup temporarily and portable
- Some are non-skid and can be walked on
- Bend to contours up to 30°
- Slightly less efficient
- Not as rugged

RIGID VS FLEXIBLE PANELS

HOW MUCH POWER DOES A SOLAR PANEL PRODUCE

- 100 watt panel generates 100W per hr in direct full sunlight
- Assuming 6hrs direct full sunlight per day
- Potentially100W x 6hrs = 600W / 12 V = 50AH
- Likely less

Ohm's Law
Volts =
Amps x Ohms

Power
Watts =
Amps x Volts

SELECTING SOLAR PANELS

- Power and physical size varies by brand – typically 50w, 100w, 150w
- Re panel specs, use working/operating/ rated values, not short circuit or open circuit values
- Think about where shadows may fall – partial shading can reduce power by 80% (boom, radar pole, mast, etc…)
- Pick your mounting areas and figure out what size panels fit best to meet your power needs
- Some solar is better than none
- More panels are better

SOLBIAN

FREEDOM POWERED BY THE SUN

OceanPlanet Energy
72 Front Street Bath, ME 04530
Phone# 207-370-9112
www.oceanplanetenergy.com
info@oceanplanetenergy.com

Semi-Flexible & 1/16" thick: perfect for canvas installation

Available in a variety sizes, shapes & efficiencies

Highest Power, Lightest Weight

Highest Output SP Series using SunPower cells with up to 23% cell efficiency, the most powerful flexible solar panels

Model #	SP52L	SP52Q	SP64	SP78	SP104	SP118L	SP118Q	SP130	SP144
Length	44" /1109mm	24" /601mm	29" /728mm	33.7"/855mm	44"/1109mm	49"/1236mm	33.7"/855mm	54"1363mm	59"/1490mm
Width	11.7"/292mm	21.7"/546mm	21.7"/546mm	21.7"/546mm	21.7"/546mm	21.7"/546mm	31.5"/800mm	21.7"/546mm	21.7"/546mm
Weight	1.8 lbs.	1.8 lbs.	2 lbs.	2.3 lbs.	3.1 lbs.	3.5lbs.	3.5lbs.	3.7 lbs.	4.2 lbs.
Power	52 W	52 W	64 W	78W	104 W	118W	118W	130 W	144 W
Panel V (Vmp)	9.1V	9.1V	11V	13.7V	18.2V	20.7V	20.7V	22.8V	25.3V
Max I to 12V battery	4.3A	4.3A	5.3A	6.5A	8.7A	9.8A	9.8A	10.8A	12A
Est. Sunny Day Yield	13-20Ahs/day	13-20Ahs/day	16-24Ahs/day	20-30Ahs/day	26-40Ahs/day	30-45Ahs/day	30-45Ahs/day	33-50Ahs/day	36-55Ahs/day
Price	**$529**	**$529**	**$649**	**$789**	**$1049**	**$1189**	**$1189**	**$1299**	**$1449**

RENOGY

Renogy 150 Watt 12 Volt Monocrystalline Solar Panel	Renogy 50 Watt 12 Volt Monocrystalline Solar Panel	SunPower® Flexible 100 Watt Monocrystalline Solar Panel	Renogy 100 Watt 12 Volt Monocrystalline Solar Panel (Slim Design)
			
$189.99	$79.99	$299.99	$139.99


amazon
Try Prime
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100 watt flexible solar panel
Departments
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Today's Deals
Gift Cards
Registry
Sell
Help
EN
Hello. Sign in
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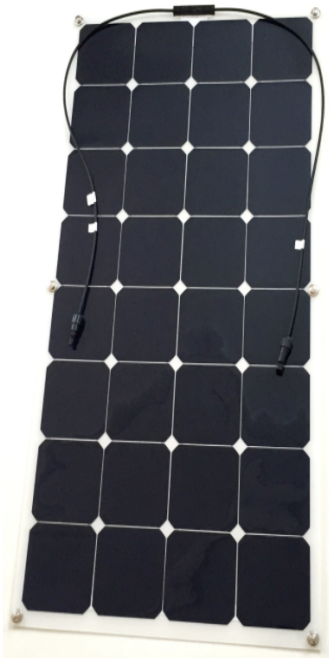
ALLPOWERS
ALLPOWERS Solar Panel 100W 18V 12V Bendable Flexible Solar Charger SunPower Solar Module with MC4 for RV, Boat, Cabin, Tent, Car, Trailer, 12v Battery or Any Other Irregular Surface
282 customer reviews | 269 answered questions
Price: $179.99 & FREE Shipping. Details
Buy 1, get a discount on selected products 7 Applicable Promotion(s)
In Stock.
Want it Tuesday, Jan. 9? Order within 2 hrs 13 mins and choose Two-Day Shipping at checkout. Details
Sold by ALLPOWERSDirect and Fulfilled by Amazon. Gift-wrap available.
Color: 18V100W
$6.59
$7.99
$8.79
$89.99
50W
$179.99
$18.99
$34.99

HAMILTONFERRIS

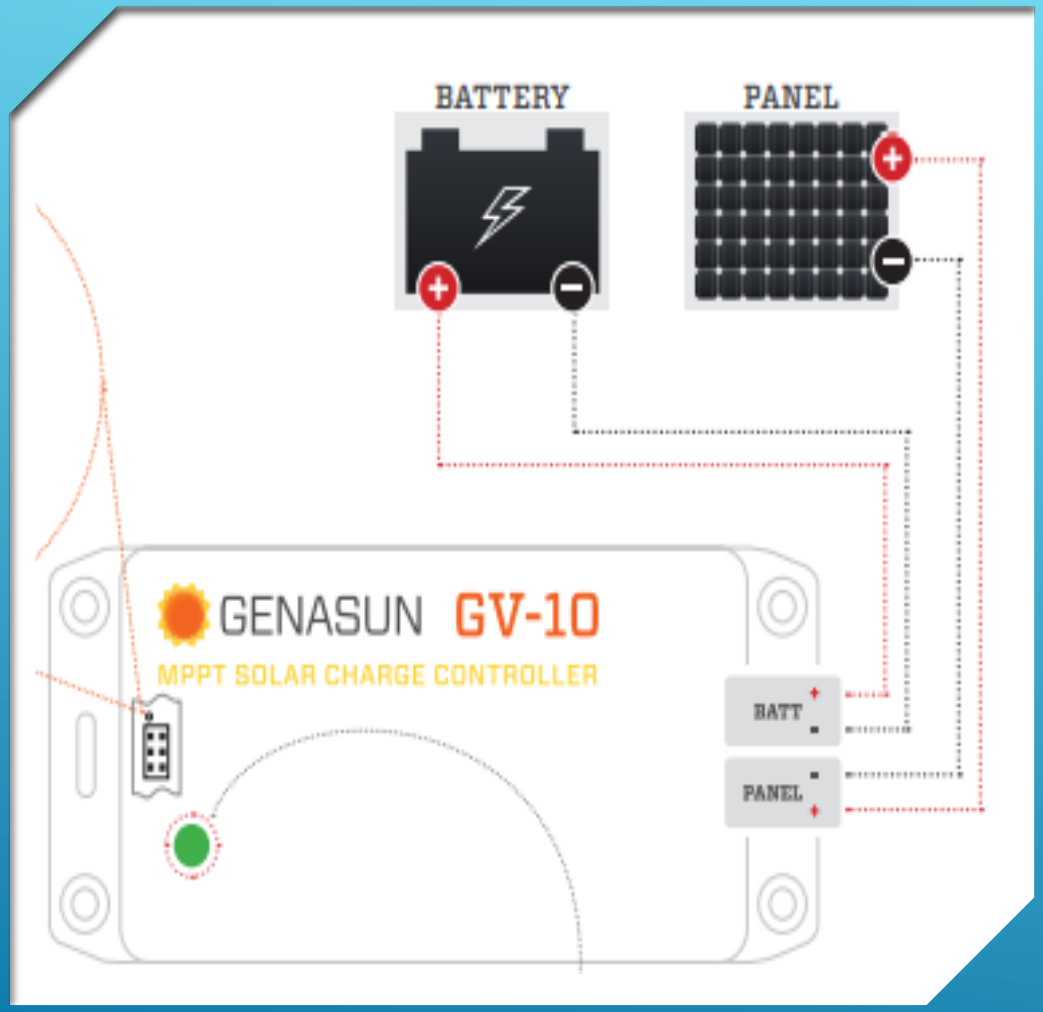
Power for Boat, Home & RV since 1975

SolarFlexx

With SolarSnaps

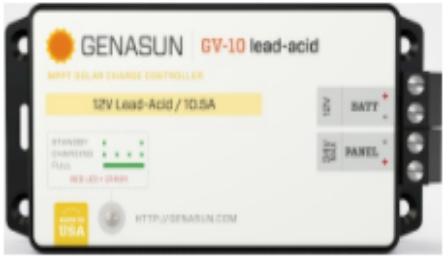


Model	Approx. A/Hr/Day	Package	Panel	Panel Size / ea.	Price
SolarFlexx 30W	30 Watt	Panel only	SF 30W	21.6" x 15.0"	$299.00
SolarFlexx 55W	55 Watt, NEW 2018	Panel only	SF 55W	22.1 x 22.0"	$399.00
SolarFlexx 110W	110 Watt, NEW 2018	Panel only	SF 110W	41.8 x 21.4"	$699.00
SF-400-4P	400 Watt 184A/Hr/Day	Live Aboard Serious Power	4x 100W	41.8 x 21.4"	$3699.00
SF-300-3P	300 Watt 138A/Hr/Day	Extended Cruising	3x 100W	41.8 x 21.4"	$2599.00
SF-200-2S	200 Watt 92A/Hr/Day	Full Time Fridge Use	2x 100W	41.8 x 21.4"	$1799.00
SF-100-1	100 Watt 46A/Hr/Day	Weekend Fridge Use	1x 100W	41.8 x 21.4"	$1099.00
SF-100-2S	100 Watt 46A/Hr/Day	Weekend Space Saver	2x 50W	22.1 x 24.6"	$1139.00
SF-50-1	50 Watt 23A/Hr/Day	House Bank Maintainer	1x 50W	22.1 x 24.6"	$659.00



SOLAR CHARGE CONTROLLERS

- Essential to optimize battery charging and prevent overcharging
- Multi-stage charging profile (bulk, absorption, float)
- MPPT (Maximum Power Point Tracking) vs PWM (Pulse Width Modulation) types
- Ideally use one controller per panel which eliminates one panel bringing down overall output
- Some can boost low voltage panels (remember batteries require up to 14v to charge)



Genasun $65-$175

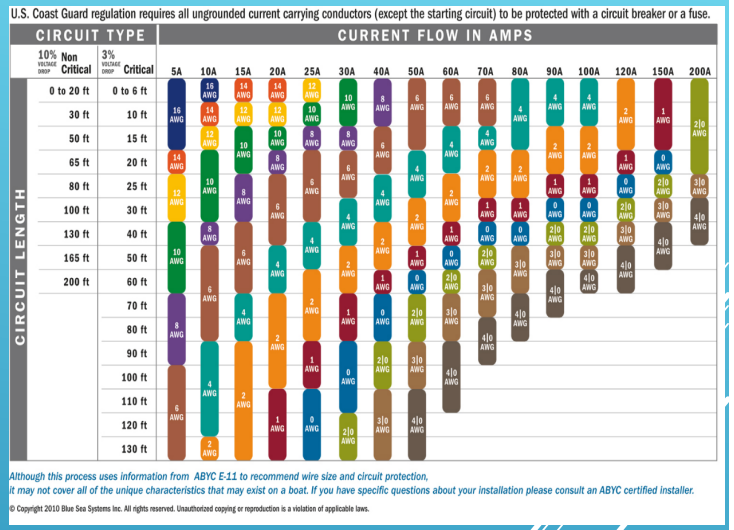
Blue Sky Energy $180-$199

Western Co. $207-$460

Victron BlueSolar $139-$381

POPULAR MPPT CONTROLLERS

- **Panel voltage and wire size**
  - For a given wattage panel, higher voltage panels have lower current and can therefore use thinner gauge wire (W = A x V)
  - Useful fact for long wire runs from panels to controller(s)
- **Choosing the optimal wire gauge**
  - The longer the run the higher the loss or voltage drop (remember the run length is measured as a round trip)
  - Good West Marine article: https://www.westmarine.com/WestAdvisor/Marine-Wire-Size-And-Ampacity
  - ABYC recommends max 3% voltage drop
  - Most wire size tables are for 12 or 24 volt only, so need a calculator for solar panel runs
    - Web: http://wiresizecalculator.net/
    - App: WireSizer for Apple: http://www.wiresizer.com/


U.S. Coast Guard regulation requires all ungrounded current carrying conductors (except the starting circuit) to be protected with a circuit breaker or a fuse.

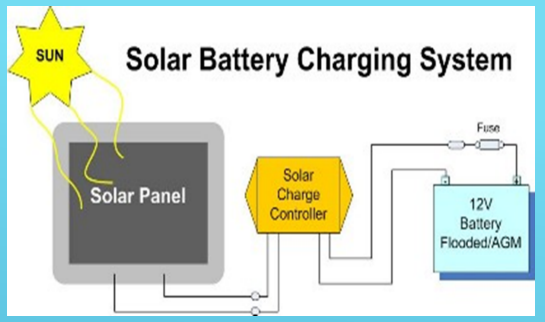
CIRCUIT TYPE		CURRENT FLOW IN AMPS															
10% VOLTAGE DROP Non Critical	3% VOLTAGE DROP Critical	5A	10A	15A	20A	25A	30A	40A	50A	60A	70A	80A	90A	100A	120A	150A	200A
CIRCUIT LENGTH																	
0 to 20 ft	0 to 6 ft	16 AWG	16 AWG	14 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	1 AWG	2/0 AWG
30 ft	10 ft	14 AWG	14 AWG	12 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	2 AWG	1 AWG	0 AWG	3/0 AWG
50 ft	15 ft	12 AWG	12 AWG	10 AWG	10 AWG	8 AWG	8 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	1 AWG	1 AWG	2/0 AWG	4/0 AWG
65 ft	20 ft	14 AWG	10 AWG	8 AWG	8 AWG	6 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	1 AWG	0 AWG	0 AWG	0 AWG	3/0 AWG	
80 ft	25 ft	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	1 AWG	1 AWG	0 AWG	2/0 AWG	2/0 AWG	2/0 AWG	4/0 AWG	
100 ft	30 ft	10 AWG	8 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	0 AWG	2/0 AWG	3/0 AWG	3/0 AWG	3/0 AWG		
130 ft	40 ft	8 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2/0 AWG	2/0 AWG	3/0 AWG	3/0 AWG	4/0 AWG	4/0 AWG	4/0 AWG		
165 ft	50 ft	6 AWG	4 AWG	2 AWG	1 AWG	1 AWG	0 AWG	2/0 AWG	3/0 AWG	3/0 AWG	4/0 AWG	4/0 AWG					
200 ft	60 ft	4 AWG	2 AWG	1 AWG	0 AWG	0 AWG	2/0 AWG	3/0 AWG	4/0 AWG	4/0 AWG							
	70 ft																
	80 ft																
	90 ft																
	100 ft																
	110 ft																
	120 ft																
	130 ft																

Although this process uses information from ABYC E-11 to recommend wire size and circuit protection, it may not cover all of the unique characteristics that may exist on a boat. If you have specific questions about your installation please consult an ABYC certified installer.

WIRE SIZING

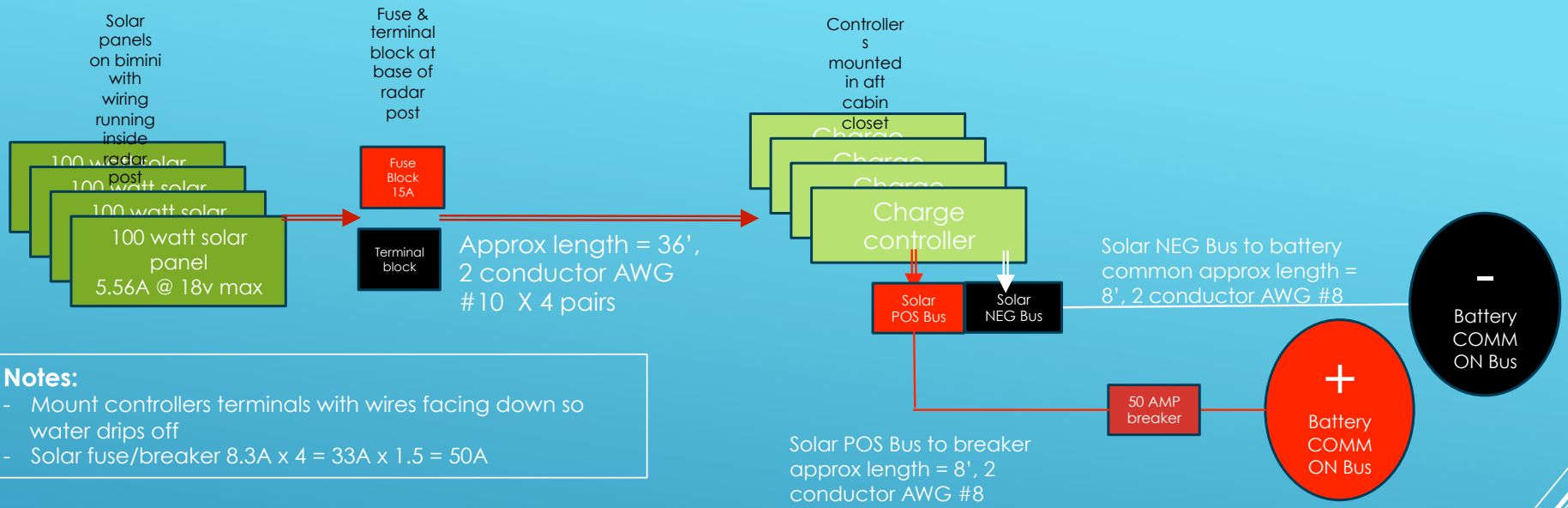
CONNECTING EVERYTHING & DISCONNECTING

- **Fuses protect the wire**
  - Sized 1.5 x max expected amps
  - Protect positive lead at each end of wire



- **MC4 connectors**
  - Industry standard plug and socket for connecting solar panels
  - Waterproof design using o-ring seals
  - Special crimping tool required
  - Disconnect tool required

- **Wire**
  - Use Ancor marine grade tinned wire: red &yellow "safety" duplex cable
  - Use waterproof heat-shrink crimp terminals



Notes:
- Mount controllers terminals with wires facing down so water drips off
- Solar fuse/breaker 8.3A x 4 = 33A x 1.5 = 50A

4 Solar Panels	Length	Length x 2	Volts	Amps	WireSizer app	CharlieWing tables	Min CM from Charlie Wang	CM AWG based on table
Solar panels to controllers	36	72	18	5.56	10	8	7,969	10
Controllers to buses	8	16	12	33	8	8	15,767	8
Buses to battery	8	16	12	33	8	8	15,767	8

AWG	Min CM for AWG
18	1,620
16	2,580
14	4,110
13	6,530
10	10,380
8	16,510
6	26,240

MYSTIC ROSE WIRING & FUSES

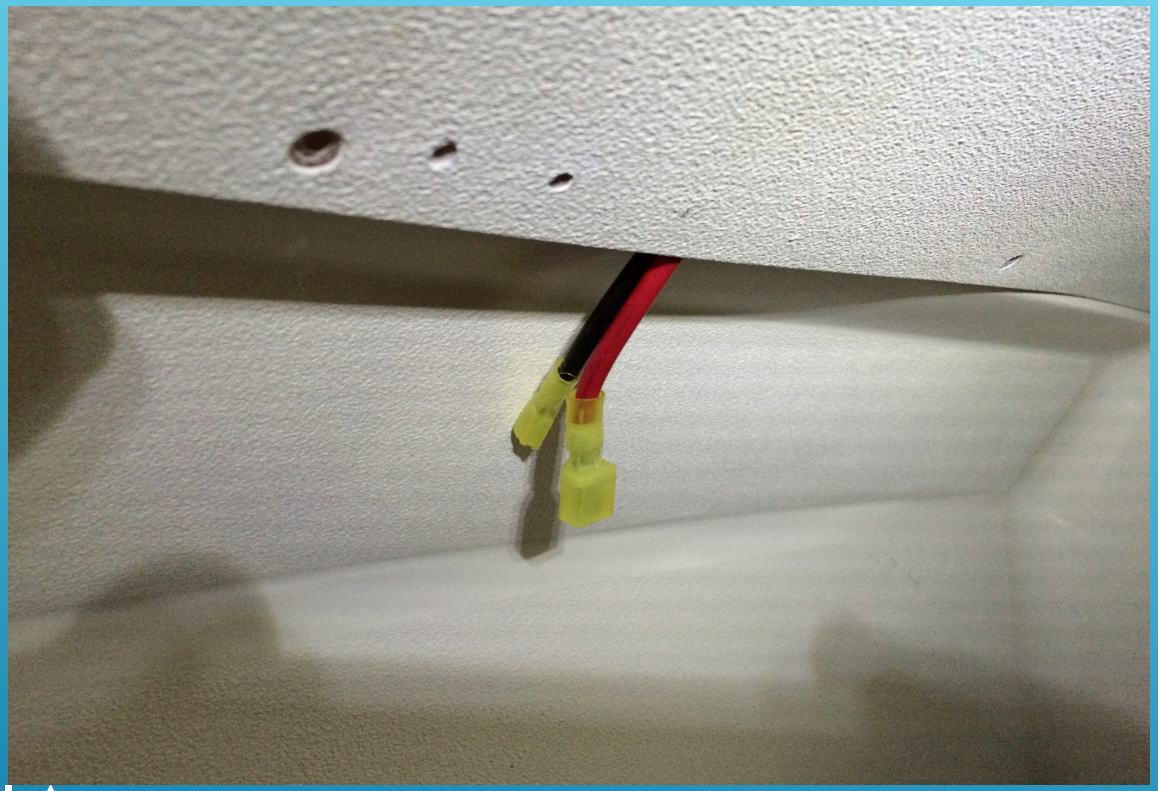
MYSTIC ROSE INSTALLATION

Take a pic of fuse block base of radar post

SALACIA INSTALLATION

SALACIA INSTALLATION

SALACIA INSTALLATION



SALACIA INSTALLATION

SALACIA INSTALLATION

SALACIA INSTALLATION

COSTS FOR MYSTIC ROSE INSTALLATION

- **Parts:**
  - Solar panels: 4 x $180 = $720
  - Controllers: 4 x $100 = $400
  - Wire, terminals, fuse blocks: $350
  - Canvas work - velcro strips to bimini and panels: $500
- **Total Parts:** $1970
- **Personal Labor:** 40 hrs

COSTS FOR SALACIA INSTALLATION

- **Parts:**
  - Solar panels, wiring, cable clam, regulator = $1,252
  - Battery Monitor = $169
  - Canvas work - velcro strips to dodger and panels: $450
- **Total Parts:** $1871
- **Personal Labor:** hrs = Endless

WHAT'S NEXT

- Mystic Rose experimenting with 2x 50w panels on shrinkwrap to charge batteries during winter
- Considering adding 2x 50w to bimini this spring

REFERENCES

- **BruceSchwab Energy Systems:** https://www.bruceschwab.com/solar-power/
- **Renogy solar panels:** https://www.renogy.com/
- **Victron battery monitors and controllers:** https://www.victronenergy.com/battery-monitors
- **HamiltonFerris:** http://www.hamiltonferris.com/categories/Solar_Power/6
- **Genasun controllers:** https://genasun.com/
- **Seafrost refrigeration:** http://seafrost.com/
- **Ancor wire and terminals:** http://www.ancorproducts.com

- **PDF of this presentation**: http://bit.ly/BWSC-DIYSolar