

SOLAR PANEL INFO

What is PV & how does it work?

PV stands for photovoltaic. Photo = Light and Voltaic = Electricity. A solar cell converts light to electricity.

A solar cell is made of silicon. Computer chips are made of this same material. Basically, when light strikes the surface of a solar cell some of it is absorbed into the silicon. This light energy bumps the electrons loose and causes energy to flow.

By packaging approximately 36 solar cells together a solar panel or a solar module is created. When you have more than one solar panels you create a solar array.

What makes up a PV system? What is BOS?

BOS stands for Balance of System. For a complete system you will need more than just a solar panel. Here is a short list of other components that might be required for your system.

- Solar Panel Mount
- Inter Module Wiring
- Output Cable
- Charge Controller
- Fusing
- Battery

- Low Voltage Disconnect, This is built into most charge controllers
- Inverter, For AC power

System Setup:

Solar---Charge Controller---Battery---Inverter---AC Loads

or

Solar---Charge Controller---Battery---DC Loads

What kind of inverter do I need?

The type and size of inverter necessary depends on your application. To determine this you must first calculate the maximum amount of load you will be running on the inverter at one time.

There are basically four size ranges of inverters. The first is 50-300 watts; these are small portable inverters. These inverters are ideal for laptops, small lights and other minimal draw AC loads.

The next size range is 300-800 watts. These are also somewhat portable and still have the outlets on the front of the inverter. This size inverter is good for small microwaves and other small appliances.

The third range is from 800-2000 watts. These units usually have battery chargers built into them. You can recharge your batteries with utility power or generator power. They are also great for powering medium size AC loads, or running multiple smaller loads at one time. These units are typically permanently installed.

The final inverter grouping is a permanently installed units ranging 2,000-11,000

watts. They function much like small generators, yet are completely silent in operation. They are great for your larger loads, such as refrigerators.

The other question that needs to be answered when selecting an inverter is the type of wave form. If you are running sensitive electronic equipment, like fax machines, laser printers or high tech stereo equipment you need a sine wave inverter. A sine wave inverter has a wave form that is very similar to the form of grid electricity. Other options may include modified sine wave, which is fine for items that are not supersensitive to clean power. You may experience a humming sound when powering clocks, and small radios on a modified sine wave inverter.

What Kind of Battery do I need?

The most common type of battery used in a solar system is a lead-acid battery. They are generally used because they have a low initial cost and are readily available. These batteries must be deep-cycle batteries. If the battery is a shallow cycle or automotive type it will not function correctly in the system. The deep cycle batteries are designed to discharge and recharge or cycle day after day for years.

The next decision is whether the batteries are sealed or flooded. A sealed battery never needs water added nor does it need an equalization charge. The benefits of this battery are; the battery can be mounted in any position and are easy to transport. The one downside is that they need to be monitored closely as to not overcharge. A flooded battery also needs close attention. The water level needs to be checked often and re-filled. You will also need to perform an equalization charge, which is a long steady controlled overcharge. This removes sulfation from the battery plates. While this restores the battery's capacity, it can lessen the life of the batteries by warping the plates.

So you need to decide which battery fits your specific needs. As long as the battery is taken care of you can expect a long battery life using either battery type.

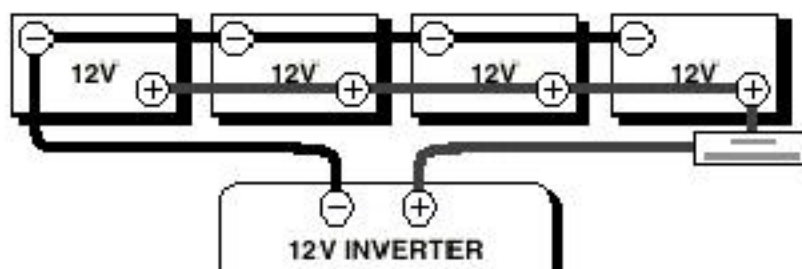
When do I need a charge controller and why?

The safest way to figure out if you need a charge controller is to take Battery Amp Hour Capacity and divide this by the Solar Panel max. power amp rating. If the quotient is above 200, you don't need a controller. If the number is less than 200 than you need a controller.

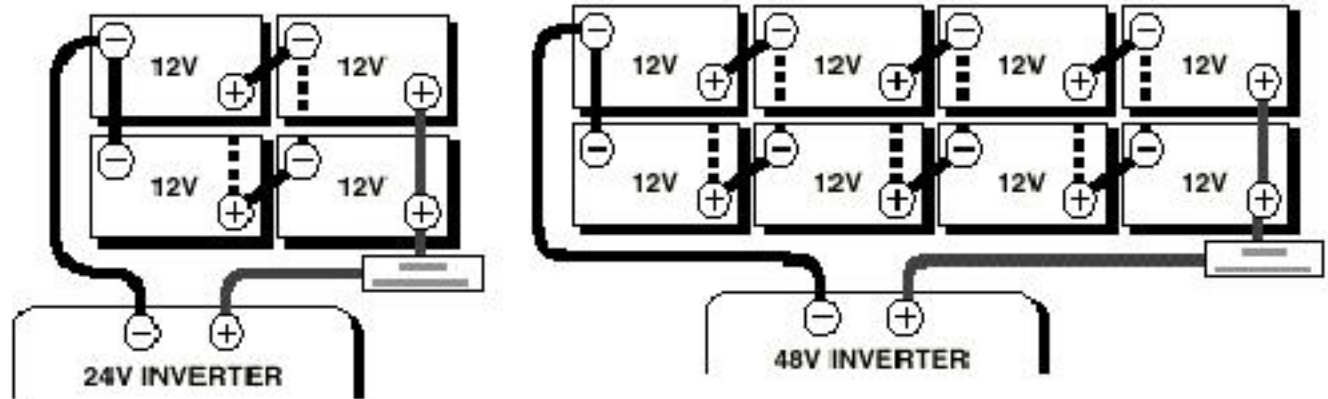
For example if you have a 100 amp hour battery and a 10 watt panel, you take 100 and divide it by .6 (600mA) and you get 166.6. Since this is less than 200 you need a charge controller. If you have a five-watt panel in the above example you take 100 divided by .3 (300mA) and you come up with 333.3. Since this is larger than 200 you do not need a charge controller. However you still need a blocking diode, to prevent the battery from discharging to the panel at night. So as a general rule of thumb you don't need a charge controller unless you have more than five watts of solar for every 100-amp hours of battery capacity.

How do I wire my batteries for different voltages?

There are two major terms in battery wiring: series, and parallel. Parallel wiring keeps the voltages the same, while increasing the capacity. Parallel can be described as positive to positive, negative to negative. Here is an example of paralleling four batteries in a 12volt system.



Series connecting increases the voltage in a system, while capacity of the battery bank remains the same. Here is an example of series connecting four batteries together to create a 48volt system, and a 24volt system. Then paralleling the 24 and 48volt banks with another 24 and 48volt bank to increase capacity.



What size wire do I need?

Using the below charts, find the current in amps on the left. Follow this to the left until you see the one way length of wire you need in feet. Then look straight up to the wire size at the top. For example, I want to run a 10 amp load wire 50' with 5% losses or less at 12 volt. I will need #6 AWG wire.

Wire Sizing Chart

Voltage	12												
	Loss	5%											
Current (amps)	Wire Gauge												
	14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0	
1	106	169	269	427	679	1080	1717	2166	2730	3444	4342	5475	
2	53	85	134	214	340	540	859	1083	1365	1722	2171	2738	
3	35	56	90	142	226	360	572	722	910	1148	1447	1825	
4	27	42	67	107	170	270	429	542	682	861	1086	1369	
5	21	34	54	85	136	216	343	433	546	689	868	1095	
6	18	28	45	71	113	180	286	361	455	574	724	913	

7	15	24	38	61	97	154	245	309	390	492	620	782
8	13	21	34	53	85	135	215	271	341	430	543	684
9	12	19	30	47	75	120	191	241	303	383	482	608
10	11	17	27	43	68	108	172	217	273	344	434	548
15	7	11	18	28	45	72	114	144	182	230	289	365
20	NA	8	13	21	34	54	86	108	136	172	217	274
25	NA	NA	11	17	27	43	69	87	109	138	174	219
30	NA	NA	9	14	23	36	57	72	91	115	145	183
35	NA	NA	NA	12	19	31	49	62	78	98	124	156
40	NA	NA	NA	NA	17	27	43	54	68	86	109	137
45	NA	NA	NA	NA	15	24	38	48	61	77	96	122
50	NA	NA	NA	NA	14	22	34	43	55	69	87	110
55	NA	NA	NA	NA	12	20	31	39	50	63	79	100
60	NA	NA	NA	NA	11	18	29	36	45	57	72	91

Voltage	12												
Loss	2%												
		Wire Gauge											
		14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0
Current													
(amps)													
1	43	68	107	171	272	432	687	866	1092	1377	1737	2190	
2	21	34	54	85	136	216	343	433	546	689	868	1095	
3	14	23	36	57	91	144	229	289	364	459	579	730	
4	11	17	27	43	68	108	172	217	273	344	434	548	
5	9	14	21	34	54	86	137	173	218	275	347	438	
6	7	11	18	28	45	72	114	144	182	230	289	365	

7	6	10	15	24	39	62	98	124	156	197	248	313
8	5	8	13	21	34	54	86	108	136	172	217	274
9	5	8	12	19	30	48	76	96	121	153	193	243
10	4	7	11	17	27	43	69	87	109	138	174	219
15	3	5	7	11	18	29	46	58	73	92	116	146
20	NA	3	5	9	14	22	34	43	55	69	87	110
25	NA	NA	4	7	11	17	27	35	44	55	69	88
30	NA	NA	4	6	9	14	23	29	36	46	58	73
35	NA	NA	NA	5	8	12	20	25	31	39	50	63
40	NA	NA	NA	NA	7	11	17	22	27	34	43	55
45	NA	NA	NA	NA	6	10	15	19	24	31	39	49
50	NA	NA	NA	NA	5	9	14	17	22	28	35	44
55	NA	NA	NA	NA	5	8	12	16	20	25	32	40
60	NA	NA	NA	NA	5	7	11	14	18	23	29	37

Voltage	24												
Loss	5%												
		Wire Gauge											
		14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0
Current													
(amps)													
1	213	338	537	854	1359	2160	3434	4332	5460	6887	8684	10951	
2	106	169	269	427	679	1080	1717	2166	2730	3444	4342	5475	
3	71	113	179	285	453	720	1145	1444	1820	2296	2895	3650	
4	53	85	134	214	340	540	859	1083	1365	1722	2171	2738	
5	43	68	107	171	272	432	687	866	1092	1377	1737	2190	
6	35	56	90	142	226	360	572	722	910	1148	1447	1825	

7	30	48	77	122	194	309	491	619	780	984	1241	1564
8	27	42	67	107	170	270	429	542	682	861	1086	1369
9	24	38	60	95	151	240	382	481	607	765	965	1217
10	21	34	54	85	136	216	343	433	546	689	868	1095
15	14	23	36	57	91	144	229	289	364	459	579	730
20	NA	17	27	43	68	108	172	217	273	344	434	548
25	NA	NA	21	34	54	86	137	173	218	275	347	438
30	NA	NA	18	28	45	72	114	144	182	230	289	365
35	NA	NA	NA	24	39	62	98	124	156	197	248	313
40	NA	NA	NA	NA	34	54	86	108	136	172	217	274
45	NA	NA	NA	NA	30	48	76	96	121	153	193	243
50	NA	NA	NA	NA	27	43	69	87	109	138	174	219
55	NA	NA	NA	NA	25	39	62	79	99	125	158	199
60	NA	NA	NA	NA	23	36	57	72	91	115	145	183

Voltage	24												
Loss	2%												
		Wire Gauge											
		14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0
Current	(amps)												
1		85	135	215	342	543	864	1374	1733	2184	2755	3474	4380
2		43	68	107	171	272	432	687	866	1092	1377	1737	2190
3		28	45	72	114	181	288	458	578	728	918	1158	1460
4		21	34	54	85	136	216	343	433	546	689	868	1095
5		17	27	43	68	109	173	275	347	437	551	695	876

6	14	23	36	57	91	144	229	289	364	459	579	730
7	12	19	31	49	78	123	196	248	312	394	496	626
8	11	17	27	43	68	108	172	217	273	344	434	548
9	9	15	24	38	60	96	153	193	243	306	386	487
10	9	14	21	34	54	86	137	173	218	275	347	438
15	6	9	14	23	36	58	92	116	146	184	232	292
20	NA	7	11	17	27	43	69	87	109	138	174	219
25	NA	NA	9	14	22	35	55	69	87	110	139	175
30	NA	NA	7	11	18	29	46	58	73	92	116	146
35	NA	NA	NA	10	16	25	39	50	62	79	99	125
40	NA	NA	NA	NA	14	22	34	43	55	69	87	110
45	NA	NA	NA	NA	12	19	31	39	49	61	77	97
50	NA	NA	NA	NA	11	17	27	35	44	55	69	88
55	NA	NA	NA	NA	10	16	25	32	40	50	63	80
60	NA	NA	NA	NA	9	14	23	29	36	46	58	73

Voltage	48												
Loss	5%												
		Wire Gauge											
		14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0
Current													
(amps)													
1	425	676	1074	1709	2717	4320	6869	8664	10919	13774	17369	21902	
2	213	338	537	854	1359	2160	3434	4332	5460	6887	8684	10951	
3	142	225	358	570	906	1440	2290	2888	3640	4591	5790	7301	
4	106	169	269	427	679	1080	1717	2166	2730	3444	4342	5475	

5	85	135	215	342	543	864	1374	1733	2184	2755	3474	4380
6	71	113	179	285	453	720	1145	1444	1820	2296	2895	3650
7	61	97	153	244	388	617	981	1238	1560	1968	2481	3129
8	53	85	134	214	340	540	859	1083	1365	1722	2171	2738
9	47	75	119	190	302	480	763	963	1213	1530	1930	2434
10	43	68	107	171	272	432	687	866	1092	1377	1737	2190
15	28	45	72	114	181	288	458	578	728	918	1158	1460
20	NA	34	54	85	136	216	343	433	546	689	868	1095
25	NA	NA	43	68	109	173	275	347	437	551	695	876
30	NA	NA	36	57	91	144	229	289	364	459	579	730
35	NA	NA	NA	49	78	123	196	248	312	394	496	626
40	NA	NA	NA	NA	68	108	172	217	273	344	434	548
45	NA	NA	NA	NA	60	96	153	193	243	306	386	487
50	NA	NA	NA	NA	54	86	137	173	218	275	347	438
55	NA	NA	NA	NA	49	79	125	158	199	250	316	398
60	NA	NA	NA	NA	45	72	114	144	182	230	289	365

Voltage	48												
Loss	2%												
		Wire Gauge											
		14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0
Current													
(amps)													
1	170	270	430	683	1087	1728	2748	3466	4368	5510	6947	8761	
2	85	135	215	342	543	864	1374	1733	2184	2755	3474	4380	

3	57	90	143	228	362	576	916	1155	1456	1837	2316	2920
4	43	68	107	171	272	432	687	866	1092	1377	1737	2190
5	34	54	86	137	217	346	550	693	874	1102	1389	1752
6	28	45	72	114	181	288	458	578	728	918	1158	1460
7	24	39	61	98	155	247	393	495	624	787	992	1252
8	21	34	54	85	136	216	343	433	546	689	868	1095
9	19	30	48	76	121	192	305	385	485	612	772	973
10	17	27	43	68	109	173	275	347	437	551	695	876
15	11	18	29	46	72	115	183	231	291	367	463	584
20	NA	14	21	34	54	86	137	173	218	275	347	438
25	NA	NA	17	27	43	69	110	139	175	220	278	350
30	NA	NA	14	23	36	58	92	116	146	184	232	292
35	NA	NA	NA	20	31	49	79	99	125	157	198	250
40	NA	NA	NA	NA	27	43	69	87	109	138	174	219
45	NA	NA	NA	NA	24	38	61	77	97	122	154	195
50	NA	NA	NA	NA	22	35	55	69	87	110	139	175
55	NA	NA	NA	NA	20	31	50	63	79	100	126	159
60	NA	NA	NA	NA	18	29	46	58	73	92	116	146