

## **3.5 KWh Off-Grid Solar Power Station**

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## Introduction

The 3.5KWh off-grid solar power station is a DIY (Do It Yourself) draft project with an approximate cost of \$7833.11 USD (substituting the true sine wave inverter with a modified sine wave inverter can reduce the cost several hundred dollars more). On average I've found equivalent off-grid power stations to cost approximately \$9000.00 USD (shipping / handling / installation not typically included).

This power station is rated at 1.08KW of power generation capability with 790Ah battery storage capacity. The power capability of the station, while it may be primary in some scenarios, is best suited in many cases as a power support or power reserve system. However, in a primary scenario some may consider putting together several power stations – such as one power station providing power for a section of a building, another power station providing power for a different section of a building and so forth. Such an approach would provide power independence, and, failure tolerance/ isolation.

How is the 3.5KWh measurement for this power station derived with the 12VDC, 790Ah battery pack? This measurement (to determine load in Watt-Hours a battery pack could support) can be determined by:

**Battery Pack Value:** 12VDC – 790Ah

**Step 1:** Calculate total watt-hours of battery pack

$$790\text{Ah} * 12\text{VDC} = 9480\text{Wh}$$

**Step 2:** Offset, in hours, 50% discharge

$$9480\text{Wh} * 12\text{Hours} = 113760$$

**Step 3:** Compensate for average lowest temperature (1 = 80F degrees, 1.19 = 50F degrees, 1.59 = 20F degrees)

$$113760 / 1.19 = 95596.63$$

**Step 4:** Compensate for number of days of power support

$$95596.63 / 1 = 95596.63$$

**Step 5:** Compensate for electrical inefficiencies

$$95596.63 / 1.15 = 83127.51$$

**Step 6:** Convert to Watt-Hours (24 hours in a day)

$$83127.51 / 24 = 3463\text{Wh (approximately 3.5KWh)}$$

The next question you may have is how are the number of solar panels (8 panels) determined. This measurement is heavily impacted by environmental considerations (primarily cloud-cover and hours of sunlight). The following equation can provide a good estimate of the number of solar panels required to sustain a battery pack:

## Battery Pack Watt-Hours: 3463Wh

**Step 1:** Divide by hours of sunlight in a day  
 $3463 / 6.5 = 532.76$

**Step 2:** Compensate for average cloud-cover (1.30 is about average, 1.75 is more conservative)  
 $532.76 * 1.75 = 932.33$

**Step 3:** Divide by Watt rating of solar panel desired (in this case 130Watts)  
 $932.33 / 130 = 7.17$  (round up to 8 solar panels)

What are some items that may be powered with the 3.5KWh (3463 Wh) solar power station? To better aid in assessing what the station can support, see the table below. As you may be able to tell, to determine the Wh (watt-hours) consumed by an item is calculated by finding out how many Watts of power the item requires and multiplying that by the number of hours it operates in twenty-four hours:  
 $W * H = Wh$ .

Item Watt Requirement	Number of Hours Operating	Wh Required
60 Watts	24 Hours	1440 Wh
120 Watts	24 Hours	2880 Wh
140 Watts	24 Hours	3360 Wh
150 Watts	24 Hours	3600 Wh
160 Watts	24 Hours	3840 Wh
500 Watts	7 Hours	3500 Wh
800 Watts	4 Hours	3840 Wh

**Figure 1: Hypothetical Power Use of Different Items**

There may be cases where the item does not provide how many Watts of power is consumes. Instead you may be provided with a measure known as Amps. In this case if you know the voltage and amps the item requires you can get an approximation of the Wh it requires. As an example, assume you have a mid-sized TV that uses 120VAC and 1.5 Amps. First, find the watts it consumes by using the formula  $V * A = W$ . In this case  $120 * 1.5 = 180$  watts. Let's assume it is going to be on for five hours. Second, use the formula  $W * H = Wh$  to determine how many Watts of power the item requires as:  $180 * 5 = 900Wh$ .

Given that information, the 3.5KWh solar power station (3463 Wh) can easily support the power requirements of the TV. However, not all items may be calculated so simply. For instance take a refrigerator as an example. It is an item that cycles so that it is not always on. To get a better idea of how many Wh a fictitious mid-sized refrigerator requires means taking several factors into account:

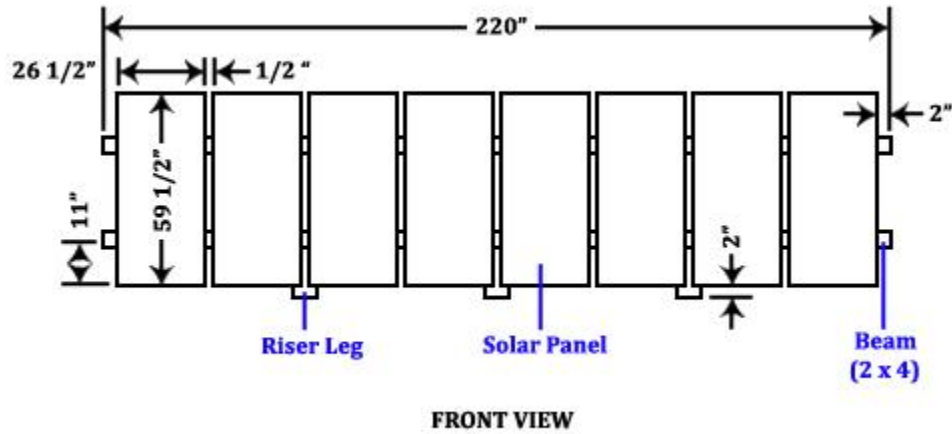
1. Power needs: 120VAC @ 3Amps
2. Cycles 12 times per hour
3. Each cycle duration is 1 minute; this means 12 minutes of run-time per hour being 288 minutes per 24 hours, or, 4.8 hours of run-time per 24 hours

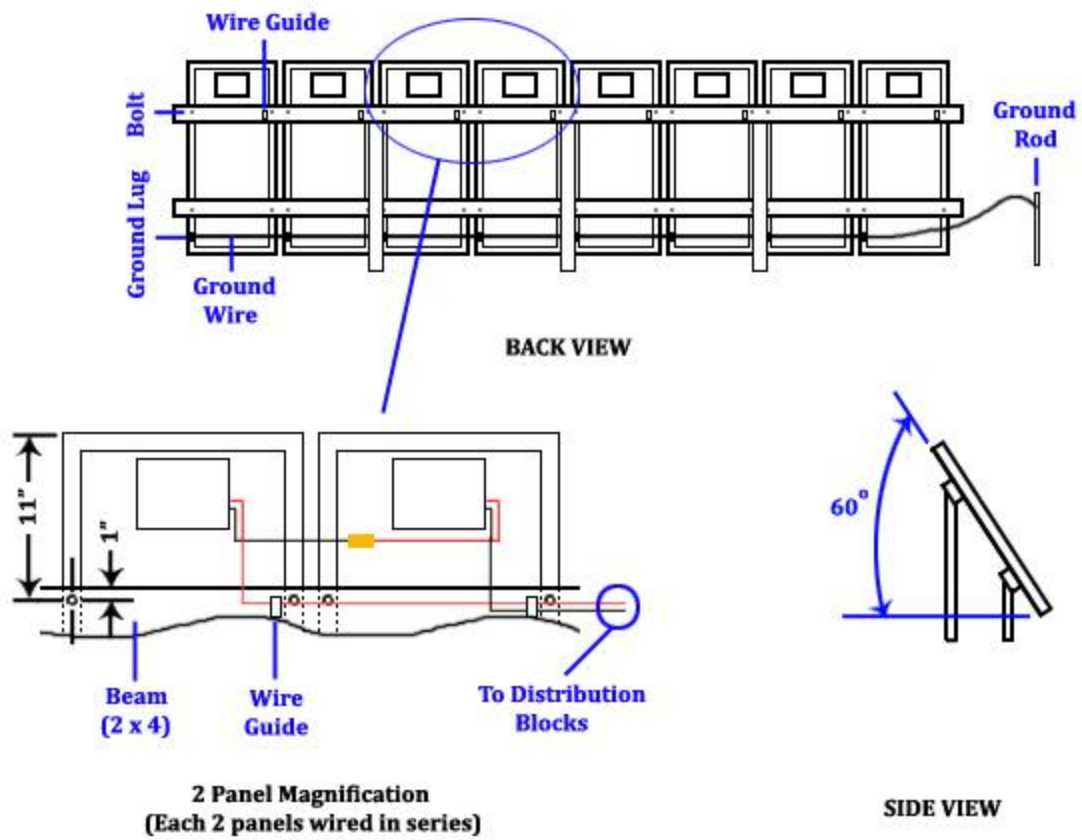
Given those observations it can be determined the refrigerator will require 1728Wh of power per 24

hours ( $360 * 4.8 = 1728$ ). This is drastically less than just calculating  $360 * 24 = 8640\text{Wh}$ ! The important thing to remember when considering a solar system is to determine exactly what it will be supporting. Finally, many items are getting more power efficient as technology is refined...so a solar power station of a certain rating may be able to power more items in the future as opposed to today.

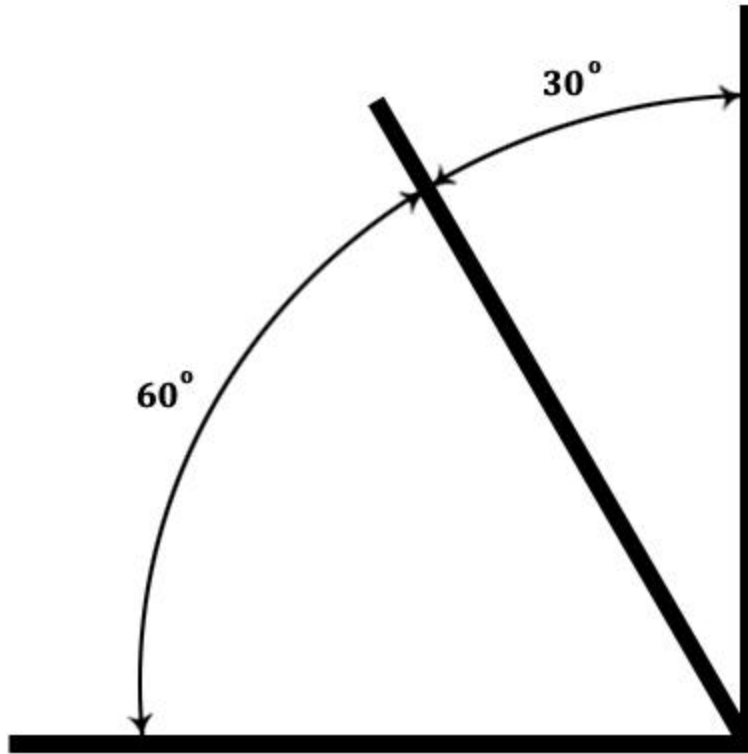
## Construction

As a DIY project there are a variety of materials and hardware (disclosed later) that are needed in order to assemble the power station. This section shows the different assembly segments along with an electrical diagram. The sequence of construction depends on how you may approach it with your experience. Let's open with the solar panel array:





Cutting angles can be challenging, depending on the equipment that may be at hand. I've found angle templates to be of use in such circumstances as shown below:

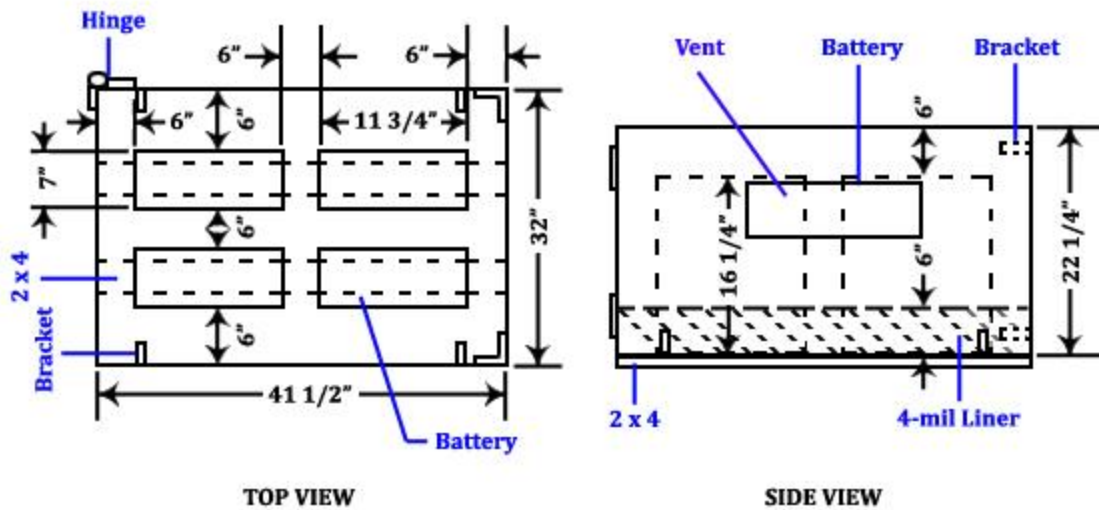


### ANGLE CUT-OUT

As you may be able to determine, the riser legs keep the bottom edge of the solar panels from touching the ground and also are cut on one end at an angle so that the solar panels are declined 30 degrees.

The next segment to put together is the battery container as shown below.

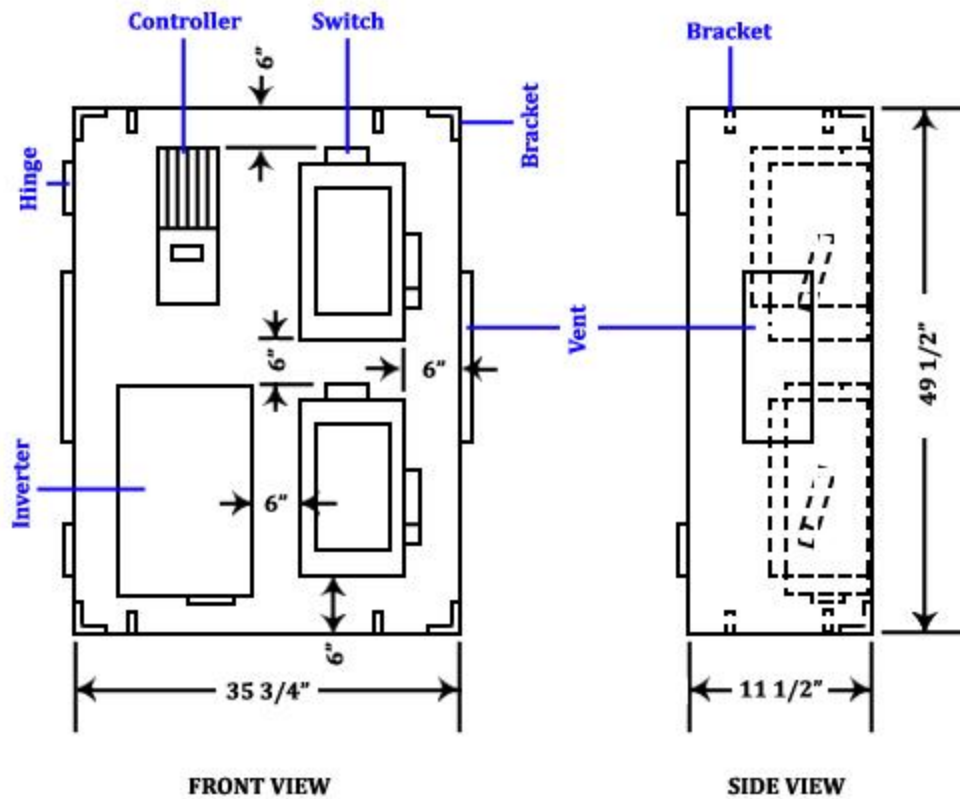




## BATTERY CONTAINER

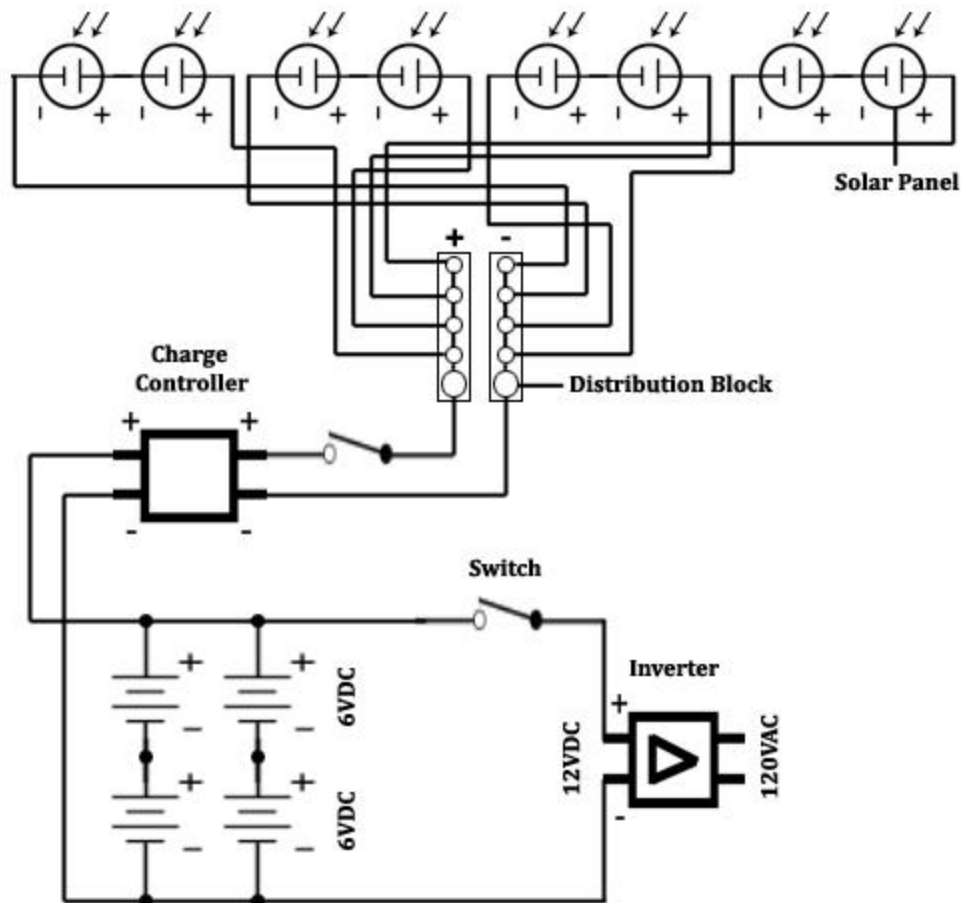
Two important things to note here is that the front panel actually opens and closes on hinges (you may want to secure it with a lock) so that the heavy batteries can be more easily placed and removed. This also means you may want to make the top of the container completely removable (and locked when in place). There is a 4-mil liner that covers the bottom of the container to form a sealed containment area. The liner is in place to catch any battery acid that may be leaked from the batteries; no need to contaminate the surface the container sits on top of. Finally, lead-acid batteries can create a lot of hydrogen (combustible). Although not shown here, you should place some type of ventilation at the top of the container so the hydrogen can escape. As well, if the battery container is inside of an enclosed structure you'll want to make sure that enclosure is ventilated.

The next segment to put together is the power container. This container will contain the components for charging the batteries as well as supplying AC power as shown below:



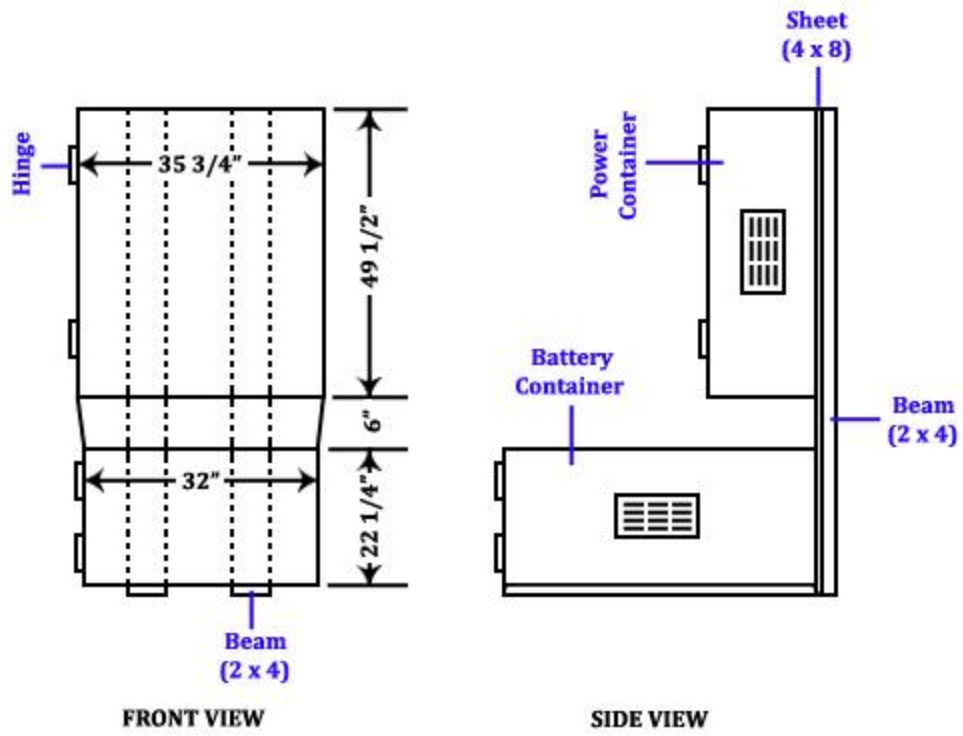
### POWER CONTROL CONTAINER

While focus is on the power control container, the next segment covered is how everything is wired together in the form of an electrical schematic; it should be straight-forward as to how components are connected.



Important things to note here is that component grounding is not shown as grounding methods may vary based on the components being used; manuals accompanying the components should be followed. Always use care when handling electrical wiring and practice the safest method of wiring everything together.

And last the battery and power containers may be put together so that they occupy the same space as shown below:



## Materials

There are a variety of materials that have been identified for the solar power station's construction. Materials are listed by business to make purchasing and tracking simpler. All prices listed are based on 2010 USD value and do not include any applicable taxes or shipping and handling charges. Some businesses are franchises or chain stores so you may be able to drive to a local business to pick up applicable materials.

### [www.altestore.com](http://www.altestore.com)

AltE - (877) 878-4060  
43 Broad Street, Suite A408  
Hudson, MA 01749-2556

Description	ID	Quantity	Price Each	Price Total
Grounding Lug with Set Screws Qty-1 <a href="http://www.altestore.com/store/Cables-Wiring/Wiring-For-Solar-Panels/Grounding-and-Wiring-Accessories/Grounding-Lug-with-Set-Screws-Qty-1/p2343/">http://www.altestore.com/store/Cables-Wiring/Wiring-For-Solar-Panels/Grounding-and-Wiring-Accessories/Grounding-Lug-with-Set-Screws-Qty-1/p2343/</a>	Item code: ALRLAY-IN-LUG-1 Model number: LAY-IN-LUG	8	5.12	40.96
Square D HU362RB 60 Amp 600V DC/AC 3 Pole Switch <a href="http://www.altestore.com/store/Enclosures-Electrical-Safety/Switch-Gear-Disconnects/Switchgear-Disconnects-DC/Square-D-HU362RB-60-Amp-600V-DCAC-3-Pole-Switch/p5683/">http://www.altestore.com/store/Enclosures-Electrical-Safety/Switch-Gear-Disconnects/Switchgear-Disconnects-DC/Square-D-HU362RB-60-Amp-600V-DCAC-3-Pole-Switch/p5683/</a>	Item code: SQUHU362RB Model number: HU362RB	2	307.23	614.46
Square D Ground Kit for HU362RB, H362RB, D223NRB <a href="http://www.altestore.com/store/Enclosures-Electrical-Safety/Switch-Gear-Disconnects/Switchgear-Disconnects-DC/Square-D-Ground-Kit-for-HU362RB-H362RB-D223NRB/p5682/">http://www.altestore.com/store/Enclosures-Electrical-Safety/Switch-Gear-Disconnects/Switchgear-Disconnects-DC/Square-D-Ground-Kit-for-HU362RB-H362RB-D223NRB/p5682/</a>	Item code: SQUGTK0610 Model number:GTK0610	2	12.99	25.98
Xantrex XW Solar Charge Controller MPPT 865-1030 <a href="http://www.altestore.com/store/Charge-Controllers/Solar-Charge-Controllers/MPPT-Solar-Charge-Controllers/Xantrex-MPPT-Solar-Charge-Controllers/Xantrex-XW-Solar-Charge-Controller-MPPT-865-1030/p5946/">http://www.altestore.com/store/Charge-Controllers/Solar-Charge-Controllers/MPPT-Solar-Charge-Controllers/Xantrex-MPPT-Solar-Charge-Controllers/Xantrex-XW-Solar-Charge-Controller-MPPT-865-1030/p5946/</a>	Item code: XANXWMPPT60-150 Model number: 865-1030-1	1	537.00	537.00
Go Power 1500W SW1500-12 12V Inverter <a href="http://www.altestore.com/store/Inverters/Off-Grid-Inverters/1000-to-1999-Watts/Go-Power-1500W-SW1500-12-12V-Inverter/p584/">http://www.altestore.com/store/Inverters/Off-Grid-Inverters/1000-to-1999-Watts/Go-Power-1500W-SW1500-12-12V-Inverter/p584/</a> <b>Note:</b> Depending on needs, a modified sine wave Inverter could be substituted which costs several hundred dollars less	Item code: OPGPSW1500-12 Model number: GP-SW-1500-12	1	665.00	665.00

**Total: 1883.40**

### [stormgrounding.electrical-insulators-and-copper-ground-bars.com](http://stormgrounding.electrical-insulators-and-copper-ground-bars.com)

Storm Copper Components Co. - 888-334-2177  
PO Box 99, 240 Industrial Lane  
Decatur, TN 37322

Description	ID	Quantity	Price Each	Price Total
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Portable Ground Rod Kit <a href="http://stormgrounding.electrical-insulators-and-copper-ground-bars.com/grounding-rods.html">http://stormgrounding.electrical-insulators-and-copper-ground-bars.com/grounding-rods.html</a>	#GRK-625-108	1	262.45	262.45
SRC Ground Rod Clamp: Ground Rod Size: 1/2" - 5/8" - 3/4" <a href="http://stormgrounding.electrical-insulators-and-copper-ground-bars.com/grounding-clamps.html">http://stormgrounding.electrical-insulators-and-copper-ground-bars.com/grounding-clamps.html</a>	#GVN-SRC-Clamp	2	7.40	14.80

**Total: 277.25**

### [www.frys.com](http://www.frys.com)

Fry's Electronics, Inc. - 877-688-7678  
9820 Kincaid Drive  
Fishers, IN 46038

Description	ID	Quantity	Price Each	Price Total
16-14 AWG Female .187" Quick Disconnects, Qty 19 <a href="http://www.frys.com/product/2604252?site=sr:SEARCH:MAIN_RSLT_PG">http://www.frys.com/product/2604252?site=sr:SEARCH:MAIN_RSLT_PG</a>	#: 2604252 P/N 2104H	2	1.99	3.98
12-10 AWG Butt Connectors, Qty 14 <a href="http://www.frys.com/product/2604982?site=sr:SEARCH:MAIN_RSLT_PG">http://www.frys.com/product/2604982?site=sr:SEARCH:MAIN_RSLT_PG</a>	#: 2604982 P/N 2062H	2	1.99	3.98
16-14 AWG Insulated Ring Terminals #8 Stud, Qty 19 <a href="http://www.frys.com/product/2605622?site=sr:SEARCH:MAIN_RSLT_PG">http://www.frys.com/product/2605622?site=sr:SEARCH:MAIN_RSLT_PG</a>	#: 2605622 P/N 2007H	2	1.99	3.98

**Total: 11.94**

### [www.grainger.com](http://www.grainger.com)

W.W. Grainger, Inc. - 800-323-0620  
5576 Irving St.  
Boise, ID 83706-1216

Description	ID	Quantity	Price Each	Price Total
Compression Lug, 6 AWG, 1/4 In Stud, BL <a href="http://www.grainger.com/Grainger/THOMAS-BETTS-1-Hole-Short-Barrel-Lug-3LL41">http://www.grainger.com/Grainger/THOMAS-BETTS-1-Hole-Short-Barrel-Lug-3LL41</a>	#3LL41	4	1.87	7.48

**Total: 7.48**

### [keithspecialty.com](http://keithspecialty.com)

KEITH SPECIALTY STORE - 800-705-8838  
6791 Route 119 N,  
Marion Center, PA 15759-7216

Description	ID	Quantity	Price Each	Price Total
6 AWG bare solid copper wire, used for grounding <a href="https://keithspecialty.com/elec.cable_wire.htm">https://keithspecialty.com/elec.cable_wire.htm</a>	#75-360c	35 feet	.65 foot	22.75

**Total: 22.75**

### [www.lowes.com](http://www.lowes.com)

Lowe's Companies, Inc. - 800-445-6937

20501 COOLEY ROAD  
BEND, OR 97701

Description	ID	Quantity	Price Each	Price Total
Utilitech 50'L 12-Gauge Extension Cord with Velcro Strap <a href="http://www.lowes.com/pd_242113-66906-UTK500830_0_?productId=3190815&amp;Ntt=extension+cord&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dextension%2Bcord%26page%3D2">http://www.lowes.com/pd_242113-66906-UTK500830_0_?productId=3190815&amp;Ntt=extension+cord&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dextension%2Bcord%26page%3D2</a>	Item #: 242113   Model #: UTK500830	2	44.87	89.74
Stanley-National Hardware 2 1/2" Mending Brace Zinc <a href="http://www.lowes.com/pd_315705-1277-DPB119_0_?productId=3172357&amp;Ntt=bracket&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dbracket%26page%3D35">http://www.lowes.com/pd_315705-1277-DPB119_0_?productId=3172357&amp;Ntt=bracket&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dbracket%26page%3D35</a> <b>Note:</b> Purchase bolts/nuts to fit	Item #: 315705   Model #: DPB119	3	2.46	7.38
2 x 4 x 8 Treated Lumber <a href="http://www.lowes.com/pd_85374-70740-054699261914_4294815011_4294937087_?productId=3189849&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Treated%2BLumber_4294815011_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_85374-70740-054699261914_4294815011_4294937087_?productId=3189849&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Treated%2BLumber_4294815011_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a>	Item #: 85374   Model #: 054699261914	12	4.97	59.64
Grip-Rite 1-Lb. Box 20D, 3-3/4" Cement Coated Sinker Nails <a href="http://www.lowes.com/pd_69168-1278-20CTDSKR1_4294865653_4294937087_?productId=3043039&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Nails_4294865653_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_69168-1278-20CTDSKR1_4294865653_4294937087_?productId=3043039&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Nails_4294865653_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a>	Item #: 69168   Model #: 20CTDSKR1	2	2.79	5.58
The Hillman Group Hex Tap Bolts 1/4-20 x 3 <a href="http://www.lowes.com/pd_214115-37672-883148_0_?productId=3024613&amp;Ntt=1%2F4+bolt&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3D1%252F4%2Bbolt%26page%3D5">http://www.lowes.com/pd_214115-37672-883148_0_?productId=3024613&amp;Ntt=1%2F4+bolt&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3D1%252F4%2Bbolt%26page%3D5</a>	Item #: 214115   Model #: 883148	16	1.12	17.92
The Hillman Group Hex Nuts Coarse Thread 1/4-20 <a href="http://www.lowes.com/pd_63301-37672-150003_0_?productId=3058547&amp;Ntt=1%2F4-20+nut&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3D1%252F4-20%2Bnut">http://www.lowes.com/pd_63301-37672-150003_0_?productId=3058547&amp;Ntt=1%2F4-20+nut&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3D1%252F4-20%2Bnut</a>	Item #: 63301   Model #: 150003	1	6.00	6.00
Project Pak 25 pk 1/4" Galvanized Flat Washers <a href="http://www.lowes.com/pd_41562-37672-492023_0_?productId=3033290&amp;Ntt=1%2F4+washer&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3D1%252F4%2Bwasher">http://www.lowes.com/pd_41562-37672-492023_0_?productId=3033290&amp;Ntt=1%2F4+washer&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3D1%252F4%2Bwasher</a>	Item #: 41562   Model #: 492023	2	2.61	5.22
4" Corner Brace <a href="http://www.lowes.com/pd_19165-54546-22506ZCLLG_0_?productId=3018972&amp;Ntt=bracket&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dbracket%26page%3D23">http://www.lowes.com/pd_19165-54546-22506ZCLLG_0_?productId=3018972&amp;Ntt=bracket&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dbracket%26page%3D23</a> <b>Note:</b> Purchase bolts/nuts to fit	Item #: 19165   Model #: 22506ZCLLG	20	2.69	53.80

1/4 x 2 x 4 Sanded Pine Plywood <a href="http://www.lowes.com/pd_7702-99999-7702_4294815996_4294937087_?productId=3196111&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Plywood_4294815996_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_7702-99999-7702_4294815996_4294937087_?productId=3196111&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Plywood_4294815996_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a>	Item #: 7702   Model #: 7702	1	8.73	8.73
1/4 x 4 x 8 Premium Plywood Underlayment <a href="http://www.lowes.com/pd_80246-99999-LBR80246_4294815996_4294937087_?productId=3177699&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Plywood_4294815996_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_80246-99999-LBR80246_4294815996_4294937087_?productId=3177699&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Plywood_4294815996_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a>	Item #: 80246   Model #: LBR80246	2	19.98	39.96
Stanley-National Hardware Zinc S & S Door Hinges <a href="http://www.lowes.com/pd_119229-1277-CD1751_0_?productId=3167565&amp;Ntt=door+hinges&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Ddoor%2Bhinges">http://www.lowes.com/pd_119229-1277-CD1751_0_?productId=3167565&amp;Ntt=door+hinges&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Ddoor%2Bhinges</a> <b>Note:</b> Purchase bolts/nuts to fit	Item #: 119229   Model #: CD1751	4	4.86	19.44
Air Vent 16" x 8" Mill Undereave Vent <a href="http://www.lowes.com/pd_17160-228-EV16824MF_0_?productId=3122219&amp;Ntt=vent&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dvent">http://www.lowes.com/pd_17160-228-EV16824MF_0_?productId=3122219&amp;Ntt=vent&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dvent</a>	Item #: 17160   Model #: EV16824MF	4	1.97	7.88
1/4 x 4 x 4 Sanded Pine Plywood <a href="http://www.lowes.com/pd_7703-99999-7703_4294815996_4294937087_?productId=3196113&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Plywood_4294815996_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_7703-99999-7703_4294815996_4294937087_?productId=3196113&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Plywood_4294815996_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a>	Item #: 7703   Model #: 7703	4	12.77	51.08
Contractor's Choice 10' x 25' Clear 4Mil Painter Plastic <a href="http://www.lowes.com/pd_16905-18632-RSCC410-25C_0_?productId=1040769&amp;Ntt=drop+plastic&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Ddrop%2Bplastic">http://www.lowes.com/pd_16905-18632-RSCC410-25C_0_?productId=1040769&amp;Ntt=drop+plastic&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Ddrop%2Bplastic</a>	Item #: 16905   Model #: RSCC410-25C	1	13.98	13.98

**Total: 386.35**

### www.lowes.com (Optional)

This purchase collection is optional because, as a DIY'er, more than likely you will already have the hardware listed or compatible substitutes.

Lowe's Companies, Inc. - 800-445-6937  
20501 COOLEY ROAD  
BEND, OR 97701

Description	ID	Quantity	Price Each	Price Total
PORTER-CABLE 6.0 Amp Orbital Jig Saw <a href="http://www.lowes.com/pd_160580-79992-PC600JS_4294857509_4294937087_?productId=3063759&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Jig%2BSaws_4294857509_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_160580-79992-PC600JS_4294857509_4294937087_?productId=3063759&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Jig%2BSaws_4294857509_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a>	Item #: 160580   Model #: PC600JS	1	69.97	69.97
PORTER-CABLE 10-Piece Jig Saw Blades <a href="http://www.lowes.com/ProductDisplay?partNumber=294746-70-PC1210H-&amp;iangId=-1&amp;storeId=10151&amp;productId=1208665&amp;catalogId=10051&amp;cmRelshp=rel&amp;rel=nofollow&amp;cld=PDIO1">http://www.lowes.com/ProductDisplay?partNumber=294746-70-PC1210H-&amp;iangId=-1&amp;storeId=10151&amp;productId=1208665&amp;catalogId=10051&amp;cmRelshp=rel&amp;rel=nofollow&amp;cld=PDIO1</a>	Item #: 294746   Model #: PC1210H	1	3.88	3.88



<p>PORTER-CABLE 10" JobSite Table Saw  <a href="http://www.lowes.com/pd_89913-46069-PCB220TS_4294857520_4294937087_?productId=3163783&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Table%2BSaws%2B_4294857520_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_89913-46069-PCB220TS_4294857520_4294937087_?productId=3163783&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Table%2BSaws%2B_4294857520_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a></p>	<p>Item #: 89913    Model #: PCB220TS</p>	1	299.00	299.00
<p>DEWALT 10" Wood Saw Blades Combo Pack  <a href="http://www.lowes.com/ProductDisplay?partNumber=135052-70-DW3106P5&amp;langId=-1&amp;storeId=10151&amp;productId=1214417&amp;catalogId=10051&amp;cmRelshp=rel&amp;rel=nofollow&amp;cld=PDIO1">http://www.lowes.com/ProductDisplay?partNumber=135052-70-DW3106P5&amp;langId=-1&amp;storeId=10151&amp;productId=1214417&amp;catalogId=10051&amp;cmRelshp=rel&amp;rel=nofollow&amp;cld=PDIO1</a></p>	<p>Item #: 135052    Model #: DW3106P5</p>	1	33.98	33.98
<p>DEWALT 18-Piece Pilot Point Drill Bit Set  <a href="http://www.lowes.com/pd_196676-70-DW1958_4294857552_4294937087_?productId=1229511&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Drill%2BBit%2Bsets_4294857552_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_196676-70-DW1958_4294857552_4294937087_?productId=1229511&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Drill%2BBit%2Bsets_4294857552_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a></p>	<p>Item #: 196676    Model #: DW1958</p>	1	22.98	22.98
<p>PORTER-CABLE 7-Amp 1/2" Drill  <a href="http://www.lowes.com/ProductDisplay?partNumber=36939-79992-PC700D&amp;langId=-1&amp;storeId=10151&amp;productId=1208965&amp;catalogId=10051&amp;cmRelshp=sim&amp;rel=nofollow&amp;cld=PDIO1">http://www.lowes.com/ProductDisplay?partNumber=36939-79992-PC700D&amp;langId=-1&amp;storeId=10151&amp;productId=1208965&amp;catalogId=10051&amp;cmRelshp=sim&amp;rel=nofollow&amp;cld=PDIO1</a></p>	<p>Item #: 36939    Model #: PC700D</p>	1	69.97	69.97
<p>Kobalt 16oz. Steel Rip Hammer  <a href="http://www.lowes.com/pd_19499-16878-60163_4294857565_4294937087_?productId=1056369&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Hammers%2BSledges_4294857565_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1">http://www.lowes.com/pd_19499-16878-60163_4294857565_4294937087_?productId=1056369&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Hammers%2BSledges_4294857565_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1</a></p>	<p>Item #: 19499    Model #: 60163</p>	1	14.96	14.96
<p>Greenlee Terminal Crimping Tool with Standard Handle Grip  <a href="http://www.lowes.com/pd_30891-72068-KP1022D_0_?productId=3128535&amp;Ntt=wire+crimper&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dwire%2Bcrimper">http://www.lowes.com/pd_30891-72068-KP1022D_0_?productId=3128535&amp;Ntt=wire+crimper&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dwire%2Bcrimper</a></p>	<p>Item #: 30891    Model #: KP1022D</p>	1	17.97	17.97
<p>PORTER-CABLE Deep Cut 2" 1-Piece Hole Saw  <a href="http://www.lowes.com/pd_300707-70-PC200L_4294857551+4294867793_4294937087_?productId=3031568&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Hole%2BSaw_4294857551%2B4294867793_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;facetInfo=Hole%20Saw">http://www.lowes.com/pd_300707-70-PC200L_4294857551+4294867793_4294937087_?productId=3031568&amp;Ns=p_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;pl=1&amp;currentURL=%2Fpl_Hole%2BSaw_4294857551%2B4294867793_4294937087_%3FNs%3Dp_product_prd_lis_ord_nbr 0  p_product_quantity_sold 1&amp;facetInfo=Hole%20Saw</a></p>	<p>Item #: 300707    Model #: PC200L</p>	1	7.94	7.94
<p>JACKSON 4 Lb. Sledgehammer with Fiberglass Handle  <a href="http://www.lowes.com/pd_147575-302-1206100_0_?productId=3110665&amp;Ntt=sledge+hammer&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dsledge%2Bhammer%26page%3D2">http://www.lowes.com/pd_147575-302-1206100_0_?productId=3110665&amp;Ntt=sledge+hammer&amp;pl=1&amp;currentURL=%2Fpl_0_s%3FNtt%3Dsledge%2Bhammer%26page%3D2</a></p>	<p>Item #: 147575    Model #: 1206100</p>	1	18.98	18.98

**Total: 559.63**

[www.mcmelectronics.com](http://www.mcmelectronics.com)

MCM Electronics - (888) 235-4692

405 S. Pioneer Blvd.

Springboro, OH 45066

Description	ID	Quantity	Price Each	Price Total
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8 Inch Standoff Tie with Screw; Bag of 25 <a href="http://www.mcmelectronics.com/product/VANCO-21-8735-21-8735">http://www.mcmelectronics.com/product/VANCO-21-8735-21-8735</a>	Vanco Part #: 21-8735   MCM Order #: 21-8735	1	5.69	5.69
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**Total: 5.69**

### [www.radioshack.com](http://www.radioshack.com)

Radio Shack - 800-843-7422  
680 S STATE ST  
SALT LAKE CITY, UT 84111

Description	ID	Quantity	Price Each	Price Total
20-Ft. UL-Recognized Black Hookup Wire (12AWG) <a href="http://www.radioshack.com/product/index.jsp?productId=2062647">http://www.radioshack.com/product/index.jsp?productId=2062647</a>	Model: 278-566   Catalog #: 278-566	7	4.99	34.93
20-Ft. UL-Recognized Red Hookup Wire (12AWG) <a href="http://www.radioshack.com/product/index.jsp?productId=2062646">http://www.radioshack.com/product/index.jsp?productId=2062646</a>	Model: 278-565   Catalog #: 278-565	7	4.99	34.93

**Total: 69.86**

### [www.solar-electric.com](http://www.solar-electric.com)

Northern Arizona Wind & Sun - (800) 383-0195  
4091 E Huntington Drive, Suite B  
Flagstaff, AZ 86004

Description	ID	Quantity	Price Each	Price Total
XLP Heavy Duty Wire #6 Stranded (Red) <a href="http://www.solar-electric.com/xlp-6.html">http://www.solar-electric.com/xlp-6.html</a>	Item#: XLP-6	50 feet	45.00 – 25 feet	90.00
XLP Heavy Duty Wire #6 Stranded (Black) <a href="http://www.solar-electric.com/xlp-6.html">http://www.solar-electric.com/xlp-6.html</a>	Item#: XLP-6	50 feet	45.00 – 25 feet	90.00
Crown 395 AH 6-Volt Deep Cycle Battery <a href="http://www.solar-electric.com/cr395amdecyb.html">http://www.solar-electric.com/cr395amdecyb.html</a>	Item#: CR-395	4	290.00	1160.00
18" #4 AWG Battery Cable with 3/8" Bolt Lugs, Red & Black <a href="http://www.solar-electric.com/42900.html">http://www.solar-electric.com/42900.html</a>	Item#: BIC-4-18-X	2	10.50	21.00
Kyocera Solar KD135SX-UPU - 12 Volt, 135 Watt Solar Panel With Junction Box <a href="http://www.solar-electric.com/kykc130wasop.html">http://www.solar-electric.com/kykc130wasop.html</a>	Item#: KD135SX-UPU	8	450.00	3600.00

**Total: 4961.00**

### [www.tessco.com](http://www.tessco.com)

Tessco - 800.472.7373  
4775 Aircenter Circle  
Reno, NV 89502

Description	ID	Quantity	Price Each	Price Total
Lug Crimper #2-#8 lugs <a href="http://www.tessco.com/products/displayProductInfo.do?sku=68860&amp;eventPage=1">http://www.tessco.com/products/displayProductInfo.do?sku=68860&amp;eventPage=1</a>	Mfg Part #: SP1977 TESSCO SKU : 68860 UPC: 729198688608	1	190.95	190.95

**Total: 190.95**

## www.vtewarehouse.com

VTE Warehouse - 800.227.0889  
5437 Robinson Rd.  
P.O. Box 790  
Pellston, Michigan 49769

Description	ID	Quantity	Price Each	Price Total
12 Point Power Distribution Block - Busbar w/ Ins Kit (Red) <a href="https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php">https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php</a>	71225N02	1	7.44	7.44
12 Point Power Distribution Block - Cover (Red) <a href="https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php">https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php</a>	312N9P02	1	0.82	0.82
12 Point Power Distribution Block - Busbar w/ Ins Kit (Black) <a href="https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php">https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php</a>	71225N14	1	7.44	7.44
12 Point Power Distribution Block - Cover (Black) <a href="https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php">https://www.vtewarehouse.com/content/electromech/busbar/html/12point/12point.php</a>	312N9P14	1	0.74	0.74

**Total: 16.44**

## Total Material Costs

The approximate cost of all materials (including optional): **8392.74**

The approximate cost of all materials (excluding optional): **7833.11**

**Note:** As previously mentioned costs do not include tax or shipping and handling that may be applied.