BABY MOBILE SOLAR CELL PHONE CHARGER

PLAN SET

PROVIDED BY:

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Baby Mobile Solar Cell Phone Charger

The main goal of the Baby Mobile was to create a simple cost effective solar cell phone charger that also teaches about off-grid solar. By combining readily available parts with a simple design, the Baby Mobile is a great introduction to off-grid solar. Lets learn about solar energy and charge your cell phone while we are at it. (Estimated Cost of Parts: $100*)

Below is the list of parts you will need to put together your Baby Mobile Solar Cell Phone Charger:

Main Components

10 W Solar Panel
Universal Power Group 12V, 5Ah AGM Battery (Model: UB1250 or similar)
MorningStar SunGuard Charge Controller
Blue Sea USB Charging Port (or similar)

Additional Components

12 Volt Voltage Meter
12 Volt dc rocker switch
5' of 18-2 Thermostat wire or similar (Thermostat wire has a sunlight resistant jacket)
Plastic Ammo Box
(2) F1, 18-22 Gauge Quick Disconnect Terminals
(6) F2, 18-22 Gauge Quick Disconnect Terminals
(2 Pairs) F2, 18-22 Gauge Insulated Quick Disconnect Terminals (Male/Female)
(2) F2, 18-22 Gauge Dual Horn Quick Disconnect Terminals
(2) #5 x 1 1/2" Bolt
(4) #5 washers
(2) #5 Nuts
(4) Drywall Screws
Scrap Board for Baffle

*Based on the above parts, our total build cost came in around $100 for the entire Baby Mobile. Your costs may go up or down depending on the components you use and the cost you acquire them for.

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The Components

In order to create a portable solar cell phone charger, we need three main components. These components are a solar panel, a charge controller, and a battery bank.

Solar Panel
A solar panel is a group of solar cells designed to absorb the sun's rays as a source of energy for generating electricity. Another common name for a solar panel is solar module (or just module).

Charge Controller
A Charge Controller controls the flow of current to and from the battery subsystem to protect the battery bank from overcharging. Charge controllers are essential for ensuring that the battery bank obtains a maximum state of charge and longest life. Depending on the charge controller used, the charge controller may also protect the battery bank from over discharge as well.

Battery Bank
A battery bank provides power when the power from the solar panels is unavailable. Battery banks range from a single small battery used to power a few lights or smaller electronic devices, up to multiple batteries that can power parts of a house or office.

A few other components we will need are a USB charging port, a voltage meter, and a switch.

USB Charging Port
Most cell phones today come with a charging cord that has one USB end. This USB end is designed to fit into a USB port. That USB port maybe on your computer to down load music and photos or that it may be on a wall charger. Having a USB port allows us to avoid using the wall plug by plugging the charging cord directly into the Baby Mobile.

Voltage Meter
A Voltage Meter helps us check the charge of our battery. If we see a low voltage reading, we know to let the battery charge up before using it to charge our cell phone.

Switch
Since the Voltage Meter requires energy to light up the display, we are going to add a switch to turn it on and off. We do not want the voltage meter drawing the battery bank down during the day.

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The Design

For our Baby Mobile, we choose to use a NewPowa 10 watt, 12 volt solar panel (model: NPA10 -12), a MorningStar SunGuard Charge Controller, and a Universal Power 5 ampere-hour, 12 volt battery (model: UB1250). With these three components we had the foundation for our Baby Mobile.

Why Did We Choose these Components?

First, let's start with the battery. When it comes to a battery there are three main choices to make.

1) **Battery Type**

There are numerous battery types out there: NiCAD, Lithium, Lead-Acid, and many more. In this case, we chose the most common and easy to use. This is a sealed lead-acid battery. Sealed lead-acid batteries are used across the board in various industries and are virtually maintenance free.

2) **Battery Voltage**

Since, 12 volt batteries are used in the automotive, marine, and recreation industries, it was the logical choice. Having a 12 volt battery made it easy to find any component we would need for the baby mobile. This includes the USB Charging Port for the cell phone.

3) **Battery Capacity (Ampere-Hour rating)**

All batteries have a certain capacity called the ampere-hour. The higher the ampere-hour, the more energy a battery can provide. Therefore, we had to choose a battery with enough ampere-hours to charge our cell phone.

Here are the steps needed to determine the right battery capacity:

a) Create a load profile

A load profile is simply a table that shows all of the electrical devices that will draw energy from the battery. On the next page is a summary of our load profile for the baby mobile.

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Device/ Component	Energy Draw (Watt-Hours or Wh @ 12 volts)	Run Time (in Hours)	Total Daily Energy Draw (Watt-Hours or Wh)
(1) Cell Phone	5.73 Wh	1	5.73 Wh
Charge Controller	0.07 Wh	24	1.68 Wh
USB Charging Port	0.18 Wh	24	4.32 Wh
Voltage Meter	0.18 Wh	1	0.18 Wh

Total = 11.91 Wh

As you probably have noticed, we have more items listed than just the cell phone itself. This is because most electrical devices will draw energy from the battery. By having a detailed load profile, we are insuring our systems overall performance.

-Based on the table, our battery needs to supply at least **12 watt-hours**.

b) Always double the battery's capacity

In the first step we found how much energy we need from the battery. Now we take that number and double it. This makes sure that the battery does not go below 50% of its rated capacity. This is also known as the depth of discharge. By keeping a battery above a 50% depth of discharge, we increase its life span.

-Now we take 12 watt-hours and double it to get 24 watt-hours. Our battery must have a capacity of **24 watt-hours**.

c) Convert Watt-Hours to Ampere Hours

As you may have noticed, we have been using watt-hours and not ampere-hours. Therefore, we need to convert watt-hours into ampere-hours. We do this by using Ohm's Law. If we take the watt-hours and divide it by our battery's voltage, we get ampere hours.

-24 watt-hours / 12 volts = **2 ampere-hours**

d) Revisit the Load Profile

In the load profile, we have a column titled run time. This allows us to see how long each item is running. However, this column also tells us how long it takes for us to consume the battery's capacity. The faster we consume energy from a battery, the less capacity a battery will have. In our case, we will consume the bulk of our energy in around 1 hour. Therefore, we need to upsize the battery to account for this high energy draw. For more

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information on this, please read our article "The Power of Batteries".

-A **5 ampere-hour** battery can supply 3 ampere-hours at a 1 hour rate. This is more than enough for our system.

This leads us to our next component, the solar panel. Since we will be consuming power from the battery, we need a way to recharge it. This is done through the solar panel. To choose the solar panel we need to look at a few items:

1) **Solar Panel Voltage**

With a 12 volt battery, we will want to use what is generic termed a 12 volt solar panel. In reality, a 12 volt solar panel will actually output closer to 17 or 18 volts. Do not worry as this is what we want. In fact, we want to search out a solar panel that will produce at least 17 volts. This insures that our battery will be able to be charged correctly.

2) **Solar Panel Amperage**

The amperage output of the solar panel is what replaces the batteries ampere-hour capacity. The tricky part here is that a solar panel produces energy throughout the day. Therefore, we have to account for the total ampere production over the course of a day. In solar, we use what is called the "solar window". In general, the solar window is a 5 hour period where the sun is most optimal for solar panel production.

Here are the simple steps to determine the ampere output of the solar panel:

a) Revisit the Load Profile

In our load profile, we determined how much energy we will consume from the battery in one day.

-**12 watt-hours**

c) Convert Watt-Hours to Ampere Hours

We do this again by using Ohm's Law. If we take the watt-hours and divide it by our battery's voltage, we get ampere hours.

-12 watt-hours / 12 volts = **1 ampere-hours**

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d) Divide Ampere-Hours by 5 Hours

If we divide the ampere-hours by 5 hours, we will find the amperage output our solar panel needs to have.

-1 ampere-hour / 5 hours = **0.2 amperes**

Since modules degrade over time and different weather conditions affect the ampere output of a solar panel, we wanted a higher output. The solar panel we chose has an ampere output of 0.58. This insures that our battery will always be fully charged*.

*Please note, in some areas, there will be long snow storms and rain storms. In these areas, the battery may not be able to fully recharge as there will be days without access to sunlight. In these circumstances, we recommend at least doubling the battery capacity as well as the module output amperage.

The last component is the charge controller. Since the solar panel doesn't always output a consistent power, we need to regulate its output to charge the battery. Here are the steps to selecting the right charge controller:

1) **Check the Charging Profile**

Good charge controllers come with specific charging profiles based on the battery type. In our case, we chose a sealed-lead acid battery. Therefore, we had to choose a charge controller that was programmed to charge a sealed lead-acid battery. Also, in this profile the charge controller's voltage rating must match the battery's voltage rating as well. In this case, we used a 12 volt battery. Therefore, our charge controller had to be setup to charge a 12 volt battery.

2) **Charge Controller Amperage**

The amperage rating of the charge controller must be greater than the solar panels ampere rating. The charge controller we selected has an ampere rating of 4.5. This is almost 9 times the rating of our solar panel. The overage allows for the solar panel to over produce amperage and for us to expand the array later on if we chose to. The important part to understand is that even though our module is rated at 0.58 amperes, it can actually produce more amperage than that. Here is how to determine the max amperage output of a solar panel:

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a) Determine the Short-Circuit Current (Isc)

All solar panels have a short circuit rating. This is usually listed under the Isc of the solar panel. Isc stands for amperes short-circuit.

-Our module is **0.68 amperes.**

b) Multiply the Short-Circuit Current (Isc) by 1.25

The intensity of the sun can vary changing the ampere output of a solar panel. As the sun increases intensity, it increases the ampere output of the solar panel. By multiplying the short-circuit current by 1.25, we are able to add in a safety factor to our Baby Mobile.

-0.68 amperes x 1.25 = **0.85 amperes,** or 1 ampere rounded up.

As you can see, our charge controller will easily handle our solar panel's amperage output.

c) Look for a Blocking Diode

Just as a solar panel can produce energy, it can consume it can consume energy as well. During times when the sun isn't present, a solar panel will consume power from the battery. Adding a blocking diode to a solar panel will prevent the reverse energy flow. The importance here is that smaller solar panels (usually under 40 watts) do not come with internal blocking diodes. This is why we needed a charge controller with a blocking diode.

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The Build

Before you begin building your Baby Mobile, please take the time to read and understand the following:

1) The build will require the use of some basic hand tools and possibly some power tools depending on your approach. If you are a uncomfortable with these tools or a minor, please consult with an adult who knows how to use the tools.
2) Even though a tool list is provided for you below, you may find that you either do not need a listed tool or you need a tool not listed.
3) Please read through all of the steps first. This will help you create a plan of action for your build.

Tools You will need:

-Ruler/Tape Measure
-Phillips Head Screw Driver
-Hand Saw/Power Saw
-Drill
-Drill Bits (1/8", 3/16" to 1 3/8" Step Drill Bit, Pilot Bit)
-Dremel Tool or similar
-Dremel Multi-purpose cutting bit
-Dremel Cutting Wheel
-Utility Knife
-150 Grit Sand Paper
-Pencil
-Crimp Tool
-Wire Stripper
-Side Cutters
-Soldering Iron (if your module doesn't come with leads)

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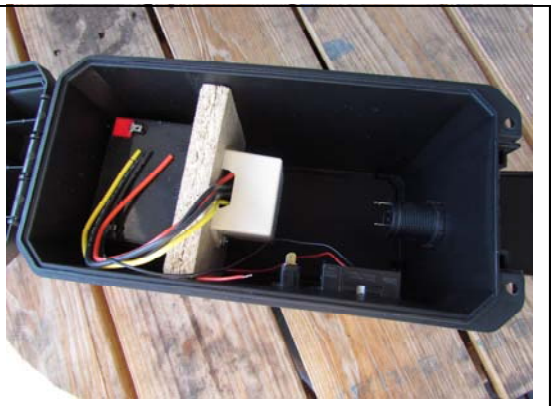
Step 1: Layout

Plan on where all of the components are going to go inside the ammo box. This includes the charge controller, switch, battery, volt meter, and USB Charging Port. (See Appendix A for a full layout)



Component Layout

Step 2: Mark Openings

Use a pencil to mark out the areas you will need to cut out for the components. At minimum, you will need to mark areas for the switch, volt meter, and USB Charging Port.

It is best to use the manufacturers instructions to determine to required cut out opening for each component.
Take your time here to avoid cutting out the wrong size openings.

Marking Cut Out Locations

Step 3: Cut Openings

To make the switch and USB Charging Port openings, you can use a 3/16" to 1 3/8" Step Bit. Note the depth markings for each step so you do not over drill the opening. If you do not have a step bit, you can use the Dremel with the Multi-purpose cutting bit.

Remember, the ammo box is soft plastic and cuts very easily. Take your time to insure your cuts are accurate.
It is always better to under cut than over cut.

Using the Dremel to cut Openings

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Step 4: Cut Openings

Since the volt meter opening is rectangular, you will need either a utility knife or the Dremel with the cutting wheel bit.

Using the cutting wheel

CAUTION

The best approach is to use the knife or wheel to cut a shallow groove first. This helps guide the tools in subsequent cuts. Do not try to cut through the box in one pass.

Step 5: Clean Out

Clean out the debris in the box left by from making the openings.

Measuring for the Baffle

Step 6: Measure for Baffle

Place the battery into the box and measure for the baffle. You can use either a ruler or tape measure. Measure the width of the box and the depth as well.

CAUTION

Be as accurate as you can with your measurements. Having a baffle that is to big or small may cause the lid of the ammo box to not shut properly.

Step 7: Cut out Baffle

Transfer your measurements to your baffle. (We used a 5/8" thick piece of MDF). With the measurements placed on the baffle, begin your cuts. You can use either a hand saw or power saw to make the cuts.

Marking up the Baffle

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Step 8: Drill holes for the Charge Controller

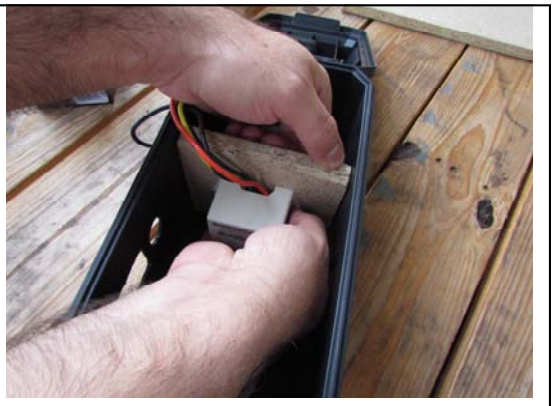
Hold the charge controller on the baffle and mark drill locations for the mounting screws. Use a 1/8" drill bit and drill out two holes.

Installing the Baffle

Step 9: Install the Baffle

Hold the baffle in place and use a pilot bit to pre-drill holes in the ammo box and baffle. With the pilots holes drill, insert course thread drywall screws.

Do not over drill with the pilot bit. This will make a hole that the screws will go right through.
Do not use a drill to tighten the screws. Use a Phillips head screw driver.



Installing the Charge Controller

Step 10: Mount the Charge Controller

Use two #5 x 1 1/2" Machine screws with matching washers. Push the screws into the baffle. (This may require a screwing them into the baffle. Once the ends are exposed, put the charge controller is place. Use two more washers and nuts to secure the charge controller into place.

Do not over tighten the nuts as they will crack the board and the charge controller. The nuts only need to be secure.

Drilling Holes in Ammo Box

Step 11: Drill Holes for Solar Panel

Use a 1/8" Drill Bit to Drill two holes in the upper back of the Ammo Box. This will be used to allow the solar panel leads to make connection inside the ammo box.

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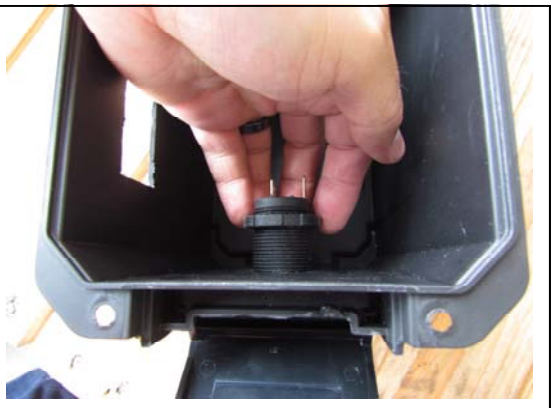
Step 12: Install USB Charging Port

Remove the plastic lock ring off of the USB Charging Port. Slide the USB Charging Port into the opening. Hold it in place and screw the lock ring back into the back. Tighten down the lock ring to secure the USB Charging Port into place.



Installing the USB Charging Port

Step 13: Install the Switch and Volt Meter

The switch and volt meter are panel mount components. To install them, line them up with there openings. Then apply and even pressure until they click into place.

If the component doesn't go in with a little pressure, stop. Take a piece of 150 grit sand paper and little sand the opening wider. Then, attempt the install again.

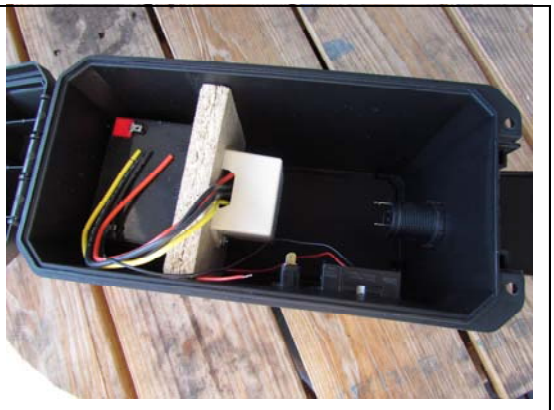
Installing the Volt Meter

Step 14: Install the Battery

Set the battery in place behind the baffle.

Step 15: Begin Wiring

Before you begin wiring the Baby Mobile, please review the block diagram and line diagram in Appendix B and C. This will help you better understand the following steps.



All Components in Place

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Step 16: Install the Battery Terminals

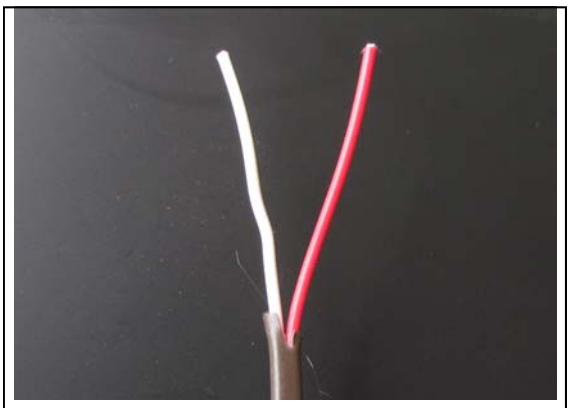
Take the Dual Horn F2 Terminals and slide one onto the negative terminal of the battery and one onto the positive terminal of the battery.

Dual Horn F2 Terminals

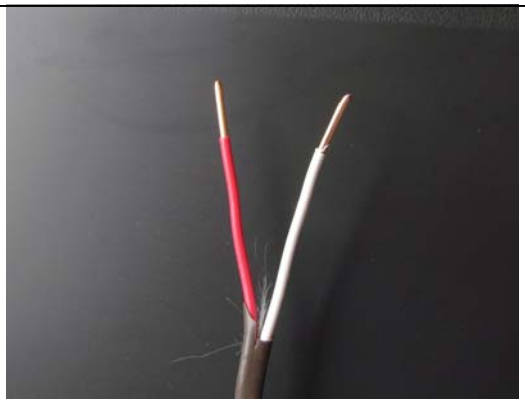
Step 17: Preparing the wire

Take the side cutters and cut out a 12” section of the 18-2 Thermostat wire. At each end of the wire, strip back the outer jacket to reveal one white and one red wire. Take the wire strippers and remove about 1/4”of the white jacket and red jacket.

Repeat the process with an 8” section of the 18-2 thermostat wire. Except this time, fully remove the outer jacket to separate the red and white jacketed wires. You will be using the red jacketed wire only. Take the wire stripes and remove about 1/4” of the red jacket.



Thermostat Wire Stripped Back



Exposing the Copper Wire

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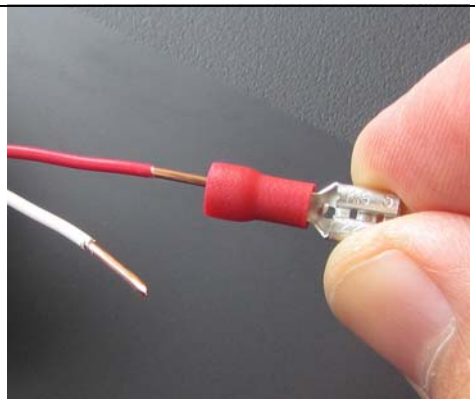
Step 18: Apply Quick Disconnect Terminals

To apply the quick disconnects terminals, you will need to take the wire and insert it into the terminal. Push the wire into the terminal until it hits the stop.

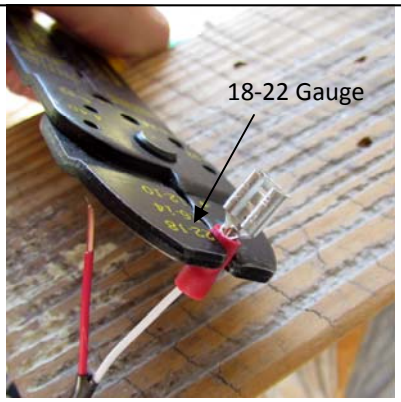


Pushing the wire into the terminal

CAUTION

Do not allow the wire to go past the stop. This can prevent the quick disconnect terminal from properly seating.

Take the crimp tool and crimp the quick disconnect terminal to the wire. Make sure you are using the 18-22 gauge setting on the crimp.



Crimping on the Terminal

CAUTION

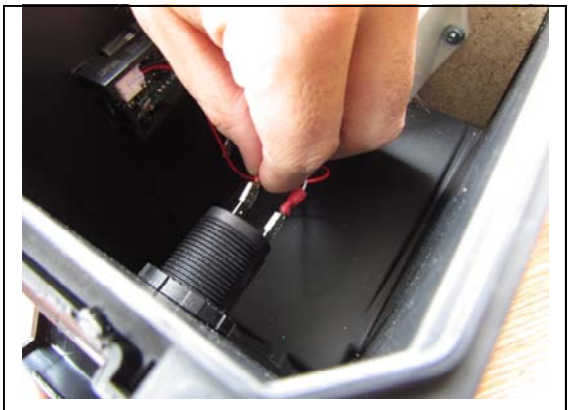
Make sure your quick disconnect terminals and crimp tool are all set for 18-22 gauge wire.
If possible make two crimps for a more secure wire. Always pull test your wires for security.

This is the process you will follow for every crimp in the Baby Mobile.

Step 19: Wiring the USB Charging Port

Apply two F2 Quick disconnects to one end of the 12” 18-2 thermostat wire. One terminal goes on the red wire and one terminal goes on the white terminal. (Use Step 18 to apply the terminals)

Slide the red wire with the F2 terminal onto the positive terminal of the USB Charging Port. The white wire with the terminal will go on the negative terminal of the USB Charging Port.



Installing the Quick Disconnect

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Step 20: Wiring the Volt Meter

Apply one F1 Quick disconnect to the red lead of the volt meter. (Use Step 18 to apply the terminals). This F1 terminal will go on the outer silver terminal of the switch.

Take one end of the 8” red wire cut earlier and apply one F1 Quick disconnect. (Use Step 18 to apply the terminals). This F1 terminal will go onto the middle silver terminal of the switch.

The Gold Terminal is not needed

Step 21: Finishing the USB and Switch Wiring

Take the white lead from the USB Charging Port and the Black lead from the Volt Meter and twist them together. Insert these two wires together into an F2 terminal. Crimp on the F2 terminal. (Use Step 18 to apply the terminals)

Take the red lead from the USB Charging Port and the red lead from the switch and twist them together. Insert these two wires together into an F2 terminal. Crimp on the F2 terminal. (Use Step 18 to apply the terminals)

Crimping the USB and Volt Meter

These terminals aren’t designed for two wires. Be patient and make sure the wires are both inside the crimp.
If you are having too much trouble, use a 16 gauge terminal.

*Do not connect these terminals to the battery at this time.

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Step 22: Wiring the Charge Controller

Apply one F2 Quick disconnect to the black battery lead of the charge controller. (Use Step 18 to apply the terminals).

Apply one F2 Quick disconnect to the red battery lead of the charge controller. (Use Step 18 to apply the terminals).

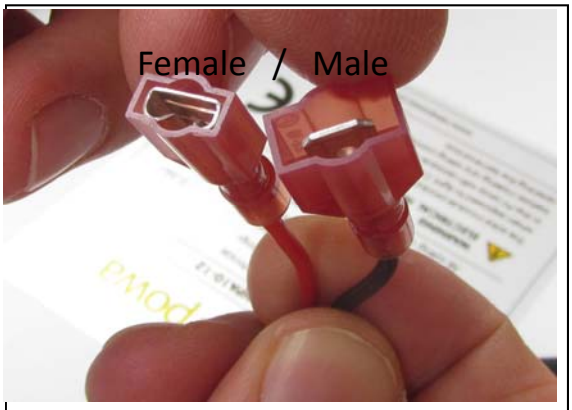
*Do not connect these terminals to the battery at this time.

Charge Controller with F2 Terminals

Take the yellow and black solar leads from the charge controller and push them through the 1/8" holes drilled in the back of the ammo box.

Apply a Female F2 Insulated Terminal to the black solar lead of the Charge Controller. (Use Step 18 to apply the terminals)

Apply a Male F2 Insulated Terminal to the yellow solar lead of the Charge Controller. (Use Step 18 to apply the terminals)



Male and Female F2 Insulated Terminals

Step 23: Wiring the Solar Panel

Apply a Female F2 Insulated Terminal to the red (+) solar panel lead. (Use Step 18 to apply the terminals)

Apply a Male F2 Insulated Terminal to the black (-) solar panel lead. (Use Step 18 to apply the terminals)

*Do not connect these terminals at this time.

Make sure that the correct polarity for the solar panel and charge controller are maintained. Accidentally reversing the polarity in the Baby Mobile can damage the equipment.

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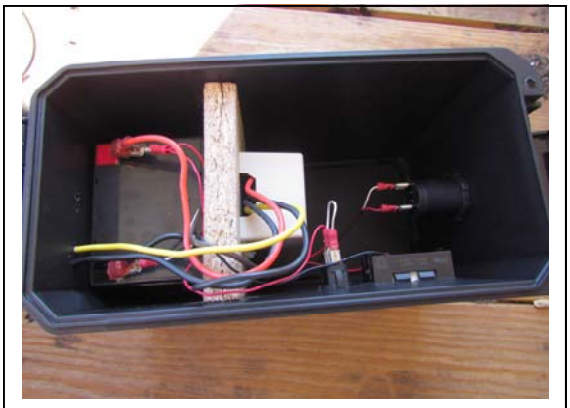
Step 23: Charge the Baby Mobile

Follow this step in order.

Connect the Charge Controller black battery lead F2 terminal to the battery's negative terminal.

Connect the Charge Controller red battery lead F2 terminal to the battery's positive terminal.

Connect the Charge Controller black solar lead F2 terminal to the solar panel's black F2 terminal.



The Baby Mobile All Wired Up

Connect the Charge Controller yellow solar lead F2 terminal to the solar panel's red F2 terminal.

Allow the Baby Mobile to charge for one full day before connecting the USB charging Port and Volt Meter to the Battery.

Baby Mobile Showing 13.9 Volts

Step 24: Finishing the Baby Mobile

Connect the combined white USB lead and black volt meter F2 terminal to the battery's negative terminal.

Connect the combined red USB lead and red switch F2 terminal to the battery's positive terminal.

Congratulations! You have completed your Baby Mobile. Here are a few tips for getting the most out of your Baby Mobile:

1) Keep you battery above 12 volts minimum
2) Do not store the Baby Mobile in very high or low temperatures. This will shorten the battery life.
3) Although the Baby Mobile can charge more than a cell phone, it is not recommended. Certain devices may consume more power than the Baby Mobile is designed for.

Finished Baby Mobile Charging Up

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Where to find your Parts

The parts and pieces used in the Solar Power Generator for your trailer can be found in a combination of local hardware stores, electrical stores and online at the following establishments:

www.eco-distributing.com
www.wholesalesolar.com
www.amazon.com
www.Ebay.com

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Thank You for Downloading the Baby Mobile Plan Set! We at Solar Unplugged value you as our customer. We encourage you to follow our Blog as we continually post articles that will help you get the most out of your Baby Mobile Cell Phone Charger. As do not forget to check out or products page from time to time as we are always adding new books and plan sets that best meet your needs.

Don't hesitate to contact us with any questions you may have.

Sincerely,

The Solar Unplugged Team

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Glossary of Terms

Ampere/ Amperage - Often shortened as Amp or A, is the unit of measure for electrical current.

Ampere-Hour - An ampere hour (Ah) is the amount of energy stored in a battery that will allow one ampere of current to flow for one hour.

Battery Bank/ Battery - A battery bank or battery stores electrical energy for later use. In a solar array, the battery stores the electrical energy produced by the solar panel.

Charge Controller - A Charge Controller controls the flow of current to and from the battery subsystem to protect the battery bank from overcharging.

Charging Profile - The charging profile refers to the way in which a charge controller charges the battery bank. Charge controllers use different algorithms to insure the battery bank is properly charged. These algorithms may have a single or multi-stage charging cycles.

Jacket (Wire) - The outer protective covering of a wire is called the jacket or insulation. The jacket prevents accidental contact with electricity flowing on/in the wire.

Load Profile - A load profile is a summary of electrical devices and their energy requirements for operation.

Ohm's Law - Ohm's law describes the relationship for the different units of an electrical circuit. Examples are: Volts = Amperage x Resistance and Watts = Voltage x Amperage.

Solar Panel - A solar panel is a group of solar cells designed to absorb the sun's rays as a source of energy for generating electricity. Another common name for a solar panel is solar module (or just module).

Switch - A switch is an electrical device used to open or close a circuit. When a switch is open, there will be no electricity flowing in the circuit.

Terminal - The point at which a wire from an electrical component comes to an end and provides a point of connection to external circuits is called a Terminal.

USB Charging Port - A USB Charging Port is a device with a regulated power supply to provide consistent power for USB powered devices.

SOLAR UNPLUGGED
POWER THAT MOVES

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Volts/Voltage - (V) Is the measure of the electrical force in a circuit.

Volt Meter - A Volt Meter measure the amount of voltage in a circuit.

Watt-hours - The watt-hour (Wh) is a unit of energy commonly used to measure electricity. One watt-hour is the amount of electrical energy equivalent to a one-watt load operating for one hour.

Wire - The wire or conductor, is the wire that allows the flow of current (amperes) from one component to another.

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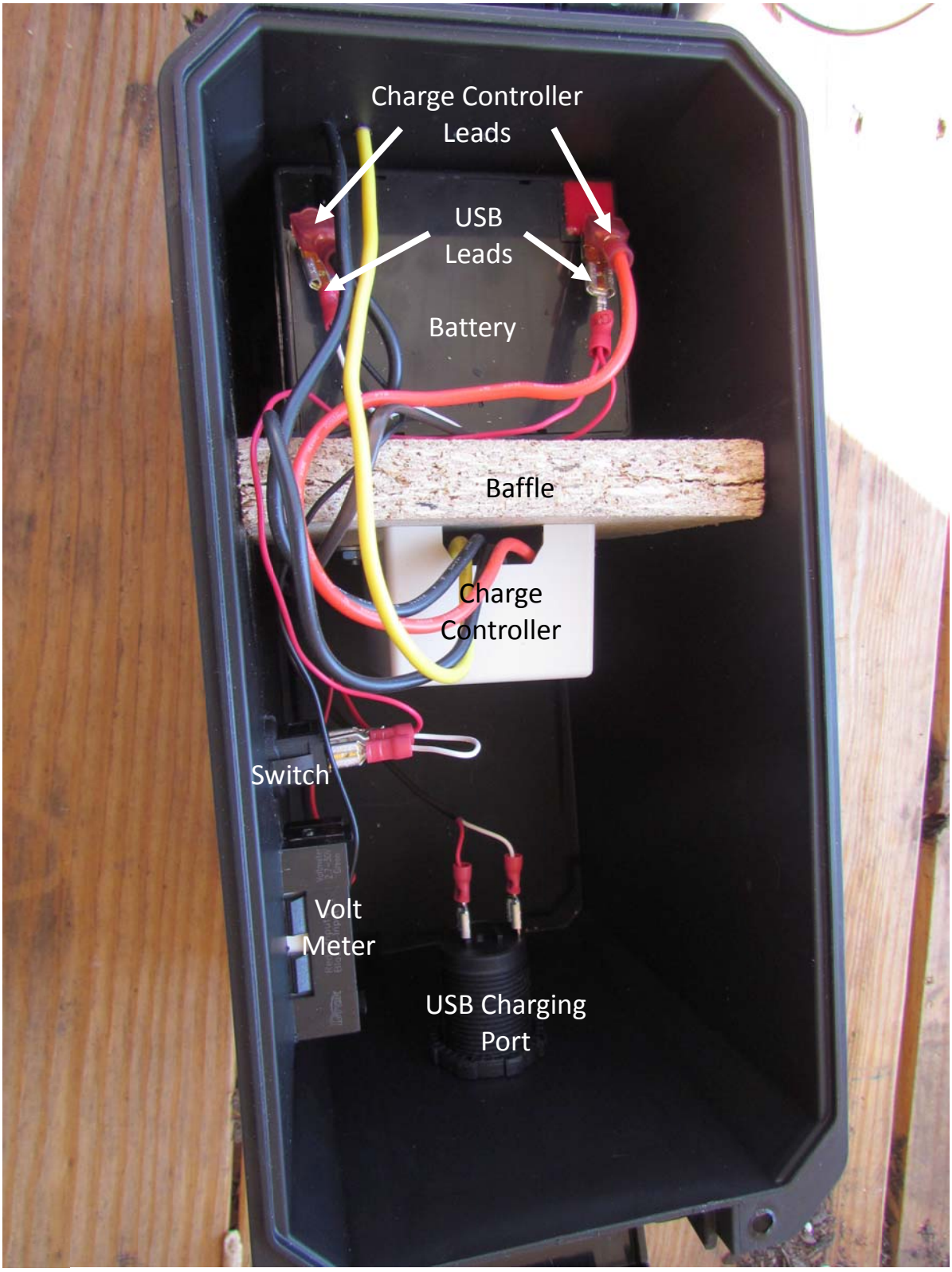
APPENDIX A



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Battery State of Charge

The following table is provided to give you idea of your battery bank's state of charge. The goal is to keep your battery bank above a 50% state of charge for maximum life. To determine your battery bank's state of charge, compare the reading on the voltage meter to the voltages listed in the left column. Once you find the voltage in the left column, move to the right to see the state of charge.

*Please note, this is not an exact way to determine the battery bank's state of charge. Your results may vary depending on your battery and the temperature of the battery.

VOLTAGE	~STATE OF CHARGE	NOTES
>12.6	100	Keep your Battery Bank in this range to promote maximum life.
12.5	90	
12.4	80	
12.3	70	
12.2	60	
12.1	50	
11.9	40	Repeated discharge to these levels will shorten your Battery Bank life.
11.8	30	
11.6	20	
11.3	10	Permanent Damage will occur
10.5	0	

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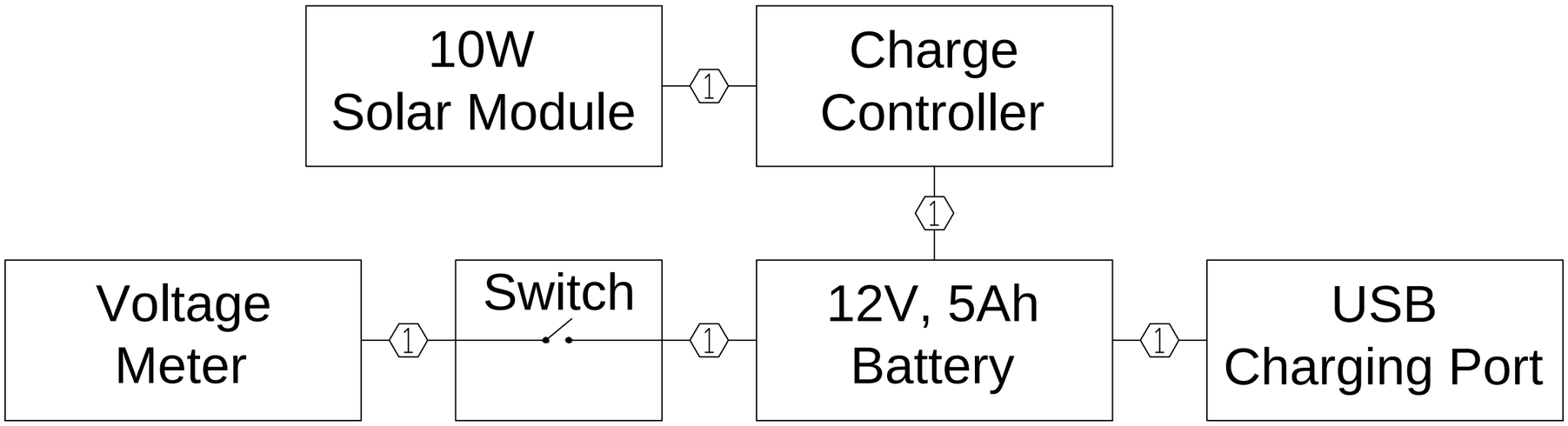

1 18-2 Thermostat Wire.

BABY MOBILE BLOCK DIAGRAM

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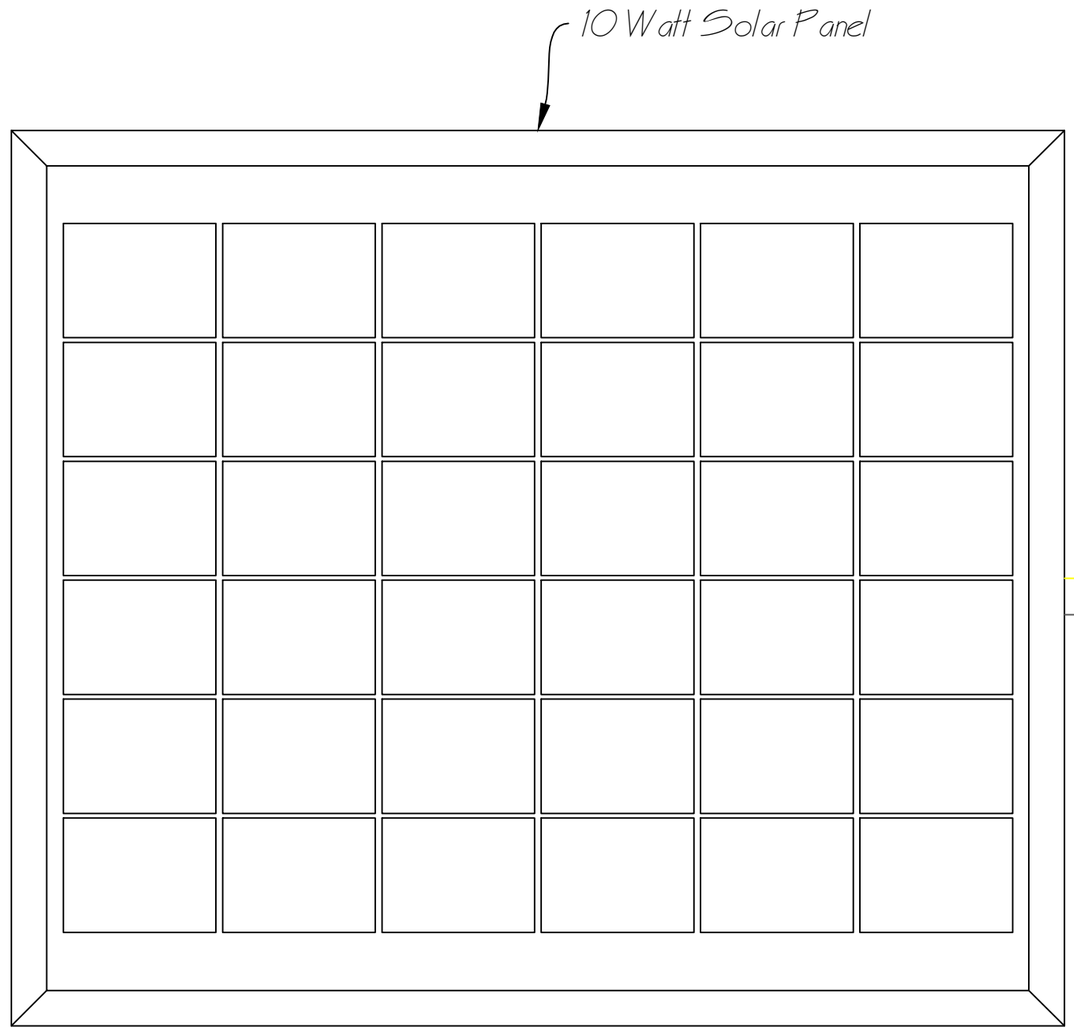
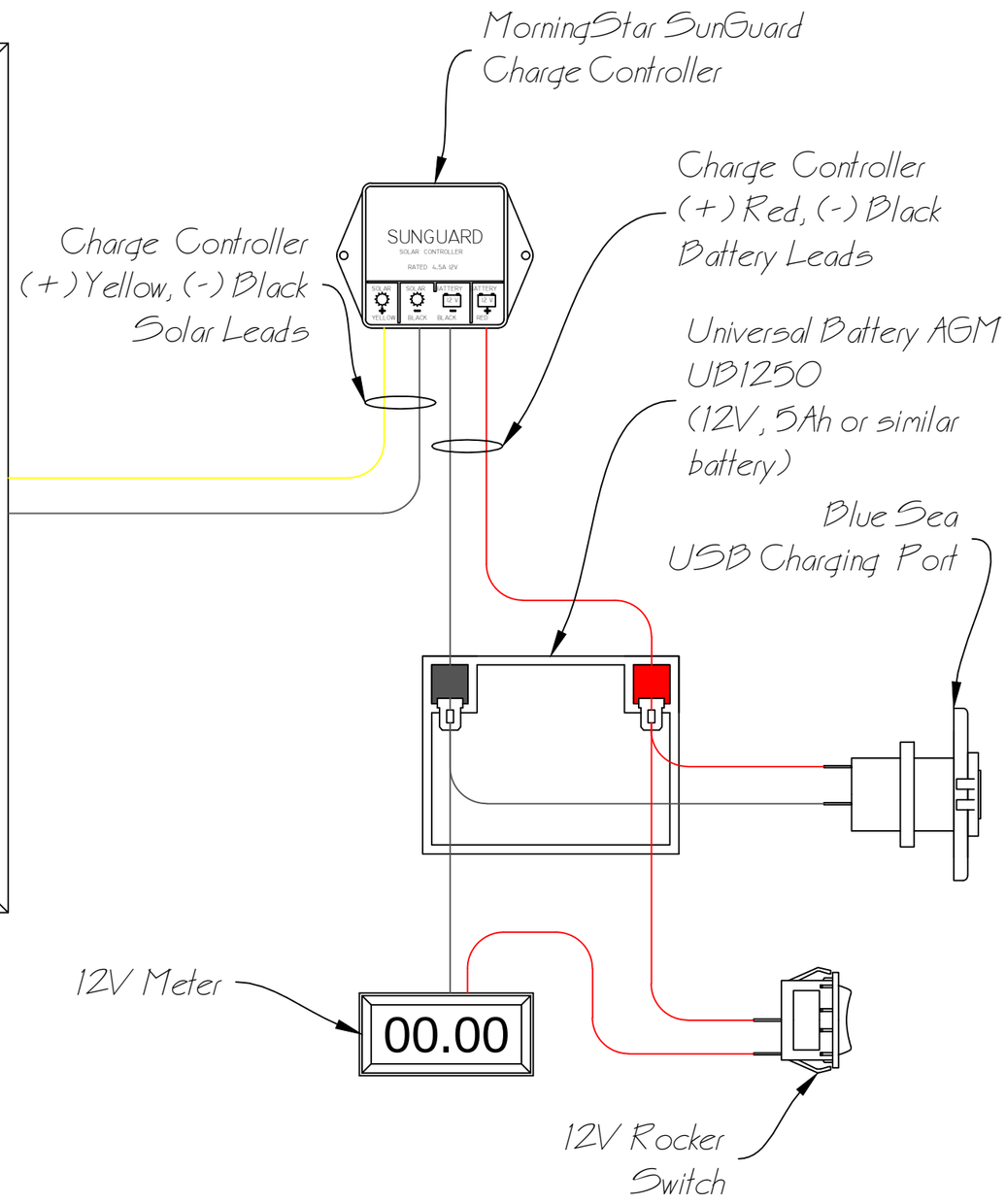
APPENDIX C





BABY MOBILE LINE DIAGRAM

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NPA10-12

Multi-Purpose Module

ELECTRICAL CHARACTERISTICS

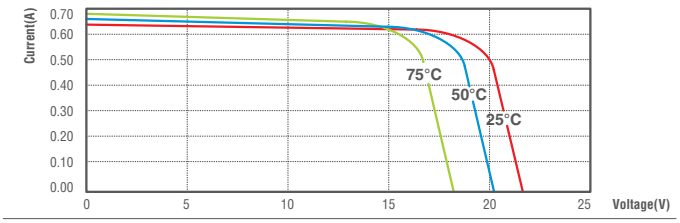
Type	NPA10-12
Power Output(W)	10W
Voltage MPP Vmpp(V)	17.0V
Current MPP Impp(A)	0.58A
Voltage Open Circuit Voc(V)	21.6V
Short Circuit Current Isc(A)	0.68A
Temperature Coefficient Of Voc	-(80±10)mV/°C
Temperature Coefficient Of Isc	(0.065±0.015)%/°C
Temperature Coefficient Of Power	-(0.5±0.05)%/°C
NOCT (Air 20°C; Sun 0.8kW/m² wind 1m/s)	47±2°C

STC: 1000W/m² Irradiance, 25°C module temperature, AM1.5g spectrum according to EN 60904-3

MECHANICAL CHARACTERISTICS

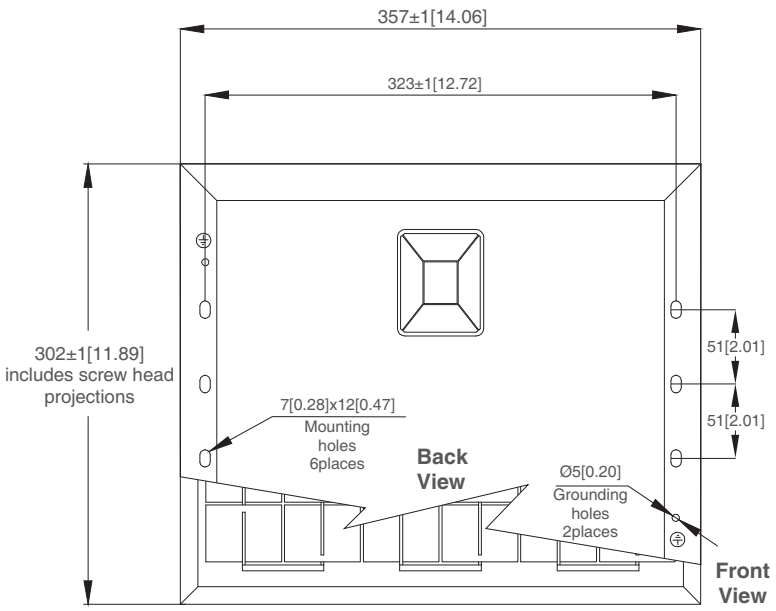
Cells	Polycrystalline Silicon
No. Of Cells And Connections	36(6X6)
Module Dimension(mm/in.)	302[11.89]x357[14.06]x30[1.18]
Weight(kg/lbs)	2.1[4.63]
Packing Information(mm/in.)	400[15.75]x335[13.19]x385[15.16]/(10pcs/ctn)

I-V CURVES (Irradiance: AM1.5, 1km/m²)



MODULE DIAGRAM

Dimensions in brackets are in inches.
Un-bracketed dimensions are in millimeters.
Unit: mm[in.]



25 years Warranty

CE

Specications subject to technical changes and tests. NEWPOWA reserves the right of nal interpretation.

Sealed Lead-Acid Battery

UPG No. D5741

UB1250

Maintenance-Free

Absorbant Glass Mat (AGM) technology for superior performance. Valve regulated, spill proof construction allows safe operation in any position. Approved for transport by air. D.O.T., I.A.T.A., F.A.A. and C.A.B. certified. U.L. r ecognized under file number MH 20567.

Specification

Nominal Voltage	12 volts
Nominal Capacity	77º F (25º C)
20-hr. (0.25A)	5.0 Ah
10-hr. (0.47A)	4.65 Ah
5-hr. (0.85A)	4.25 Ah
1-hr. (3.00A)	3.00 Ah
Approximate Weight	3.09 lbs (1.4 kgs)
Internal Resistance (approx.)	32mΩ

Shelf Life (% of normal capacity at 77º F (25º C))

3 Months	6 Months	12 Months
91%	82%	64%

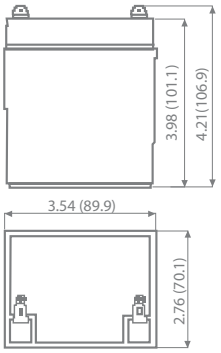
Temperature Dependancy of Capacity (20 hour rate)

104˚ F (40˚C)	77˚F (25˚C)	32˚F (0˚C)	5˚F (-15˚C)
102%	100%	85%	65%

AGM Operational Temperature	
Charge	32˚F to 104˚F (0˚C to 40˚C)
Discharge	5˚F to 113˚F (-15˚C to 45˚C)
AGM Storage Temperature	5˚F to 104˚F (-15˚C to 40˚C)

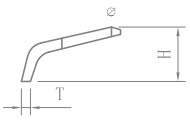
Charge Method (Constant Voltage)	
Cycle Use (Repeating Use)	
Initial Current	1.5 A or smaller
Control Voltage	14.6 - 14.8 V
Float Use	
Control Voltage	13.6 - 13.8 V

Physical Dimensions: in (mm)



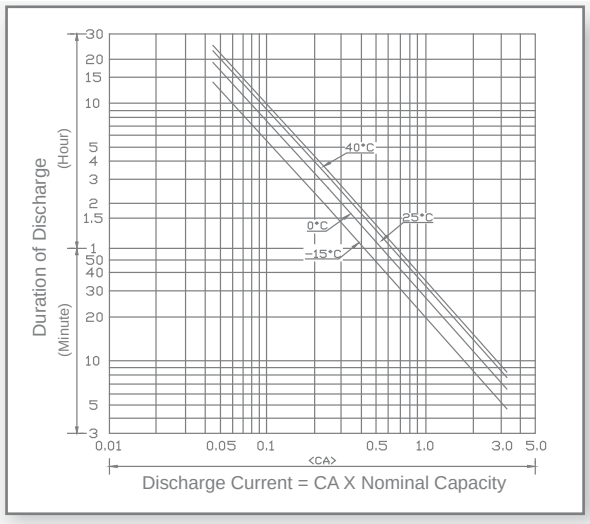
L: 3.54in (89.9 mm)
W: 2.76in (70.1 mm)
H: 3.98in (101.1 mm)
TH: 4.21in (106.9 mm)
Tolerances are +/- 0.04 in. (+/- 1mm) and +/- 0.08 in. (+/- 2mm) for height dimensions. All data subject to change without notice.

Terminals

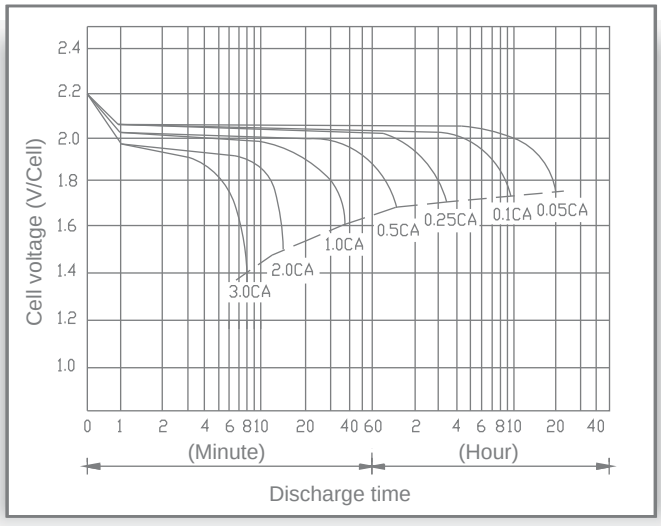


Dimension / Type	L	W	w	H	T
F1	6.50	4.75	6.00	5.00	0.80

Discharge Time vs. Discharge Current



Discharge Characteristics

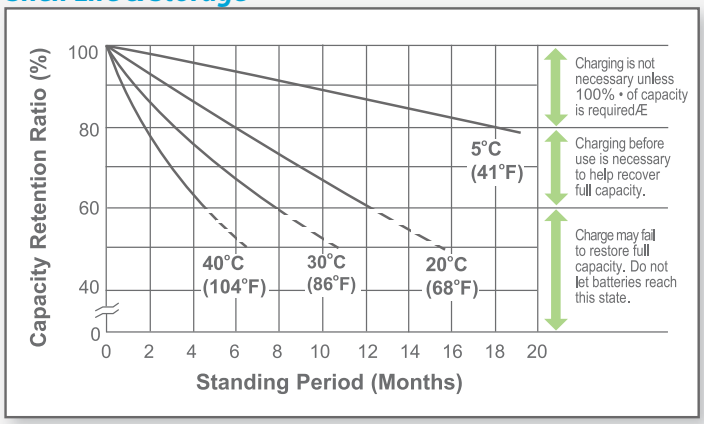


ISO 9001 :2008

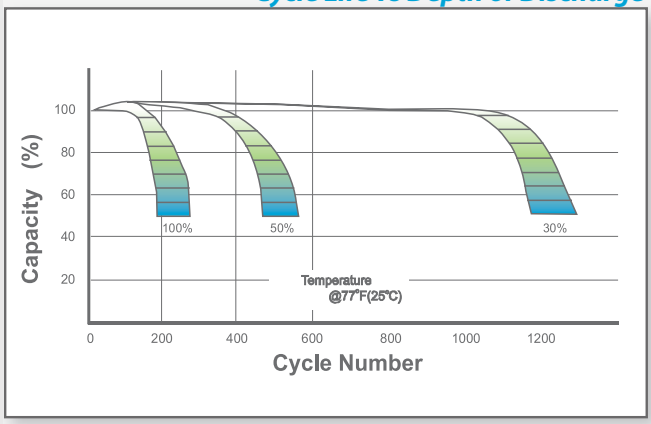
UB1250

Maintenance-Free

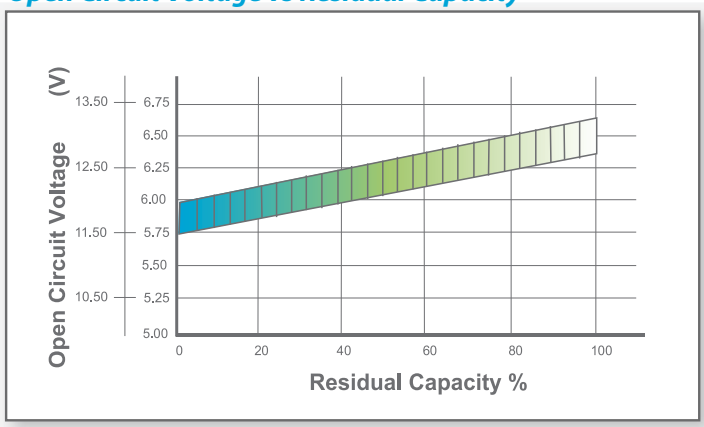
Shelf Life & Storage



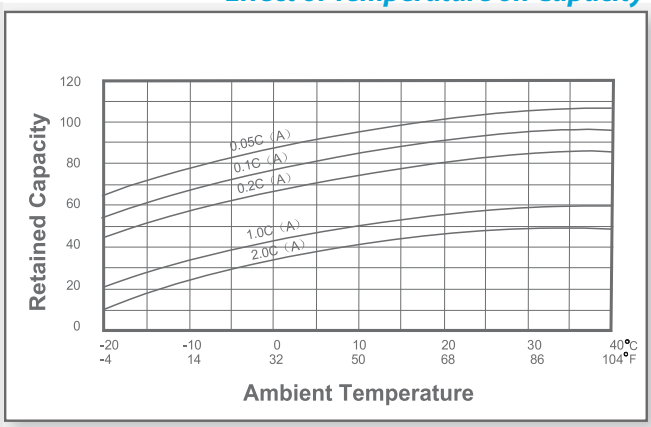
Cycle Life vs Depth of Discharge



Open Circuit Voltage vs Residual Capacity



Effect of Temperature on Capacity



Charge Current & Final Discharge Voltage

Application	Charge Voltage(V/Cell)			Max.Charge Current
	Temperature	Set Point	Allowable Range	
Cycle Use	25℃(77℉)	2.45	2.40~2.50	0.30°C
Standby	25℃(77℉)	2.30	2.27~2.30	

Final Discharge Voltage V/Cell	1.75	1.70	1.60	1.30
Discharge Current(A)	0.2C>(A)	0.2C<(A)<0.5C	0.5C<(A)<1.0C	(A)>1.0C

MORNINGSTAR corporation

Morningstar's ***SunGuard*** is the most advanced small, economical solar charge controller on the market today.

SunGuard's technology provides:

- Exceptional Reliability
- PWM Battery Charging
- Consistent High Quality
- Low Cost

The SunGuard is able to match the quality and performance of the world-leading SunSaver controllers because:

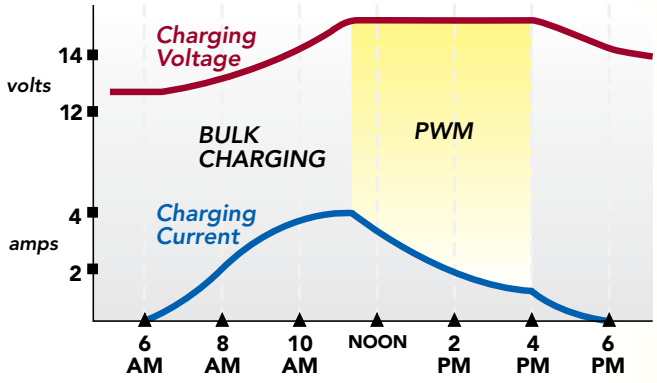
- SunGuards are made on the same high speed, automated production lines
- SunGuards use the same charging circuit
- SunGuards use the same high quality components

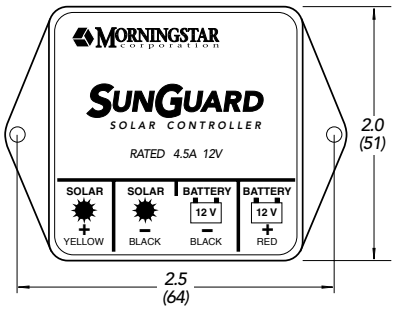
Features:

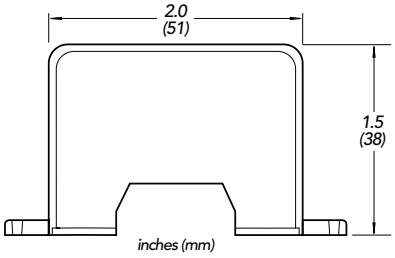
- ISO 9002 quality programs
- Series design (not shunt)
- 100% solid state
- True 0 to 100% PWM duty cycle
- Setpoint accuracy to 60 mV
- Temperature compensation
- Rated for 25% overloads
- No need to derate
- Lightning protected with 1500 W transorbs
- Self-consumption is 6 mA
- Fully encapsulated in epoxy potting
- ABS plastic, impact-resistant case
- Outdoor rated, Hypalon connecting wires

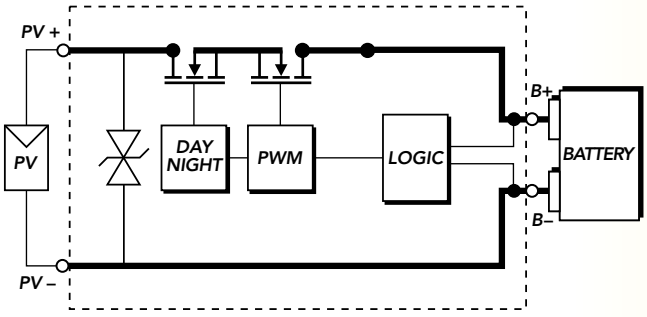
SUNGUARD™ TECHNICAL SPECIFICATIONS

Advanced PWM Battery Charging









Advantages

SunGuard's PWM charging compared to On-Off solar regulators:

- Typically 30% more solar energy into the battery per day
- Average battery State-of-Charge is 90 – 95% compared to 55 – 60% for On-Off regulators

Mechanical Specifications

Wire size #16 AWG

ABS plastic case

Epoxy encapsulated

Weight is 3 oz (0.09 kg)

Electrical Specifications

Rated Solar Input	4.5	Amps
Max. Input (5 min.)	5.5	Amps
System Voltage	12	Volts
Max. Solar Voltage	30	Volts
Regulation Voltage	14.1	Volts
Accuracy	60	mV
Self-consumption	6	mA
Temp. Compensation	–28	mV/°C
Reverse Current Leakage	<10	µA
Operating Temperature	–40 to +85°C	

WARRANTY: ***Five year warranty period. Contact Morningstar or your authorized distributor for complete terms.***

AUTHORIZED MORNINGSTAR DISTRIBUTOR:

MORNINGSTAR corporation

8 Pheasant Run
Newtown, PA 18940 USA
Tel: +1 215-321-4457 Fax: +1 215-321-4458
E-mail: info@morningstarcorp.com
Website: www.morningstarcorp.com

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BLUE SEA® SYSTEMS

NEW

Dual USB CHARGERS

Charge two mobile devices on the go

Made with corrosion resistant materials which ensure a solid contact and low voltage drop.

- Fits in same mounting hole as a traditional 12 Volt outlet
- Compatible with most mobile devices including Apple® products
- Protective dust cap with tether keeps dust and spray from shortening the life of the charger
- Conformal coated circuit board to stand up to the harsh marine environment

Dual USB Chargers 1016/1016200/1018
Easy to install in existing 12V DC socket hole providing convenient access for charging mobile devices

Dual USB Charger Plug 1017
Easy to use in common 12V DC sockets found in boats, cars, and recreational vehicles

1016, 12V DC
1018, 12/24V DC
Dual USB Chargers

1016200, 12V DC
Dual USB Charger

Related Products

12V DC Plug

12V DC Sockets

12V DC Socket and Dual USB Charger

USB Extension

Dual USB Charger Plug

DUAL USB CHARGERS

Scan for additional product information

Specifications	1016/1016200/ 1017/1019	1018/1039
Maximum Output Current	2.1A DC (total)	2.1A DC (total)
Input Voltage	12V DC	12-24V DC
Input Voltage Range	9-16V DC	9-32V DC
Output Voltage	5V DC ±5%	5V DC ±5%
Port Configuration	D+ = 2.0V D- =2.8V	D+ = 2.0V D− =2.8V
Parasitic Current Draw	15mA	15mA
Thermal Overload Protection	Yes	Yes
Short Circuit Protection	Yes	Yes
Reverse Polarity Protection	Yes	Yes
USB	2.0	2.0
1016/1016200/1018		
Cut Out Dimensions	1-1/8" (29 mm) dia. hole	1-1/8" (29 mm) dia. hole
1019/1039		
Cut Out Dimensions	1.45" x 0.83" (36.83 mm x 21.08 mm)	1.45" x 0.83" (36.83 mm x 21.08 mm)

Regulatory

E13 RoHS FC CE Class B Compliant

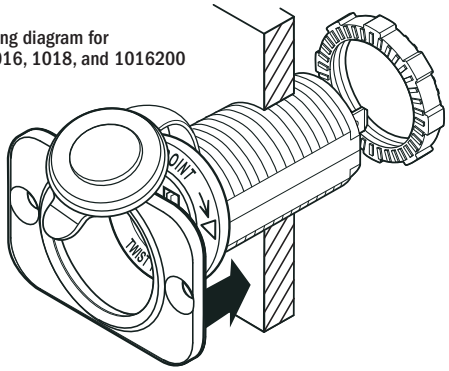
PN	Voltage	Color	Description
1016	12V DC	Black	Dual USB Charger Socket
1016200	12V DC	White	Dual USB Charger Socket
1017	12V DC	Black/Silver	Dual USB Charger Plug
1018	12 /24V DC	Black	Dual USB Charger Socket

1016, 12V DC
1018, 12/24V DC
Dual USB Charger

1016200, 12V DC
Dual USB Charger

1017, 12V DC
Dual USB Charger Plug

Mounting diagram for
PNs 1016, 1018, and 1016200



8346050
12V DC Accessories
Micro Merchandising Plan

BLUE SEA® SYSTEMS

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f 360.734.4195
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www.bluesea.com

Specifications subject to change.
See bluesea.com for current information.

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