Transcript: How To Build A Solar Setup: COMPLETE Step-by-Step, DIY Guide (12V, 2000W)

Video ID: L4HiYD1i71A

Extraction Date: 2025-04-02 06:46:35

**[00:00:00]** in this video I'm going to walk you

**[00:00:02]** through a DIY solar setup I'm going to

**[00:00:04]** show you the entire process of setting

**[00:00:06]** up a 12 volt system with a 2000 watt

**[00:00:09]** inverter and a 12 volt fuse block it's a

**[00:00:12]** pretty common and popular setup what I'm

**[00:00:14]** going to do in this video is I'm going

**[00:00:15]** to break it into two parts I'm going to

**[00:00:16]** go into the classroom where I'll explain

**[00:00:18]** the reasoning behind everything and then

**[00:00:21]** we're going to go into the lab where

**[00:00:22]** we're going to implement everything that

**[00:00:23]** we learn now after watching this video

**[00:00:25]** you will be able to easily build your

**[00:00:28]** own setup by either following what I

**[00:00:30]** outline or you can make changes specific

**[00:00:32]** to your setup based on what I teach be

**[00:00:35]** sure to stick around until the end as

**[00:00:37]** after we cover everything I'm going to

**[00:00:38]** explain how to easily build a diagram

**[00:00:40]** using the principles that we outline so

**[00:00:43]** that you can customize your own setup

**[00:00:44]** shown here on the screen are the two

**[00:00:47]** sections for this video we're going to

**[00:00:48]** talk about the classroom in the lab and

**[00:00:50]** I'm going to put the time stamps where

**[00:00:51]** it begins so that you can move around if

**[00:00:54]** you want to come back and review any

**[00:00:55]** part of the video also Below in the

**[00:00:57]** description section I'm going to put the

**[00:00:58]** times in the video on various sub

**[00:01:00]** objects you may want to go back and

**[00:01:01]** watch things like we'll go over fuses

**[00:01:03]** inverter charge controller Etc plus I'm

**[00:01:06]** going to put links to all the items that

**[00:01:08]** we covered so the parts and the tools

**[00:01:10]** everything that I'm going to go over you

**[00:01:11]** can pick those up later by going through

**[00:01:13]** the links below there's a lot to cover

**[00:01:15]** so let's Jump Right In

**[00:01:17]** foreign

**[00:01:21]** why do I recommend starting here in the

**[00:01:23]** classroom I wanted to go over the

**[00:01:24]** concepts of each part of this setup I've

**[00:01:26]** watched enough videos online showing how

**[00:01:28]** to piece everything together which we're

**[00:01:30]** going to do in a moment when we get into

**[00:01:31]** the lab but more importantly is trying

**[00:01:34]** to understand what each part does and

**[00:01:36]** what the considerations that you have to

**[00:01:38]** really make before you buy these various

**[00:01:40]** components so let's start with a very

**[00:01:42]** quick overview of this setup this is a

**[00:01:44]** 12 volt 2000 watt setup again it's very

**[00:01:47]** popular as it can output about the same

**[00:01:48]** amount of power that you'd get from your

**[00:01:50]** home wall socket when you plug in a

**[00:01:52]** device so how does this all work

**[00:01:54]** together now I'll be using a few

**[00:01:55]** technical terms in this explanation but

**[00:01:57]** just follow along and you'll get a

**[00:01:59]** general ideal as I explain it in a

**[00:02:02]** nutshell you have solar panels which

**[00:02:04]** collect energy from the Sun and then

**[00:02:06]** they send the energy to a charge

**[00:02:08]** controller now the charge controller

**[00:02:10]** regulates this energy and sends it to

**[00:02:12]** batteries our batteries then store this

**[00:02:15]** energy when we need to access the energy

**[00:02:18]** from the batteries we simply turn on the

**[00:02:20]** inverter which which converts the energy

**[00:02:21]** stored in the batteries into usable

**[00:02:24]** power for our devices that we plug in

**[00:02:27]** here on the side like our phones maybe a

**[00:02:29]** laptop a refrigerator or even power

**[00:02:31]** tools so let's take a quick moment to

**[00:02:33]** review a simple formula I promise I'm

**[00:02:35]** not going to get technical but I do need

**[00:02:37]** to bring this formula up because it will

**[00:02:39]** determine the wiring and the fuses that

**[00:02:41]** we're going to use to connect these

**[00:02:42]** primary components together now after I

**[00:02:45]** go through this formula I'm going to

**[00:02:46]** give you a simple example to help

**[00:02:48]** reinforce this the formula is W divided

**[00:02:52]** by V equals a now we know our inverter

**[00:02:55]** is 2000 watts and we know that for this

**[00:02:58]** setup we're going to be powering as much

**[00:03:00]** as 2 000 Watts 2000 is the first value

**[00:03:04]** for the W in our equation next our

**[00:03:07]** inverter our battery and our 12 volt

**[00:03:10]** fuse block we're using our all rated for

**[00:03:13]** 12 volts so for the v in our equation we

**[00:03:17]** have 12. now that we know the values for

**[00:03:20]** w and V let's find our third value in

**[00:03:24]** our equation a getting back to our

**[00:03:26]** formula if we divide 2000 by 12 we get

**[00:03:32]** 166.67 so a equals

**[00:03:36]** 166.67 okay so what does that tell us

**[00:03:39]** well a lot actually in order to connect

**[00:03:42]** our inverter to the battery that value

**[00:03:45]** of a or amps will determine the size of

**[00:03:47]** our wiring the fuses and our switches

**[00:03:50]** that we're going to need in this whole

**[00:03:52]** setup if you understand what I just

**[00:03:54]** explained you're doing fine now before

**[00:03:56]** we go forward let me give you a quick

**[00:03:58]** example to put this into terms that

**[00:04:00]** maybe you're more comfortable with if

**[00:04:02]** you live in somewhere like a house an

**[00:04:03]** apartment an RV or wherever you may have

**[00:04:06]** power you will have a fuse box if you've

**[00:04:09]** ever tricked a circuit maybe while

**[00:04:11]** running a toaster a hair dryer or a

**[00:04:12]** microwave at the same time you've got to

**[00:04:14]** go to the circuit breaker and reset the

**[00:04:16]** fuse if we look at the fuses for our

**[00:04:19]** wall plug-ins at least this is the case

**[00:04:21]** in most American Homes you're going to

**[00:04:22]** see 15 on them this fuse is rated for 15

**[00:04:26]** amps so if we use the formula again the

**[00:04:30]** a in our equation amps equals 15. the

**[00:04:34]** next variable in our equation is V which

**[00:04:36]** is voltage now the voltage in American

**[00:04:39]** Homes is 120 volts so if a power line in

**[00:04:42]** our house runs 120 volts at 15 amps that

**[00:04:46]** means we can determine the maximum

**[00:04:48]** wattage a wall socket can output so to

**[00:04:51]** find W or watts in this formula we would

**[00:04:54]** simply multiply 120 by 15 and that would

**[00:04:58]** give us 1800. so the typical American

**[00:05:00]** wall socket can output 1800 watts this

**[00:05:04]** is why a 2000 watt system like what we

**[00:05:07]** have here in front of us is very popular

**[00:05:09]** the output on the inverter is very

**[00:05:11]** similar to a typical home wall socket if

**[00:05:14]** what I just explained to you is

**[00:05:16]** confusing I'd recommend you go back and

**[00:05:18]** watch it a few times as the rest of this

**[00:05:20]** video is really going to build off these

**[00:05:21]** principles that we just laid out

**[00:05:23]** here's what we're going to do next

**[00:05:24]** before we start connecting everything up

**[00:05:26]** let's explain the components that we're

**[00:05:28]** going to need and how to properly size

**[00:05:30]** them here's what we're going to cover

**[00:05:32]** we're going to go over wiring cable lugs

**[00:05:34]** fuses switches shunts and bus bars

**[00:05:39]** wiring

**[00:05:40]** wiring allows us to connect the

**[00:05:42]** components together in our system wiring

**[00:05:44]** comes in different sizes but how do we

**[00:05:46]** determine the correct size to use to

**[00:05:48]** connect all of the components in our

**[00:05:50]** system together let's start this

**[00:05:52]** discussion with connecting our inverter

**[00:05:54]** to the batteries and we're going to need

**[00:05:56]** to return to our equation W divided by V

**[00:05:59]** equals a we determine that to power our

**[00:06:02]** inverter we're going to need wiring that

**[00:06:03]** can support

**[00:06:04]** 166 amps now there's only one thing I

**[00:06:08]** need to mention here before we move on

**[00:06:09]** inverter inefficiency no inverter is 100

**[00:06:12]** efficient typically they're around about

**[00:06:15]** 85 to 90 percent efficiency so what

**[00:06:18]** difference does this make for our setup

**[00:06:20]** remember earlier we use the equation W

**[00:06:23]** divided by V equals a to get our

**[00:06:26]** amperage we need to run through the

**[00:06:28]** wiring well due to inefficiency to power

**[00:06:30]** the inverter from the batteries we need

**[00:06:33]** to factor this into our equation which

**[00:06:34]** now becomes 2000 divided by 12 divided

**[00:06:37]** by 0.85 which now gives us a value of

**[00:06:40]** 190 six so technically we're going to be

**[00:06:43]** pushing 196 amps of current through our

**[00:06:46]** wiring if we run our inverter at full

**[00:06:49]** capacity how do you find information for

**[00:06:51]** the wiring size based on the current

**[00:06:52]** that we need to send through it there's

**[00:06:55]** a chart that's often referenced and I'll

**[00:06:57]** put a link to it in the description

**[00:06:58]** section which gives us that information

**[00:06:59]** since we need to run 196 amps through

**[00:07:03]** our wire if you look at the chart you

**[00:07:05]** see we're between 150 and 200 amps when

**[00:07:09]** you're between numbers on a chart like

**[00:07:10]** this then you need to round up to a

**[00:07:12]** higher number why well because if you

**[00:07:15]** use a wire that's not capable of

**[00:07:17]** handling the current that you're going

**[00:07:18]** to be pushing through it you can burn it

**[00:07:20]** up and start a fire so you always want

**[00:07:22]** to go with the next size up if you're in

**[00:07:24]** between numbers from the chart we see

**[00:07:26]** that we need a two odd gauge to support

**[00:07:28]** 196 amps also pay attention to the

**[00:07:31]** distance in the chart it shows you the

**[00:07:34]** size of the wiring based on how long

**[00:07:35]** your wiring will be as distance

**[00:07:38]** increases the wiring will start increase

**[00:07:40]** increasing in size since our run from

**[00:07:43]** the battery to the inverters under three

**[00:07:45]** meters two out gauge is perfect so now

**[00:07:48]** we know the size of the cable that we're

**[00:07:50]** going to need to connect the inverter to

**[00:07:51]** the battery you'll use this exact

**[00:07:53]** principle later when you size the cables

**[00:07:55]** that connect the solar panels to the

**[00:07:57]** charge controller the charge controller

**[00:07:59]** and the 12 volt fuse block to the system

**[00:08:01]** to the bus bar it just really comes down

**[00:08:04]** to understanding how much of the

**[00:08:05]** components draw in amps and then based

**[00:08:08]** on the chart we just showed you you can

**[00:08:09]** find wiring that can support that

**[00:08:11]** amperage cable lugs at the end of our

**[00:08:14]** wires we need to add cable lugs to

**[00:08:16]** connect to the posts of things like our

**[00:08:18]** inverter our 12 volt DC fuse block our

**[00:08:21]** battery our bus bars and switches there

**[00:08:23]** are a few things that you'll need to pay

**[00:08:25]** attention to the first is the wire gauge

**[00:08:28]** size you can put this on remember in our

**[00:08:31]** previous point that we discussed the

**[00:08:32]** size of the wiring that we're going to

**[00:08:33]** be using once we start building this

**[00:08:35]** setup we're going to see that we'll need

**[00:08:37]** different wire sizes for different

**[00:08:38]** devices in our system now we need to pay

**[00:08:41]** attention to the size of the inner

**[00:08:43]** diameter of the screw or posts that

**[00:08:46]** we're going to be connecting this lug to

**[00:08:47]** some of the posts that will Mount our

**[00:08:49]** wires to are large some are going to be

**[00:08:50]** small and when purchasing each one of

**[00:08:52]** these products online that you'll be

**[00:08:54]** connecting these lugs to they'll have

**[00:08:56]** information about the size so it will

**[00:08:58]** help you decide what cable lug size to

**[00:09:00]** buy how many will you need and what

**[00:09:03]** sizes we're going to discuss all that

**[00:09:05]** momentarily

**[00:09:06]** fuses next up is fuses fuses help

**[00:09:10]** protect our wiring the inverter and the

**[00:09:12]** charge controller they already have to

**[00:09:14]** use this built-in to protect them so

**[00:09:16]** they're good but the fuses we select

**[00:09:18]** will need to match the maximum amperage

**[00:09:21]** that a wire can carry remember in the

**[00:09:23]** previous discussion about wiring when we

**[00:09:25]** determine the size based on the chart if

**[00:09:28]** a wire can only handle 100 amps and

**[00:09:30]** that's all it's rated for then we need

**[00:09:32]** to place a hundred amp fuse at the

**[00:09:33]** beginning of the wiring before a current

**[00:09:35]** is sent down it to prevent the wire from

**[00:09:38]** even carrying too many amps in our setup

**[00:09:40]** we're going to be sending current from

**[00:09:42]** our batteries we're going to be sending

**[00:09:44]** it from solar panels a charge controller

**[00:09:46]** and a bus bar therefore we're going to

**[00:09:49]** place fuses at each of these devices and

**[00:09:52]** then connect the fuse to the wiring that

**[00:09:54]** goes to other components I know this may

**[00:09:57]** sound a bit conceptual at this point but

**[00:09:59]** once I build this setup you're going to

**[00:10:01]** see where I place the fuses

**[00:10:03]** switches switches allow us to easily

**[00:10:05]** disconnect the system from incoming

**[00:10:07]** energy sources in our setup we have

**[00:10:09]** solar panels sending energy to our

**[00:10:11]** charge controller and we have battery

**[00:10:13]** sending energy to the entire setup by

**[00:10:16]** placing switches in between the solar

**[00:10:19]** panels and the charge controller we can

**[00:10:21]** safely disconnect the panels and the

**[00:10:23]** batteries from the setup when we need to

**[00:10:25]** make changes or we just want to turn the

**[00:10:26]** system off now during the build we'll

**[00:10:29]** explain the switches you'll need and

**[00:10:31]** where to place them

**[00:10:33]** bus bars bus bars are metallic strips

**[00:10:36]** that allow for the distribution of

**[00:10:37]** incoming current as you can see here in

**[00:10:39]** our setup we've got a bus bar where our

**[00:10:41]** positive connections all tie into by

**[00:10:44]** doing this we can tie into other devices

**[00:10:46]** we may want to power here on this bar

**[00:10:48]** and you can see that there are posts

**[00:10:50]** with bolts along with small screws that

**[00:10:53]** you can easily secure wiring to we've

**[00:10:55]** got our positive bus Bar connected to

**[00:10:57]** our batteries our inverter our charge

**[00:10:59]** controller and our 12 volt fuse block

**[00:11:01]** also as you can see here we've got a bus

**[00:11:03]** Bar for our negative connections I

**[00:11:06]** purchased a red and black bus bar so

**[00:11:08]** it's clear where to connect the positive

**[00:11:10]** and negative wiring too

**[00:11:12]** shunts the last component I'll mention

**[00:11:15]** here is a shot shown here this shunt is

**[00:11:18]** connected to our system and is connected

**[00:11:20]** to a battery monitor these are optional

**[00:11:22]** and just help us monitor the status of

**[00:11:24]** our batteries

**[00:11:26]** layout

**[00:11:27]** for this entire setup I'm using a piece

**[00:11:29]** of plywood to lay this all out in a way

**[00:11:31]** that you can easily fall along your

**[00:11:33]** setup will likely be very different

**[00:11:34]** whether you're setting this up in a bus

**[00:11:36]** an RV a van a boat a shed or whatever

**[00:11:39]** but again I'll detail all the reasons

**[00:11:41]** and give you the necessary information

**[00:11:42]** so you can modify things as you need to

**[00:11:45]** typically at this point you would want

**[00:11:47]** to diagram this out on paper before you

**[00:11:49]** start but I want to show you the entire

**[00:11:52]** setup and then cover the diagram at the

**[00:11:54]** end why well after you see how this

**[00:11:56]** whole setup is laid out I think it will

**[00:11:58]** give you a much more clear understanding

**[00:12:00]** before you create your own diagram which

**[00:12:02]** we'll cover momentarily

**[00:12:04]** lab inverter to batteries all right it's

**[00:12:07]** time to start connecting things up let's

**[00:12:09]** start by connecting the inverter to the

**[00:12:12]** batteries I'm purposefully going to go

**[00:12:14]** through quickly so you can see the big

**[00:12:15]** picture first after doing this I'll then

**[00:12:17]** Circle back and explain how and why I

**[00:12:20]** performed each step I want you to see

**[00:12:22]** the whole picture before we get bogged

**[00:12:24]** down into the details also I set up the

**[00:12:27]** connection from the inverter to the

**[00:12:28]** batteries first as the cables we're

**[00:12:30]** using are thick and they don't really

**[00:12:32]** Bend much at all as such I wanted to get

**[00:12:34]** this first component in place all right

**[00:12:36]** we're going to connect the positive

**[00:12:38]** terminal on the inverter to a fuse we're

**[00:12:40]** going to connect the fuse to the

**[00:12:42]** positive bus bar we're going to connect

**[00:12:44]** the positive bus bar to a switch and

**[00:12:47]** then we're going to connect the switch

**[00:12:49]** to a wire which will later connect to

**[00:12:51]** the positive terminal of the battery

**[00:12:53]** then we're going to connect the negative

**[00:12:55]** terminal of the inverter to a negative

**[00:12:58]** bus bar connect the bus bar to a shunt

**[00:13:01]** and then connect the shunt to a wire

**[00:13:04]** which will later connect to the negative

**[00:13:06]** terminal of the battery

**[00:13:08]** I know I covered a lot very quickly but

**[00:13:10]** let's swing back and explain everything

**[00:13:12]** in detail let's start with the inverter

**[00:13:14]** there are some holes on the side which

**[00:13:16]** we'll use to mount this down to the

**[00:13:18]** plywood we can easily access the AC

**[00:13:20]** ports here at the top to plug in our

**[00:13:22]** appliances now in order to connect our

**[00:13:24]** inverter to the fuse we're going to need

**[00:13:26]** to cut some wiring and add cable lugs on

**[00:13:28]** the end of The Wire remember earlier

**[00:13:31]** when we discussed the amount of current

**[00:13:32]** that this inverter will require based on

**[00:13:35]** a formula we determined that we need

**[00:13:36]** wiring that can handle 196 amps the wire

**[00:13:40]** that we have here is two out gauge and

**[00:13:42]** can handle 200 amps as shown here I put

**[00:13:46]** the cable lugs on the post of the

**[00:13:48]** components we're going to connect

**[00:13:49]** together this serves two purposes first

**[00:13:52]** I can make sure I'm getting the correct

**[00:13:54]** cable lug as some have different sizes

**[00:13:57]** based on what you're connecting to

**[00:13:58]** secondly I can then measure the distance

**[00:14:01]** of the cable based on where these cable

**[00:14:03]** lugs are located due to the thickness of

**[00:14:05]** this particular cable I had to use a

**[00:14:07]** bolt cutter to cut the wire now once I

**[00:14:10]** cut the wire I had to strip off the

**[00:14:12]** insulation off both ends of the cable I

**[00:14:15]** use this cutting tool I was very careful

**[00:14:17]** to gently make cuts to get through the

**[00:14:18]** insulation and not impact the metal

**[00:14:20]** inside the wiring I had to then add the

**[00:14:23]** cable lugs on the end as shown I had to

**[00:14:26]** use a special tool to hammer the cable

**[00:14:28]** lug so the wire there are tools that are

**[00:14:30]** smaller to connect the lugs to cables

**[00:14:32]** we're going to cover those shortly but

**[00:14:33]** due to the thickness of this particular

**[00:14:35]** wire I had to use this particular device

**[00:14:38]** which requires you to hammer it down

**[00:14:40]** also remember when putting these cable

**[00:14:42]** lugs on please keep them at the same

**[00:14:44]** orientation what do I mean if we add one

**[00:14:48]** cable lug on one end and then we started

**[00:14:50]** the process to add the second lug on the

**[00:14:52]** other end if the second cable lug was at

**[00:14:54]** a 90 degree angle to the first I

**[00:14:57]** wouldn't be able to mount these on our

**[00:14:59]** inverter and fuse so as shown here

**[00:15:01]** they're at the same angle relative to

**[00:15:04]** each other next we need to add shrink

**[00:15:07]** wrap to the wire so that we're in

**[00:15:08]** isolating and protecting the area or

**[00:15:10]** cable lugs and wiring connect these kits

**[00:15:13]** you order online will typically come

**[00:15:14]** with these you can use either a

**[00:15:16]** cigarette lighter to apply heat to these

**[00:15:18]** or as shown here use a heat gun but be

**[00:15:21]** careful as these will get very hot one

**[00:15:23]** other Pro tip when I purchased the two

**[00:15:25]** out gauge wiring at Home Depot they had

**[00:15:28]** only black cable for this part of the

**[00:15:30]** video we're connecting the positive

**[00:15:32]** terminal of the inverter to the positive

**[00:15:34]** terminal of the battery so I went back

**[00:15:37]** and I wrapped the black cables with red

**[00:15:39]** tape ideally you want to purchase red

**[00:15:41]** cables but we improvised here

**[00:15:43]** additionally when adding the shrink wrap

**[00:15:46]** to the cables put red shrink wrap on the

**[00:15:49]** positive cables and black shrink wrap on

**[00:15:51]** the negative cables as shown here I will

**[00:15:54]** connect our cable to a 200 amp fuse

**[00:15:56]** which is held in a fuse holder which you

**[00:15:59]** can secure down with screws I put this

**[00:16:01]** fuse between the inverter and the bus

**[00:16:03]** bar next I connect my custom wire from

**[00:16:07]** the fuse to our positive bus bar the

**[00:16:10]** positive bus bar is where we'll also

**[00:16:12]** connect our charge controller and 12

**[00:16:13]** volt fuse block momentarily think of

**[00:16:16]** this as a hub where we'll connect

**[00:16:17]** different devices that send or receive

**[00:16:20]** current from the bus bar I'll repeat the

**[00:16:23]** process of sizing and customizing our

**[00:16:25]** cable then connect it to the switch our

**[00:16:28]** system will have two switches but for

**[00:16:30]** this particular one I need the ability

**[00:16:32]** to send a lot of amperage through this

**[00:16:34]** particular switch this particular switch

**[00:16:37]** is rated for 275 amps which is more than

**[00:16:40]** enough for the 200 amp maximum current

**[00:16:42]** that we're going to pull from the

**[00:16:44]** battery as you can see here the switch

**[00:16:46]** has two studs which will bolt our wires

**[00:16:48]** onto when working on the system all I

**[00:16:52]** have to do is disconnect the batteries

**[00:16:53]** via the switch lastly I'll add the cable

**[00:16:56]** that goes from our switch to the

**[00:16:59]** batteries again I'm not going to connect

**[00:17:00]** the batteries yet but rather I'll just

**[00:17:03]** connect the wiring which will then

**[00:17:05]** connect to the battery later alright now

**[00:17:07]** that we have all the wiring connected to

**[00:17:08]** each component I'm going to secure these

**[00:17:10]** components to the board I waited until I

**[00:17:12]** finished connecting everything as these

**[00:17:14]** cables are so thick that you really

**[00:17:16]** can't bend them I had mounted a few of

**[00:17:18]** the components earlier before cutting

**[00:17:20]** off the cables and I found that if the

**[00:17:21]** connections on the end of the cables or

**[00:17:23]** even something as short as a quarter of

**[00:17:25]** an inch off I have to then move the bus

**[00:17:27]** bar or fuse holder to get everything to

**[00:17:29]** connect properly so let's run through

**[00:17:31]** the negative connection from the

**[00:17:32]** inverter to the battery we're repeating

**[00:17:34]** the same process I create custom wires

**[00:17:37]** with cable lugs that connect each

**[00:17:38]** component together since this wire is

**[00:17:40]** already black I don't have to add tape

**[00:17:42]** as I did with the red tape on The Wire

**[00:17:44]** running down the positive side I then

**[00:17:46]** connected it from the negative terminal

**[00:17:48]** of the inverter to the negative bus bar

**[00:17:50]** as described earlier in the video the

**[00:17:52]** bus bar is a central juncture where we

**[00:17:54]** can tie into other wires in one place

**[00:17:57]** our bus bar is required in this project

**[00:17:59]** like this not necessarily as you could

**[00:18:01]** tie everything together in one

**[00:18:02]** connection for the negative wires but it

**[00:18:04]** does make managing things a lot easier

**[00:18:06]** from the negative bus bar I created

**[00:18:08]** another custom wire for our shunt as we

**[00:18:11]** detailed earlier the shunt allows us to

**[00:18:13]** connect a battery monitor so we can see

**[00:18:15]** the status of the battery is it required

**[00:18:18]** not really but it's a nice item to have

**[00:18:20]** to see in real time what the battery

**[00:18:21]** status is now on the other end of the

**[00:18:23]** shunt we're going to connect our cable

**[00:18:25]** that will later connect to the negative

**[00:18:27]** terminal of our batteries in order to

**[00:18:29]** connect the shunt to the battery monitor

**[00:18:31]** it comes with a small cord that runs

**[00:18:33]** down to the power positive terminal of

**[00:18:35]** our first battery that we have connected

**[00:18:37]** in parallel

**[00:18:38]** now I know we covered a lot in this

**[00:18:40]** segment but the rest of the video

**[00:18:41]** utilizes these principles we just laid

**[00:18:43]** out let's move into connecting solar via

**[00:18:46]** the charge controller

**[00:18:48]** solar charge controller

**[00:18:51]** for our setup we're using a charge

**[00:18:52]** controller that can handle a maximum of

**[00:18:55]** 520 Watts on a 12 volt system like ours

**[00:18:58]** I've got four 100 watt monocrystalline

**[00:19:01]** solar panels in series in the manual for

**[00:19:03]** this charge controller they recommend a

**[00:19:05]** fuse between the solar panels and the

**[00:19:07]** charge controller to determine the fuse

**[00:19:09]** size since we're connecting the solar

**[00:19:12]** panels in series the amperage will not

**[00:19:14]** increase but the voltage will now it

**[00:19:16]** gets a bit beyond the scope of this

**[00:19:17]** video to detail the series versus

**[00:19:19]** parallel solar panel setup but a quick

**[00:19:22]** search on Google will explain this in

**[00:19:23]** more detail if you want to do a deeper

**[00:19:25]** dive since we're only using four small

**[00:19:27]** panels a series connection made the most

**[00:19:30]** sense for me for these panels they're

**[00:19:32]** short circuit current writing or ISC is

**[00:19:35]** 5.21 amps so to determine the fuse size

**[00:19:38]** to put on the positive wire coming from

**[00:19:40]** the solar panels connected in series and

**[00:19:43]** multiply 5.21 by a factor of 1.56 which

**[00:19:46]** gives us 8.13 now getting into a lengthy

**[00:19:49]** discussion of where we get one point

**[00:19:51]** five six is again beyond the scope of

**[00:19:53]** this video but it's a value that in this

**[00:19:55]** industry is standard to determine the

**[00:19:56]** few size to connect to the solar panels

**[00:19:59]** again with our calculated value of 8.13

**[00:20:02]** we need to find the fuse this size or

**[00:20:04]** larger looking online I found an inline

**[00:20:07]** mc4 fuse which is rated for 10 amps

**[00:20:09]** shown here now before we connect our

**[00:20:12]** solar panels to our charge controller I

**[00:20:14]** want to install a disconnect switch that

**[00:20:16]** allows us to easily disconnect our solar

**[00:20:18]** from our system we need a circuit

**[00:20:20]** breaker specifically designed for DC

**[00:20:22]** which is what comes from our solar

**[00:20:24]** panels and is rated for high voltage I

**[00:20:27]** found the circuit breaker which did the

**[00:20:29]** trick adding in our positive and

**[00:20:31]** negative wires to the top I then ran the

**[00:20:34]** positive and negative wires to our

**[00:20:35]** charge controller from the switch again

**[00:20:38]** our charge controller handles the energy

**[00:20:40]** coming from the panels which it then

**[00:20:42]** sends to the batteries I mounted the

**[00:20:45]** charge controller at the top of the

**[00:20:46]** board next to our inverter with the

**[00:20:48]** wires coming from our circuit breaker I

**[00:20:50]** plug the red or positive wire into the

**[00:20:53]** PV Plus Port on the charge controller

**[00:20:56]** and the negative wire or black wire into

**[00:20:59]** the PV negative port on the charge

**[00:21:01]** controller next we're going to run the

**[00:21:04]** positive and negative wire from our

**[00:21:05]** charge controller to the positive and

**[00:21:07]** negative bus bars to do this on the

**[00:21:10]** charge controller there are two ports at

**[00:21:12]** the bottom bat minus and bat plus that

**[00:21:15]** will put our wires into but what size

**[00:21:18]** wiring and fuse should we add in here

**[00:21:20]** since this is a 40 amp charge controller

**[00:21:23]** our wiring coming from the charge

**[00:21:25]** controller we'll need to be able to

**[00:21:27]** handle a maximum of 40 amps according to

**[00:21:30]** our chart 40 amps requires 8 gauge

**[00:21:33]** wiring again I picked this up at Home

**[00:21:36]** Depot Purchasing red and black 8 gauge

**[00:21:38]** wiring additionally the manual for the

**[00:21:41]** charge controller recommends a 40 amp

**[00:21:43]** fuse coming from the charge controller

**[00:21:44]** remember in our discussion earlier about

**[00:21:47]** fuses we want to put these as close to

**[00:21:49]** the power source to protect our wiring I

**[00:21:52]** therefore installed the 40 amp fuse

**[00:21:53]** close to the charge controller earlier

**[00:21:56]** in the video I went into detail

**[00:21:58]** explaining how to cut the cables cut off

**[00:22:00]** the insulation on the ends and then add

**[00:22:02]** cable lugs on the large two watt cable

**[00:22:04]** the tools needed for smaller cables are

**[00:22:06]** different to begin with we'll determine

**[00:22:08]** the distance from the charge controller

**[00:22:10]** to the 40 amp fuse measuring that

**[00:22:13]** distance will then cut our wire with the

**[00:22:14]** tool shown here

**[00:22:16]** to strip the insulation off the ends of

**[00:22:18]** this eight gauge or smaller wire there

**[00:22:20]** is a tool that you can use as shown here

**[00:22:22]** it cuts the installation perfectly and

**[00:22:24]** you can then strip the insulation off

**[00:22:26]** the end on one end of the wire we're not

**[00:22:29]** going to need a cable lug as we'll plug

**[00:22:30]** this directly into the charge controller

**[00:22:31]** and then on the other end we're going to

**[00:22:33]** put on a Cable log since these cables

**[00:22:35]** aren't as large as the two odd gauge

**[00:22:37]** wire there's a tool to crimp the cable

**[00:22:40]** lug onto the end of the cable again find

**[00:22:43]** the right cable lug based on the wire

**[00:22:44]** size and the size of the posts that

**[00:22:47]** you're going to be connecting to before

**[00:22:48]** attaching it to the cable we're going to

**[00:22:50]** repeat this process going from the fuse

**[00:22:52]** to the positive bus bar measuring the

**[00:22:55]** length of the cable we'll need cutting

**[00:22:56]** the wiring stripping the insulation

**[00:22:58]** putting on the cable lug and then

**[00:23:01]** finally adding the shrink wrap

**[00:23:02]** additionally from the charge controller

**[00:23:04]** we're going to need to run another cable

**[00:23:06]** to the negative bus bar it will be the

**[00:23:09]** same size as the cable we ran to the

**[00:23:10]** positive bus bar but this one will be

**[00:23:12]** black additionally we can connect a

**[00:23:15]** Bluetooth module to the charge control

**[00:23:16]** roller which will allow us to monitor it

**[00:23:18]** via app 12 volt fuse block the last

**[00:23:21]** major component that we're going to add

**[00:23:23]** is a 12 volt fuse block this allows us

**[00:23:25]** to run 12 volt devices this one I

**[00:23:28]** purchased can handle 125 amps maximum

**[00:23:31]** coming in now if we go back to our chart

**[00:23:33]** we'll see we need a one gauge wire to

**[00:23:35]** handle 125 amps now I don't plan on

**[00:23:38]** using more than a few devices all

**[00:23:39]** connects so I purposefully went small on

**[00:23:41]** the cable that's coming in to connect

**[00:23:42]** the fuse block to our system I went with

**[00:23:45]** a 4 gauge wire which is only rated at

**[00:23:46]** 100 amps remember this is a custom setup

**[00:23:49]** particular to my needs my plans are to

**[00:23:51]** only plug in maybe one or two 12 volt

**[00:23:53]** devices which will be less than one amp

**[00:23:55]** so I purposefully went small on the

**[00:23:58]** cable and connecting the fuse block to

**[00:24:00]** the rest of the system plus I put in a 5

**[00:24:02]** amp fuse shown here in the block that

**[00:24:04]** connects a 12 volt device but if you do

**[00:24:07]** plan on using your fuse block for a

**[00:24:09]** heavier load then of course connect this

**[00:24:10]** to the bus bars with a one gauge wire as

**[00:24:13]** recommended if you want to push the

**[00:24:15]** maximum load through this additionally

**[00:24:17]** it is recommended that you put a fuse

**[00:24:19]** between the positive bus bar and the

**[00:24:20]** fuse block as we've done with the

**[00:24:22]** inverter and the charge controller but

**[00:24:24]** since I'm barely going to be using this

**[00:24:25]** device I just skipped the views entirely

**[00:24:27]** and that was my decision for my setup

**[00:24:29]** but please configure your setup as

**[00:24:32]** recommended based on what you're going

**[00:24:34]** to be powering again as we did with the

**[00:24:36]** other components in the system I measure

**[00:24:38]** the distance from the fuse block to the

**[00:24:40]** positive and negative bus bars and then

**[00:24:41]** customize the cables and cable lugs

**[00:24:43]** accordingly you'll want to pay attention

**[00:24:45]** to the cable lugs on the end of the

**[00:24:46]** wires as they'll be different sizes on

**[00:24:49]** both ends as opposed on the bus bars is

**[00:24:52]** much bigger than the post on the fuse

**[00:24:53]** block these wires are still malleable

**[00:24:56]** enough to bend into place

**[00:24:58]** batteries I use 12 volt 100 amp hour

**[00:25:01]** lithium iron phosphate self-heating

**[00:25:03]** batteries that can be connected in

**[00:25:04]** parallel before connecting them test the

**[00:25:07]** voltage to make sure they're close they

**[00:25:09]** both register the same voltage so we can

**[00:25:12]** now connect them if they don't match

**[00:25:14]** charge them one at a time to Max

**[00:25:16]** Capacity or discharge them completely

**[00:25:19]** and then you'll be ready to connect them

**[00:25:20]** I purchased these cables that allow me

**[00:25:23]** to connect them in parallel as shown

**[00:25:24]** here for this particular manufacturer

**[00:25:27]** you can only connect up to a total of

**[00:25:28]** foreign parallel when you first get

**[00:25:30]** these batteries they're in shelf mode to

**[00:25:33]** activate them simply use the tool they

**[00:25:35]** send by plugging it in then holding down

**[00:25:36]** the button until it turns a bright blue

**[00:25:38]** this will activate them both as they're

**[00:25:40]** connected together Additionally you can

**[00:25:43]** connect these together with a CAT5 cable

**[00:25:45]** to monitor their status you can monitor

**[00:25:47]** their status by connecting a module that

**[00:25:49]** either allows you to directly connect to

**[00:25:51]** your phone via Bluetooth to their app or

**[00:25:54]** we can monitor them with a battery

**[00:25:55]** monitor that we installed earlier when

**[00:25:57]** connecting to the shunt to connect the

**[00:25:59]** batteries to our system first make sure

**[00:26:01]** the switch we installed is in the off

**[00:26:03]** position since we have two batteries in

**[00:26:06]** parallel I'll connect the positive cable

**[00:26:08]** coming from our system to the positive

**[00:26:10]** terminal on the first battery and the

**[00:26:13]** negative cable on the negative terminal

**[00:26:15]** on the second battery also note that

**[00:26:18]** I've placed the 200 amp fuse on the

**[00:26:20]** positive terminal that are cable going

**[00:26:23]** to the system is connected to since our

**[00:26:25]** system is a 200 amp setup that's the max

**[00:26:27]** current that we can ever pull from these

**[00:26:29]** batteries and our wires are rated to

**[00:26:31]** only handle 200 amps so it's important

**[00:26:33]** that we put our fuse right here at the

**[00:26:34]** point of origin for our power to protect

**[00:26:36]** all of the cables earlier we mentioned

**[00:26:38]** installing a shunt as you can see here

**[00:26:40]** the shunt is connected to our battery

**[00:26:42]** via the small cord and we can then see

**[00:26:44]** the status of the battery

**[00:26:46]** quarter organization when we've got

**[00:26:48]** everything laid out you can use Clips

**[00:26:50]** like this to secure down the wires to

**[00:26:51]** make sure everything stays neatly in

**[00:26:53]** place but since most of our wires are

**[00:26:55]** fairly stiff I didn't really need many

**[00:26:57]** but they were useful in a few places

**[00:26:59]** grounding next we need to ground our

**[00:27:02]** inverter and charge controller if you

**[00:27:03]** look at the side of both of these they

**[00:27:05]** have a grounding connection that we can

**[00:27:06]** connect to depending on where you put

**[00:27:08]** this setup for example if you're in a

**[00:27:10]** vehicle you want to connect the

**[00:27:12]** grounding cable to the chassis I'm going

**[00:27:14]** to be putting my setup in a shed in my

**[00:27:16]** backyard and I have a grounding rod that

**[00:27:18]** I can connect to there you can also

**[00:27:20]** connect these to the negative bus bar

**[00:27:22]** and your system is shown here and then

**[00:27:24]** connect the negative bus bar to the

**[00:27:26]** grounding device I'm using a green six

**[00:27:28]** gauge wire green is typically the color

**[00:27:30]** for grounding

**[00:27:32]** testing okay we've built this out and

**[00:27:35]** I've had it connected to solar panels

**[00:27:36]** that charge the batteries so let's test

**[00:27:38]** this out shown here I'm testing the pure

**[00:27:40]** sine wave capabilities on the AC

**[00:27:42]** inverter everything looks good let's

**[00:27:44]** connect a few simple devices and monitor

**[00:27:46]** the battery output as we're running them

**[00:28:03]** after running them let's take a look to

**[00:28:05]** see if the cables or cable lugs got warm

**[00:28:07]** as shown here they barely warmed up so

**[00:28:09]** we're good again with the right size

**[00:28:11]** wiring we'll be fine also shown here

**[00:28:14]** with the solar panels connected we're

**[00:28:15]** getting power coming into our charge

**[00:28:17]** controller

**[00:28:18]** diagram so now that we see everything is

**[00:28:21]** working let's take a look at billing a

**[00:28:22]** simple diagram based on everything that

**[00:28:24]** we learn before you start building out

**[00:28:26]** your system I would encourage you to

**[00:28:28]** start here as it will really help you to

**[00:28:29]** understand what you need to purchase and

**[00:28:32]** then how to lay everything out in your

**[00:28:33]** own particular setup let me just make a

**[00:28:35]** quick comment about doing a diagram what

**[00:28:37]** I did is if you look I just really sat

**[00:28:40]** down and established okay you know I've

**[00:28:42]** got a 2001 inverter I've got a charge

**[00:28:44]** controller I've got you know bus bars

**[00:28:47]** I've got fuses where do I want to place

**[00:28:49]** them I've got batteries and then you can

**[00:28:52]** see the red represents positive and I

**[00:28:54]** kept black as black later I went in and

**[00:28:56]** I added the grounding lines you don't

**[00:28:58]** see those here represented I just added

**[00:29:00]** those at the end but the thought process

**[00:29:02]** was pretty simple I just started out

**[00:29:04]** with the inverter as kind of more or

**[00:29:06]** less a Cornerstone I just built around

**[00:29:08]** it and as you saw throughout the video

**[00:29:09]** this is how my setup ended up looking

**[00:29:11]** and you'll see in some places where

**[00:29:14]** we've kind of got you know a half dome

**[00:29:16]** look where we hop over wire

**[00:29:18]** by no means a electrician but just

**[00:29:22]** studying different diagrams online I saw

**[00:29:24]** how they use that process to help

**[00:29:25]** establish you know where lines cross

**[00:29:28]** each other but again this is you know

**[00:29:32]** just really what I'm trying to show here

**[00:29:34]** is just the thought process you can see

**[00:29:36]** I per and again this is not based on any

**[00:29:39]** units or anything like that I put W for

**[00:29:41]** wiring f for fuses and I think there was

**[00:29:44]** one other designation that I use oh yeah

**[00:29:46]** amps or rather the fuses I put F is for

**[00:29:49]** fuse and then what I did is I came over

**[00:29:51]** and I labeled over on the side you know

**[00:29:54]** like okay fuses

**[00:29:56]** um you know then the S and the W's you

**[00:29:59]** know I just started documenting

**[00:30:00]** everything here on the side so that way

**[00:30:02]** I could see what do I need to go back

**[00:30:04]** and I'm sorry s by the way a switch and

**[00:30:07]** this is just a system I came up with

**[00:30:08]** again use whatever makes the most sense

**[00:30:10]** for you but the purpose is start with

**[00:30:12]** this before you really buying the

**[00:30:14]** components go through think it through

**[00:30:16]** where you want to place everything how

**[00:30:18]** you want to wire it up fuses the

**[00:30:20]** switches and I would encourage you to go

**[00:30:22]** online and look at for example even post

**[00:30:24]** size on these different devices because

**[00:30:25]** then you'll you'll know what size cable

**[00:30:27]** lugs you'll need to buy it's just really

**[00:30:29]** again about mapping this out and I'll

**[00:30:31]** post links to other professional

**[00:30:33]** diagrams this is just kind of my

**[00:30:34]** rudimentary very amateur I went through

**[00:30:38]** and kind of cleaned it up later where I

**[00:30:40]** just you know and then I had and there

**[00:30:42]** were several thought processes that I

**[00:30:43]** had to go through and then I even sat

**[00:30:46]** down and took notes you know as I was

**[00:30:47]** going along but doing this really helped

**[00:30:49]** me think through the setup before I

**[00:30:51]** bought anything or put anything down and

**[00:30:54]** again I'll post links to other diagrams

**[00:30:56]** that you can go and look at that will

**[00:30:57]** help a lot hopefully this video gave you

**[00:30:59]** enough information to help you build

**[00:31:01]** your own custom setup now I know there

**[00:31:03]** was a lot that we covered but taking

**[00:31:05]** information that we use in the classroom

**[00:31:07]** where I went through and explained the

**[00:31:08]** components and the logic behind

**[00:31:10]** everything and then showing how I

**[00:31:12]** implemented that in the lab you know

**[00:31:14]** building this all out hopefully by

**[00:31:16]** taking that information and showing you

**[00:31:17]** you can understand how to build your own

**[00:31:19]** setup there's really no requirements

**[00:31:22]** that you build like I do again just use

**[00:31:24]** the wiring chart make sure that you have

**[00:31:26]** the right lug size make sure that you're

**[00:31:28]** just oversizing when you're not sure but

**[00:31:30]** make sure that you have fuses and

**[00:31:32]** everything set up based on the values in

**[00:31:33]** the way we explain it a lot of this is

**[00:31:35]** not complicated it's just sitting down

**[00:31:36]** really making sure that you're using

**[00:31:39]** again the right wire size the Right View

**[00:31:41]** size and the right lug sizes to make

**[00:31:44]** sure everything ties together correctly

**[00:31:45]** if you have any feedback any thoughts

**[00:31:47]** any questions feel free to post that

**[00:31:48]** below and I'll post links to the charts

**[00:31:51]** the diagrams all the parts all the tools

**[00:31:52]** everything that we talked about in the

**[00:31:54]** description and comments section below

**[00:31:56]** as always stay safe out there

# Full Text (without timestamps)

in this video I'm going to walk you through a DIY solar setup I'm going to show you the entire process of setting up a 12 volt system with a 2000 watt inverter and a 12 volt fuse block it's a pretty common and popular setup what I'm going to do in this video is I'm going to break it into two parts I'm going to go into the classroom where I'll explain the reasoning behind everything and then we're going to go into the lab where we're going to implement everything that we learn now after watching this video you will be able to easily build your own setup by either following what I outline or you can make changes specific to your setup based on what I teach be sure to stick around until the end as after we cover everything I'm going to explain how to easily build a diagram using the principles that we outline so that you can customize your own setup shown here on the screen are the two sections for this video we're going to talk about the classroom in the lab and I'm going to put the time stamps where it begins so that you can move around if you want to come back and review any part of the video also Below in the description section I'm going to put the times in the video on various sub objects you may want to go back and watch things like we'll go over fuses inverter charge controller Etc plus I'm going to put links to all the items that we covered so the parts and the tools everything that I'm going to go over you can pick those up later by going through the links below there's a lot to cover so let's Jump Right In foreign why do I recommend starting here in the classroom I wanted to go over the concepts of each part of this setup I've watched enough videos online showing how to piece everything together which we're going to do in a moment when we get into the lab but more importantly is trying to understand what each part does and what the considerations that you have to really make before you buy these various components so let's start with a very quick overview of this setup this is a 12 volt 2000 watt setup again it's very popular as it can output about the same amount of power that you'd get from your home wall socket when you plug in a device so how does this all work together now I'll be using a few technical terms in this explanation but just follow along and you'll get a general ideal as I explain it in a nutshell you have solar panels which collect energy from the Sun and then they send the energy to a charge controller now the charge controller regulates this energy and sends it to batteries our batteries then store this energy when we need to access the energy from the batteries we simply turn on the inverter which which converts the energy stored in the batteries into usable power for our devices that we plug in here on the side like our phones maybe a laptop a refrigerator or even power tools so let's take a quick moment to review a simple formula I promise I'm not going to get technical but I do need to bring this formula up because it will determine the wiring and the fuses that we're going to use to connect these primary components together now after I go through this formula I'm going to give you a simple example to help reinforce this the formula is W divided by V equals a now we know our inverter is 2000 watts and we know that for this setup we're going to be powering as much as 2 000 Watts 2000 is the first value for the W in our equation next our inverter our battery and our 12 volt fuse block we're using our all rated for 12 volts so for the v in our equation we have 12. now that we know the values for w and V let's find our third value in our equation a getting back to our formula if we divide 2000 by 12 we get 166.67 so a equals 166.67 okay so what does that tell us well a lot actually in order to connect our inverter to the battery that value of a or amps will determine the size of our wiring the fuses and our switches that we're going to need in this whole setup if you understand what I just explained you're doing fine now before we go forward let me give you a quick example to put this into terms that maybe you're more comfortable with if you live in somewhere like a house an apartment an RV or wherever you may have power you will have a fuse box if you've ever tricked a circuit maybe while running a toaster a hair dryer or a microwave at the same time you've got to go to the circuit breaker and reset the fuse if we look at the fuses for our wall plug-ins at least this is the case in most American Homes you're going to see 15 on them this fuse is rated for 15 amps so if we use the formula again the a in our equation amps equals 15. the next variable in our equation is V which is voltage now the voltage in American Homes is 120 volts so if a power line in our house runs 120 volts at 15 amps that means we can determine the maximum wattage a wall socket can output so to find W or watts in this formula we would simply multiply 120 by 15 and that would give us 1800. so the typical American wall socket can output 1800 watts this is why a 2000 watt system like what we have here in front of us is very popular the output on the inverter is very similar to a typical home wall socket if what I just explained to you is confusing I'd recommend you go back and watch it a few times as the rest of this video is really going to build off these principles that we just laid out here's what we're going to do next before we start connecting everything up let's explain the components that we're going to need and how to properly size them here's what we're going to cover we're going to go over wiring cable lugs fuses switches shunts and bus bars wiring wiring allows us to connect the components together in our system wiring comes in different sizes but how do we determine the correct size to use to connect all of the components in our system together let's start this discussion with connecting our inverter to the batteries and we're going to need to return to our equation W divided by V equals a we determine that to power our inverter we're going to need wiring that can support 166 amps now there's only one thing I need to mention here before we move on inverter inefficiency no inverter is 100 efficient typically they're around about 85 to 90 percent efficiency so what difference does this make for our setup remember earlier we use the equation W divided by V equals a to get our amperage we need to run through the wiring well due to inefficiency to power the inverter from the batteries we need to factor this into our equation which now becomes 2000 divided by 12 divided by 0.85 which now gives us a value of 190 six so technically we're going to be pushing 196 amps of current through our wiring if we run our inverter at full capacity how do you find information for the wiring size based on the current that we need to send through it there's a chart that's often referenced and I'll put a link to it in the description section which gives us that information since we need to run 196 amps through our wire if you look at the chart you see we're between 150 and 200 amps when you're between numbers on a chart like this then you need to round up to a higher number why well because if you use a wire that's not capable of handling the current that you're going to be pushing through it you can burn it up and start a fire so you always want to go with the next size up if you're in between numbers from the chart we see that we need a two odd gauge to support 196 amps also pay attention to the distance in the chart it shows you the size of the wiring based on how long your wiring will be as distance increases the wiring will start increase increasing in size since our run from the battery to the inverters under three meters two out gauge is perfect so now we know the size of the cable that we're going to need to connect the inverter to the battery you'll use this exact principle later when you size the cables that connect the solar panels to the charge controller the charge controller and the 12 volt fuse block to the system to the bus bar it just really comes down to understanding how much of the components draw in amps and then based on the chart we just showed you you can find wiring that can support that amperage cable lugs at the end of our wires we need to add cable lugs to connect to the posts of things like our inverter our 12 volt DC fuse block our battery our bus bars and switches there are a few things that you'll need to pay attention to the first is the wire gauge size you can put this on remember in our previous point that we discussed the size of the wiring that we're going to be using once we start building this setup we're going to see that we'll need different wire sizes for different devices in our system now we need to pay attention to the size of the inner diameter of the screw or posts that we're going to be connecting this lug to some of the posts that will Mount our wires to are large some are going to be small and when purchasing each one of these products online that you'll be connecting these lugs to they'll have information about the size so it will help you decide what cable lug size to buy how many will you need and what sizes we're going to discuss all that momentarily fuses next up is fuses fuses help protect our wiring the inverter and the charge controller they already have to use this built-in to protect them so they're good but the fuses we select will need to match the maximum amperage that a wire can carry remember in the previous discussion about wiring when we determine the size based on the chart if a wire can only handle 100 amps and that's all it's rated for then we need to place a hundred amp fuse at the beginning of the wiring before a current is sent down it to prevent the wire from even carrying too many amps in our setup we're going to be sending current from our batteries we're going to be sending it from solar panels a charge controller and a bus bar therefore we're going to place fuses at each of these devices and then connect the fuse to the wiring that goes to other components I know this may sound a bit conceptual at this point but once I build this setup you're going to see where I place the fuses switches switches allow us to easily disconnect the system from incoming energy sources in our setup we have solar panels sending energy to our charge controller and we have battery sending energy to the entire setup by placing switches in between the solar panels and the charge controller we can safely disconnect the panels and the batteries from the setup when we need to make changes or we just want to turn the system off now during the build we'll explain the switches you'll need and where to place them bus bars bus bars are metallic strips that allow for the distribution of incoming current as you can see here in our setup we've got a bus bar where our positive connections all tie into by doing this we can tie into other devices we may want to power here on this bar and you can see that there are posts with bolts along with small screws that you can easily secure wiring to we've got our positive bus Bar connected to our batteries our inverter our charge controller and our 12 volt fuse block also as you can see here we've got a bus Bar for our negative connections I purchased a red and black bus bar so it's clear where to connect the positive and negative wiring too shunts the last component I'll mention here is a shot shown here this shunt is connected to our system and is connected to a battery monitor these are optional and just help us monitor the status of our batteries layout for this entire setup I'm using a piece of plywood to lay this all out in a way that you can easily fall along your setup will likely be very different whether you're setting this up in a bus an RV a van a boat a shed or whatever but again I'll detail all the reasons and give you the necessary information so you can modify things as you need to typically at this point you would want to diagram this out on paper before you start but I want to show you the entire setup and then cover the diagram at the end why well after you see how this whole setup is laid out I think it will give you a much more clear understanding before you create your own diagram which we'll cover momentarily lab inverter to batteries all right it's time to start connecting things up let's start by connecting the inverter to the batteries I'm purposefully going to go through quickly so you can see the big picture first after doing this I'll then Circle back and explain how and why I performed each step I want you to see the whole picture before we get bogged down into the details also I set up the connection from the inverter to the batteries first as the cables we're using are thick and they don't really Bend much at all as such I wanted to get this first component in place all right we're going to connect the positive terminal on the inverter to a fuse we're going to connect the fuse to the positive bus bar we're going to connect the positive bus bar to a switch and then we're going to connect the switch to a wire which will later connect to the positive terminal of the battery then we're going to connect the negative terminal of the inverter to a negative bus bar connect the bus bar to a shunt and then connect the shunt to a wire which will later connect to the negative terminal of the battery I know I covered a lot very quickly but let's swing back and explain everything in detail let's start with the inverter there are some holes on the side which we'll use to mount this down to the plywood we can easily access the AC ports here at the top to plug in our appliances now in order to connect our inverter to the fuse we're going to need to cut some wiring and add cable lugs on the end of The Wire remember earlier when we discussed the amount of current that this inverter will require based on a formula we determined that we need wiring that can handle 196 amps the wire that we have here is two out gauge and can handle 200 amps as shown here I put the cable lugs on the post of the components we're going to connect together this serves two purposes first I can make sure I'm getting the correct cable lug as some have different sizes based on what you're connecting to secondly I can then measure the distance of the cable based on where these cable lugs are located due to the thickness of this particular cable I had to use a bolt cutter to cut the wire now once I cut the wire I had to strip off the insulation off both ends of the cable I use this cutting tool I was very careful to gently make cuts to get through the insulation and not impact the metal inside the wiring I had to then add the cable lugs on the end as shown I had to use a special tool to hammer the cable lug so the wire there are tools that are smaller to connect the lugs to cables we're going to cover those shortly but due to the thickness of this particular wire I had to use this particular device which requires you to hammer it down also remember when putting these cable lugs on please keep them at the same orientation what do I mean if we add one cable lug on one end and then we started the process to add the second lug on the other end if the second cable lug was at a 90 degree angle to the first I wouldn't be able to mount these on our inverter and fuse so as shown here they're at the same angle relative to each other next we need to add shrink wrap to the wire so that we're in isolating and protecting the area or cable lugs and wiring connect these kits you order online will typically come with these you can use either a cigarette lighter to apply heat to these or as shown here use a heat gun but be careful as these will get very hot one other Pro tip when I purchased the two out gauge wiring at Home Depot they had only black cable for this part of the video we're connecting the positive terminal of the inverter to the positive terminal of the battery so I went back and I wrapped the black cables with red tape ideally you want to purchase red cables but we improvised here additionally when adding the shrink wrap to the cables put red shrink wrap on the positive cables and black shrink wrap on the negative cables as shown here I will connect our cable to a 200 amp fuse which is held in a fuse holder which you can secure down with screws I put this fuse between the inverter and the bus bar next I connect my custom wire from the fuse to our positive bus bar the positive bus bar is where we'll also connect our charge controller and 12 volt fuse block momentarily think of this as a hub where we'll connect different devices that send or receive current from the bus bar I'll repeat the process of sizing and customizing our cable then connect it to the switch our system will have two switches but for this particular one I need the ability to send a lot of amperage through this particular switch this particular switch is rated for 275 amps which is more than enough for the 200 amp maximum current that we're going to pull from the battery as you can see here the switch has two studs which will bolt our wires onto when working on the system all I have to do is disconnect the batteries via the switch lastly I'll add the cable that goes from our switch to the batteries again I'm not going to connect the batteries yet but rather I'll just connect the wiring which will then connect to the battery later alright now that we have all the wiring connected to each component I'm going to secure these components to the board I waited until I finished connecting everything as these cables are so thick that you really can't bend them I had mounted a few of the components earlier before cutting off the cables and I found that if the connections on the end of the cables or even something as short as a quarter of an inch off I have to then move the bus bar or fuse holder to get everything to connect properly so let's run through the negative connection from the inverter to the battery we're repeating the same process I create custom wires with cable lugs that connect each component together since this wire is already black I don't have to add tape as I did with the red tape on The Wire running down the positive side I then connected it from the negative terminal of the inverter to the negative bus bar as described earlier in the video the bus bar is a central juncture where we can tie into other wires in one place our bus bar is required in this project like this not necessarily as you could tie everything together in one connection for the negative wires but it does make managing things a lot easier from the negative bus bar I created another custom wire for our shunt as we detailed earlier the shunt allows us to connect a battery monitor so we can see the status of the battery is it required not really but it's a nice item to have to see in real time what the battery status is now on the other end of the shunt we're going to connect our cable that will later connect to the negative terminal of our batteries in order to connect the shunt to the battery monitor it comes with a small cord that runs down to the power positive terminal of our first battery that we have connected in parallel now I know we covered a lot in this segment but the rest of the video utilizes these principles we just laid out let's move into connecting solar via the charge controller solar charge controller for our setup we're using a charge controller that can handle a maximum of 520 Watts on a 12 volt system like ours I've got four 100 watt monocrystalline solar panels in series in the manual for this charge controller they recommend a fuse between the solar panels and the charge controller to determine the fuse size since we're connecting the solar panels in series the amperage will not increase but the voltage will now it gets a bit beyond the scope of this video to detail the series versus parallel solar panel setup but a quick search on Google will explain this in more detail if you want to do a deeper dive since we're only using four small panels a series connection made the most sense for me for these panels they're short circuit current writing or ISC is 5.21 amps so to determine the fuse size to put on the positive wire coming from the solar panels connected in series and multiply 5.21 by a factor of 1.56 which gives us 8.13 now getting into a lengthy discussion of where we get one point five six is again beyond the scope of this video but it's a value that in this industry is standard to determine the few size to connect to the solar panels again with our calculated value of 8.13 we need to find the fuse this size or larger looking online I found an inline mc4 fuse which is rated for 10 amps shown here now before we connect our solar panels to our charge controller I want to install a disconnect switch that allows us to easily disconnect our solar from our system we need a circuit breaker specifically designed for DC which is what comes from our solar panels and is rated for high voltage I found the circuit breaker which did the trick adding in our positive and negative wires to the top I then ran the positive and negative wires to our charge controller from the switch again our charge controller handles the energy coming from the panels which it then sends to the batteries I mounted the charge controller at the top of the board next to our inverter with the wires coming from our circuit breaker I plug the red or positive wire into the PV Plus Port on the charge controller and the negative wire or black wire into the PV negative port on the charge controller next we're going to run the positive and negative wire from our charge controller to the positive and negative bus bars to do this on the charge controller there are two ports at the bottom bat minus and bat plus that will put our wires into but what size wiring and fuse should we add in here since this is a 40 amp charge controller our wiring coming from the charge controller we'll need to be able to handle a maximum of 40 amps according to our chart 40 amps requires 8 gauge wiring again I picked this up at Home Depot Purchasing red and black 8 gauge wiring additionally the manual for the charge controller recommends a 40 amp fuse coming from the charge controller remember in our discussion earlier about fuses we want to put these as close to the power source to protect our wiring I therefore installed the 40 amp fuse close to the charge controller earlier in the video I went into detail explaining how to cut the cables cut off the insulation on the ends and then add cable lugs on the large two watt cable the tools needed for smaller cables are different to begin with we'll determine the distance from the charge controller to the 40 amp fuse measuring that distance will then cut our wire with the tool shown here to strip the insulation off the ends of this eight gauge or smaller wire there is a tool that you can use as shown here it cuts the installation perfectly and you can then strip the insulation off the end on one end of the wire we're not going to need a cable lug as we'll plug this directly into the charge controller and then on the other end we're going to put on a Cable log since these cables aren't as large as the two odd gauge wire there's a tool to crimp the cable lug onto the end of the cable again find the right cable lug based on the wire size and the size of the posts that you're going to be connecting to before attaching it to the cable we're going to repeat this process going from the fuse to the positive bus bar measuring the length of the cable we'll need cutting the wiring stripping the insulation putting on the cable lug and then finally adding the shrink wrap additionally from the charge controller we're going to need to run another cable to the negative bus bar it will be the same size as the cable we ran to the positive bus bar but this one will be black additionally we can connect a Bluetooth module to the charge control roller which will allow us to monitor it via app 12 volt fuse block the last major component that we're going to add is a 12 volt fuse block this allows us to run 12 volt devices this one I purchased can handle 125 amps maximum coming in now if we go back to our chart we'll see we need a one gauge wire to handle 125 amps now I don't plan on using more than a few devices all connects so I purposefully went small on the cable that's coming in to connect the fuse block to our system I went with a 4 gauge wire which is only rated at 100 amps remember this is a custom setup particular to my needs my plans are to only plug in maybe one or two 12 volt devices which will be less than one amp so I purposefully went small on the cable and connecting the fuse block to the rest of the system plus I put in a 5 amp fuse shown here in the block that connects a 12 volt device but if you do plan on using your fuse block for a heavier load then of course connect this to the bus bars with a one gauge wire as recommended if you want to push the maximum load through this additionally it is recommended that you put a fuse between the positive bus bar and the fuse block as we've done with the inverter and the charge controller but since I'm barely going to be using this device I just skipped the views entirely and that was my decision for my setup but please configure your setup as recommended based on what you're going to be powering again as we did with the other components in the system I measure the distance from the fuse block to the positive and negative bus bars and then customize the cables and cable lugs accordingly you'll want to pay attention to the cable lugs on the end of the wires as they'll be different sizes on both ends as opposed on the bus bars is much bigger than the post on the fuse block these wires are still malleable enough to bend into place batteries I use 12 volt 100 amp hour lithium iron phosphate self-heating batteries that can be connected in parallel before connecting them test the voltage to make sure they're close they both register the same voltage so we can now connect them if they don't match charge them one at a time to Max Capacity or discharge them completely and then you'll be ready to connect them I purchased these cables that allow me to connect them in parallel as shown here for this particular manufacturer you can only connect up to a total of foreign parallel when you first get these batteries they're in shelf mode to activate them simply use the tool they send by plugging it in then holding down the button until it turns a bright blue this will activate them both as they're connected together Additionally you can connect these together with a CAT5 cable to monitor their status you can monitor their status by connecting a module that either allows you to directly connect to your phone via Bluetooth to their app or we can monitor them with a battery monitor that we installed earlier when connecting to the shunt to connect the batteries to our system first make sure the switch we installed is in the off position since we have two batteries in parallel I'll connect the positive cable coming from our system to the positive terminal on the first battery and the negative cable on the negative terminal on the second battery also note that I've placed the 200 amp fuse on the positive terminal that are cable going to the system is connected to since our system is a 200 amp setup that's the max current that we can ever pull from these batteries and our wires are rated to only handle 200 amps so it's important that we put our fuse right here at the point of origin for our power to protect all of the cables earlier we mentioned installing a shunt as you can see here the shunt is connected to our battery via the small cord and we can then see the status of the battery quarter organization when we've got everything laid out you can use Clips like this to secure down the wires to make sure everything stays neatly in place but since most of our wires are fairly stiff I didn't really need many but they were useful in a few places grounding next we need to ground our inverter and charge controller if you look at the side of both of these they have a grounding connection that we can connect to depending on where you put this setup for example if you're in a vehicle you want to connect the grounding cable to the chassis I'm going to be putting my setup in a shed in my backyard and I have a grounding rod that I can connect to there you can also connect these to the negative bus bar and your system is shown here and then connect the negative bus bar to the grounding device I'm using a green six gauge wire green is typically the color for grounding testing okay we've built this out and I've had it connected to solar panels that charge the batteries so let's test this out shown here I'm testing the pure sine wave capabilities on the AC inverter everything looks good let's connect a few simple devices and monitor the battery output as we're running them after running them let's take a look to see if the cables or cable lugs got warm as shown here they barely warmed up so we're good again with the right size wiring we'll be fine also shown here with the solar panels connected we're getting power coming into our charge controller diagram so now that we see everything is working let's take a look at billing a simple diagram based on everything that we learn before you start building out your system I would encourage you to start here as it will really help you to understand what you need to purchase and then how to lay everything out in your own particular setup let me just make a quick comment about doing a diagram what I did is if you look I just really sat down and established okay you know I've got a 2001 inverter I've got a charge controller I've got you know bus bars I've got fuses where do I want to place them I've got batteries and then you can see the red represents positive and I kept black as black later I went in and I added the grounding lines you don't see those here represented I just added those at the end but the thought process was pretty simple I just started out with the inverter as kind of more or less a Cornerstone I just built around it and as you saw throughout the video this is how my setup ended up looking and you'll see in some places where we've kind of got you know a half dome look where we hop over wire by no means a electrician but just studying different diagrams online I saw how they use that process to help establish you know where lines cross each other but again this is you know just really what I'm trying to show here is just the thought process you can see I per and again this is not based on any units or anything like that I put W for wiring f for fuses and I think there was one other designation that I use oh yeah amps or rather the fuses I put F is for fuse and then what I did is I came over and I labeled over on the side you know like okay fuses um you know then the S and the W's you know I just started documenting everything here on the side so that way I could see what do I need to go back and I'm sorry s by the way a switch and this is just a system I came up with again use whatever makes the most sense for you but the purpose is start with this before you really buying the components go through think it through where you want to place everything how you want to wire it up fuses the switches and I would encourage you to go online and look at for example even post size on these different devices because then you'll you'll know what size cable lugs you'll need to buy it's just really again about mapping this out and I'll post links to other professional diagrams this is just kind of my rudimentary very amateur I went through and kind of cleaned it up later where I just you know and then I had and there were several thought processes that I had to go through and then I even sat down and took notes you know as I was going along but doing this really helped me think through the setup before I bought anything or put anything down and again I'll post links to other diagrams that you can go and look at that will help a lot hopefully this video gave you enough information to help you build your own custom setup now I know there was a lot that we covered but taking information that we use in the classroom where I went through and explained the components and the logic behind everything and then showing how I implemented that in the lab you know building this all out hopefully by taking that information and showing you you can understand how to build your own setup there's really no requirements that you build like I do again just use the wiring chart make sure that you have the right lug size make sure that you're just oversizing when you're not sure but make sure that you have fuses and everything set up based on the values in the way we explain it a lot of this is not complicated it's just sitting down really making sure that you're using again the right wire size the Right View size and the right lug sizes to make sure everything ties together correctly if you have any feedback any thoughts any questions feel free to post that below and I'll post links to the charts the diagrams all the parts all the tools everything that we talked about in the description and comments section below as always stay safe out there