

Inverter Disconnect with pre-charge

This circuit is designed as an inverter disconnect that allows the user to pre-charge the inverter capacitors before fully turning on the system.

[Part 1: 12 & 24 Volt switch with pre-charge](#) - PERKO switch

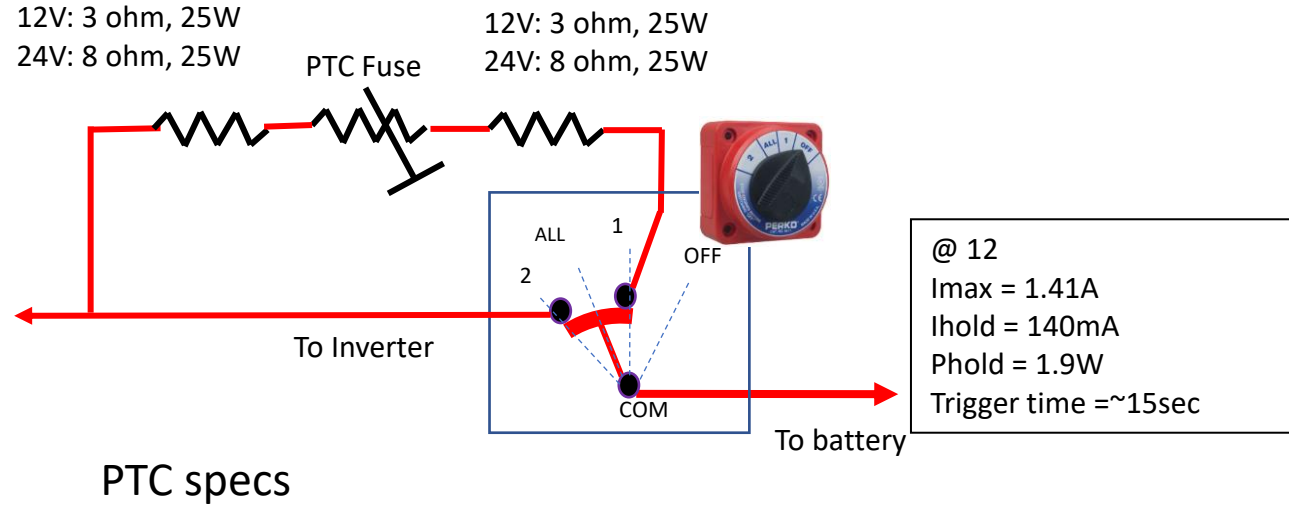
Part 2: 12 & 24 Volt Switch with Pre-charge – Blue Sea switch (available in Europe)

[Part 3: 48 Volt switch with pre-charge](#)

[Part 4: Alternate push-button design.](#)

Part 1: 12 & 24V systems - Perko

12V or 24V SYSTEM



Operation:

Turn ON

1. Ensure inverter is off
2. Turn switch to position '1' for ~1 second
3. Turn switch to position 'All' or '2'
4. Turn on inverter

Note: The PTC fuse/resistor is a safety that covers a miss-use of the switch.

If the user leaves the inverter 'On' and the switch in position 1, there may be significant current going through the resistor and over-heating it. In this case, the PTC will heat up first and will significantly reduce the current after a few seconds. If the switch is used properly, this should never happen and there will be almost no heat build-up in the main resistor. Note: The PTC will get very hot, but it can handle it.

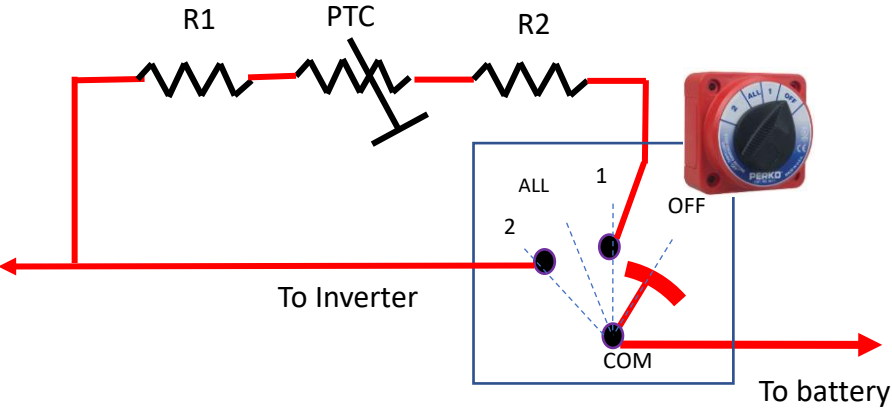
Some (Many? Most?) Inverters are such that they would not cause this heat buildup and the PTC is not needed. See Part 1B later in the deck for the circuit without the PTC.

Switch positions

The following shows the 4 positions of the switch. Note that in both the “ALL” and “2” positions, the inverter is fully connected

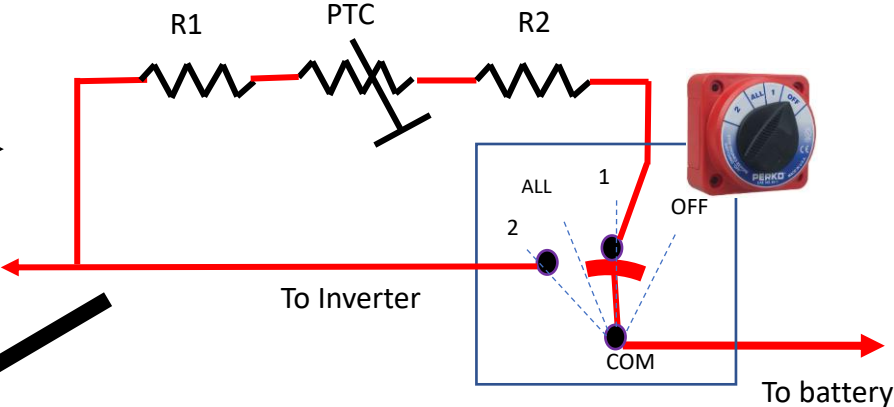
SWITCH in ‘OFF’ Position: OFF

Pre-charge Disconnected, Inverter Disconnected



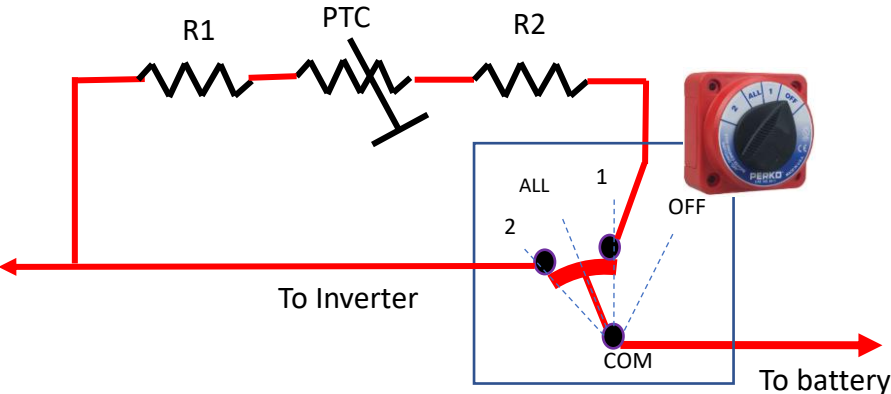
SWITCH in ‘1’ Position: Precharge

Pre-charge connected, Inverter Disconnected



SWITCH in ‘ALL’ Position: ON

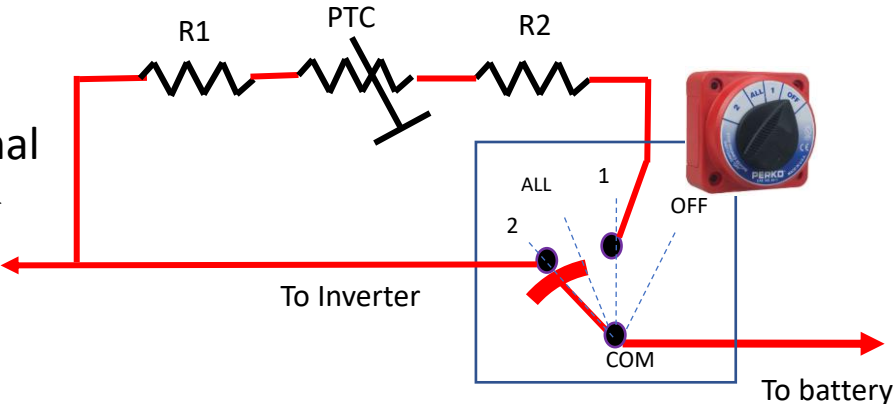
Inverter Connected, Pre-charge bypassed.



SWITCH in ‘2’ Position: ON

Inverter Connected, Pre-charge Disconnected

Optional



Assembly

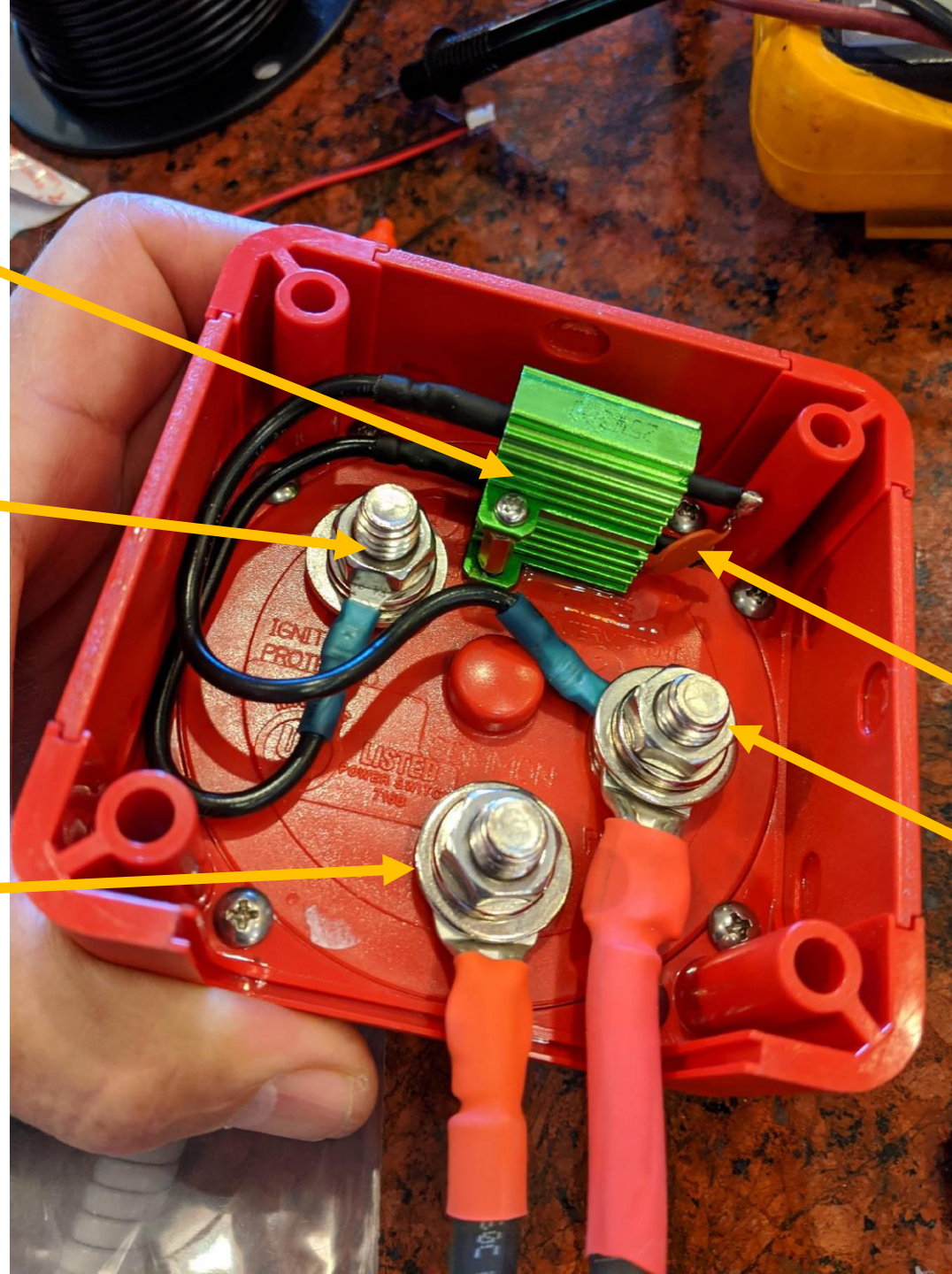
Two 25W resistors
Stacked and glued

Post 1

Common

PTC resistor
soldered between
resistors

Post 2



12V & 24V Parts

Perko Switch:

Perko 8511

<https://www.ebay.com/p/1122213842>

Or

Perko 8511

<https://www.ebay.com/itm/Perko-8511DP-Compact-Battery-Switch-7411/362536682888>

PTC Resistor: Bourns MF-R040 restable fuse.

<https://www.mouser.com/ProductDetail/Bourns/MF-R040?qs=sGAEpiMZZMsxiS4eJwGuBqUpv762iJwX>

3 ohm 25W resistor

<https://www.amazon.com/Xiaoyztan-Aluminum-Shell-Wirewound-Resistors/dp/B08X37W7H1/>

8 ohm 25W resistor

<https://www.amazon.com/TOUHIA-Aluminum-Housing-Wirewound-Resistor/dp/B07VSZC6NN>

12 ohm 25W resistor

<https://www.amazon.com/Arcol-Aluminum-Mil-Spec-Wirewound-Resistor/dp/B074Q64YNP>

Part 1 B: 12 & 24 V switches without the PTC.

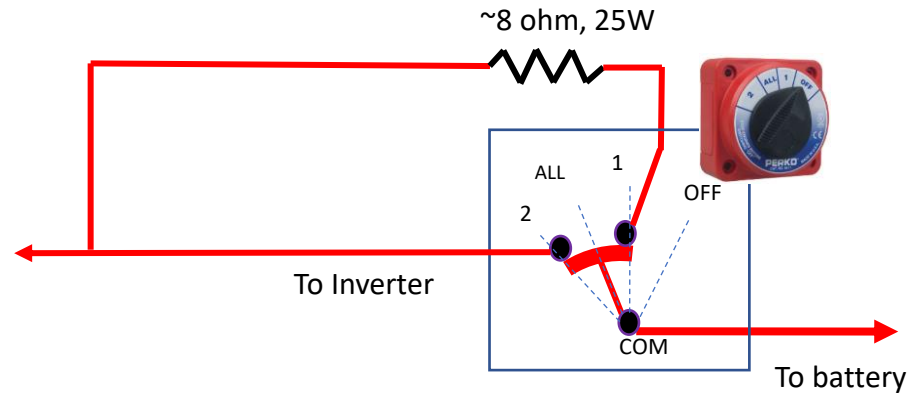
When I first developed this design, I was concerned about the case where someone leaves the switch in the “pre-charge” position and leaves the inverter on. The concern being that so much current would flow through the pre-charge resistors that they would over-heat. That led me to add the PTC as a way to limit the current if this were to happen.

I have since tested three different inverters and in each case, if the switch is in ‘pre-charge’ and the inverter is on, the inverter detects a low voltage condition and will not stay fully turned on. This means the pre-charge resistors never overheat. Consequently, the PTC is not needed for these inverters. (I tested on Victron, Cotek, and Gindel)

I do not know if all inverters will act like the 3 I have tested this with. Consequently I can not say the PTC is not needed for other inverters.

The following slides show the design without the PTC resistor. If you choose to build without the PTC resistor, you should test the ‘error’ condition to ensure it is safe. Also note that if there are other loads down stream from the disconnect switch, there may be a need for the PTC due to the current going to those loads.

12V SYSTEM (No PTC)

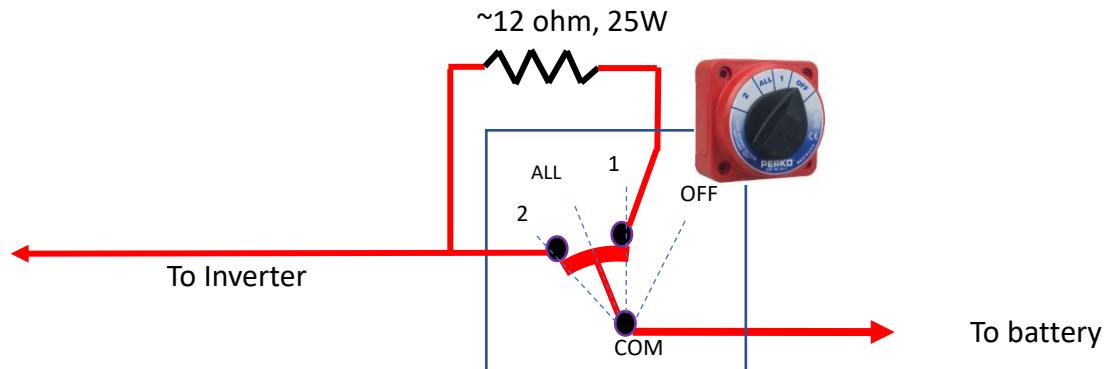


Operation:

Turn ON

1. Ensure inverter is off
2. Turn switch to position '1' for ~1 second
3. Turn switch to position 'All' or '2'
4. Turn on inverter

24V SYSTEM (No PTC)



Note: The values of the resistor is not critical. Any resistor close to the values shown should work fine. The fact is anything from 3-40 ohms would work. I chose these values to keep the pre-charge very fast while keeping the peak surge to 2 or 3 amps.

12V & 24V no-ptc Parts

Perko Switch:

<https://www.ebay.com/p/1122213842>

Or

<https://www.ebay.com/itm/Perko-8511DP-Compact-Battery-Switch-7411/362536682888>

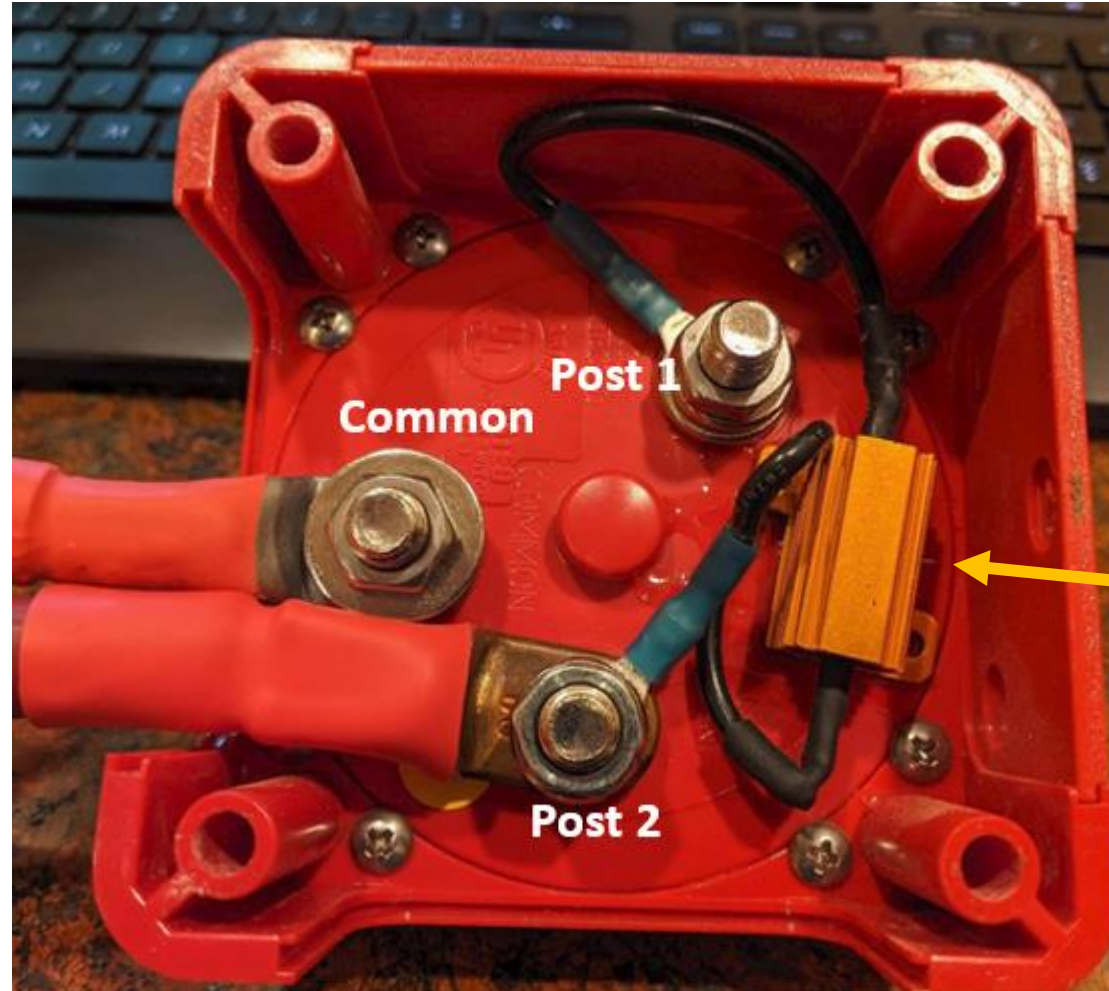
3 ohm 25W resistor (12 V System)

<https://www.ebay.com/itm/25W-3ohm-Wirewound-Power-Resistor-Aluminum-Hosing-Chasis-Mount/401838767539>

15 Ohm 25W Resistor:

<https://www.amazon.com/uxcell-Aluminum-Resistor-Wirewound-Resistors/dp/B07D21LWN4>

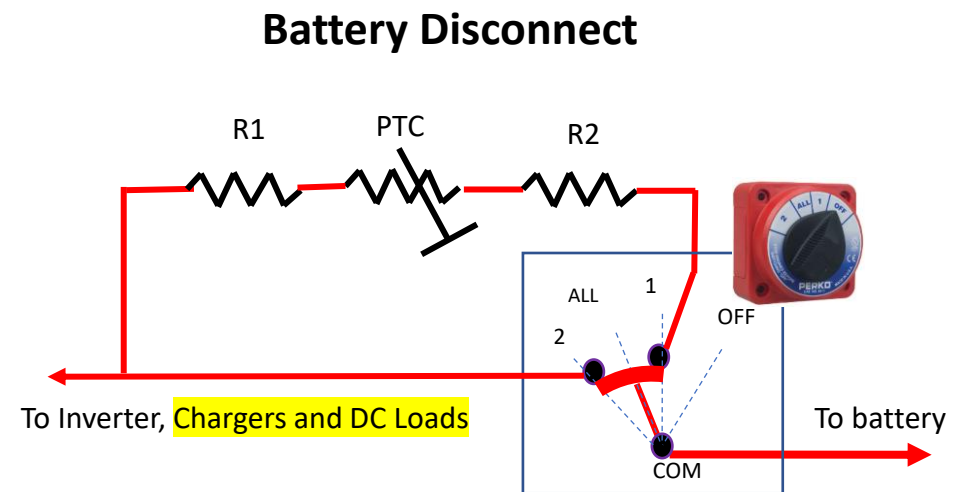
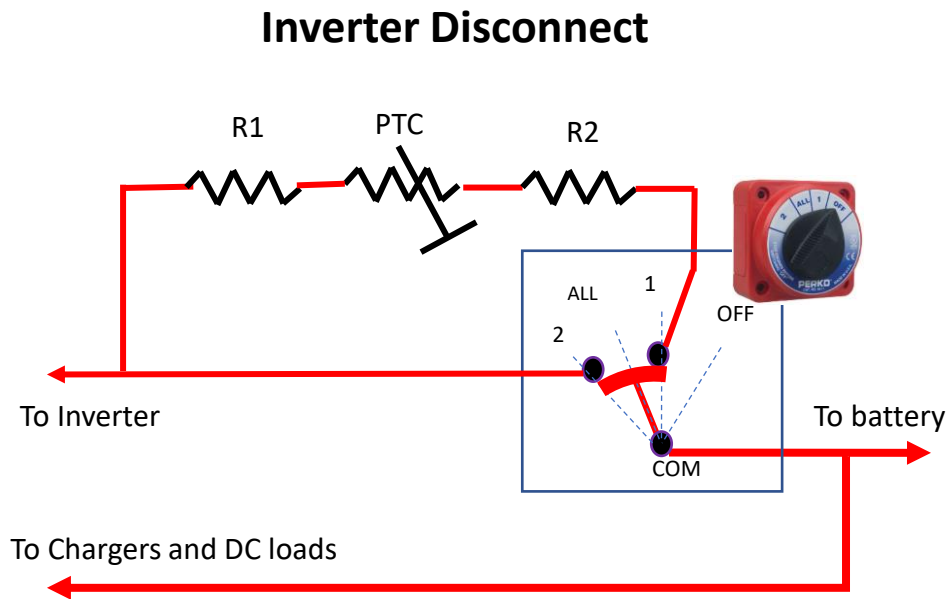
Assembly W/O PTC



One 25W resistor
glued in

Inverter Disconnect Vs Battery Disconnect.

This was originally designed to be placed between the battery and the inverter. However, it can work equally well between the battery and everything else.



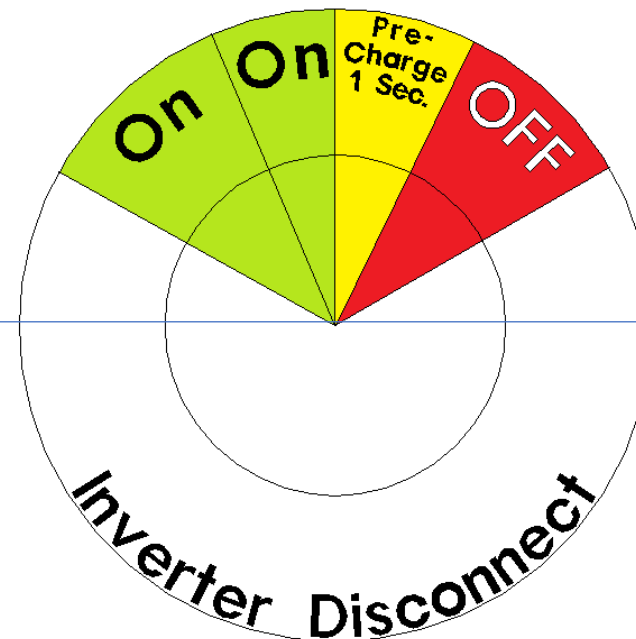
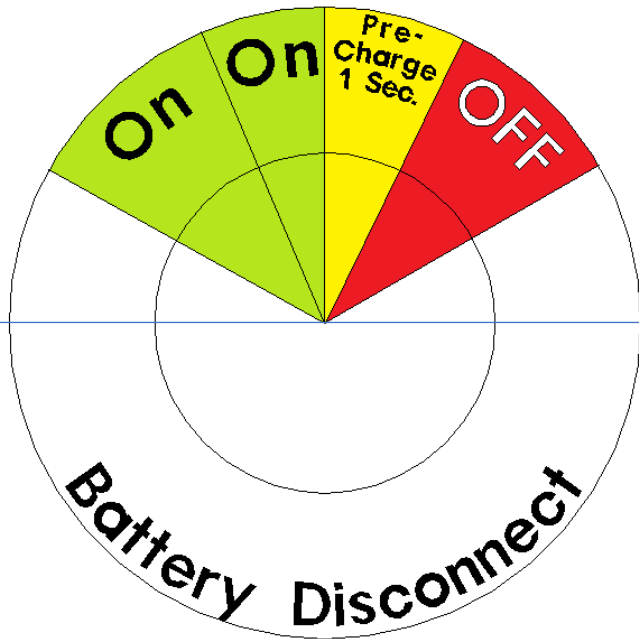
Either placement works fine. However, in the case of the Battery Disconnect, the PTC should be considered mandatory if there are loads other than the inverter.

Label to help instruct the user



Inverter/battery Disconnect Label Instructions:

1. Print this page using PDF in Adobe Reader (Be sure to select 'Actual Size' in the print dialog)
2. 'Laminate' bottom half of the one you want with clear packing tape (Both front and back)
3. 'Laminate' top half of the other one with clear packing tape (Both front and back)
4. Cut out top and bottom halves, including inner circle. (It is easiest to laminate before cutting)
5. Glue on to switch. (I used super glue)

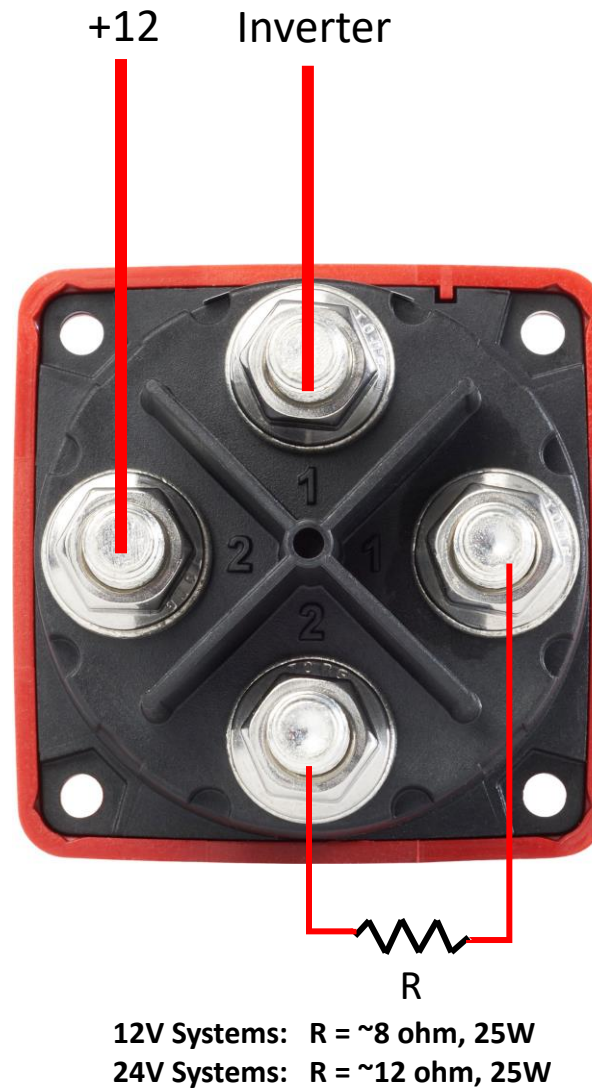
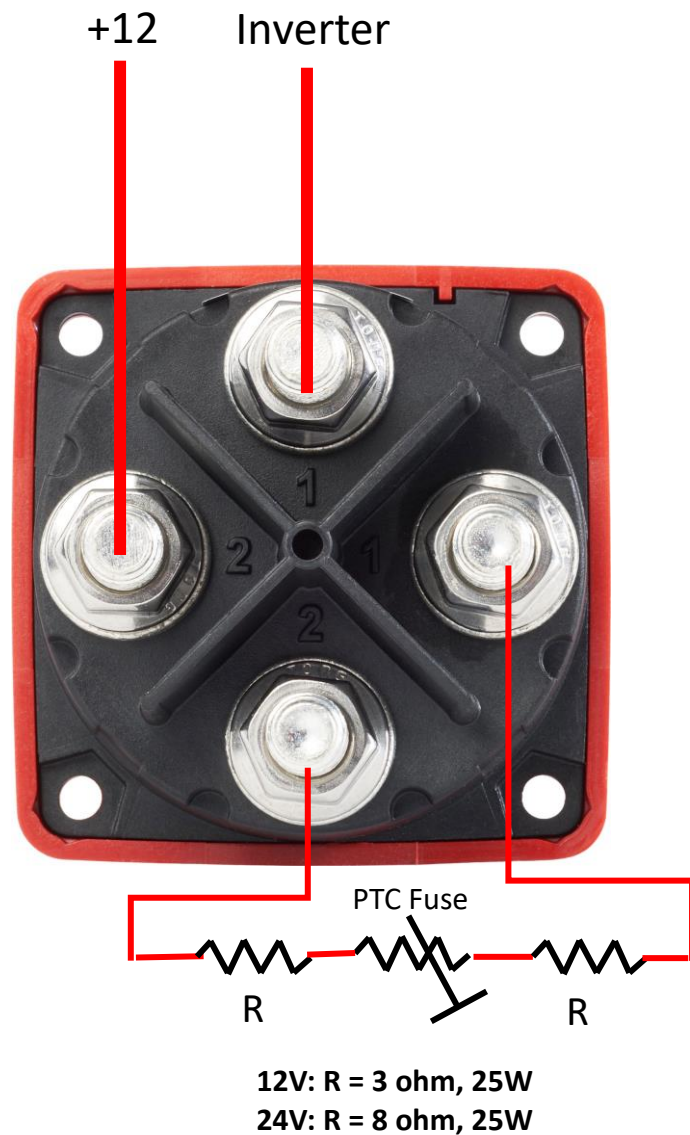


This label is designed to fit the PERKO 8511 'compact' selector switch.
It *may* fit a standard PERKO 8501 selector switch

Part 2: 12 & 24V systems – Blue Sea

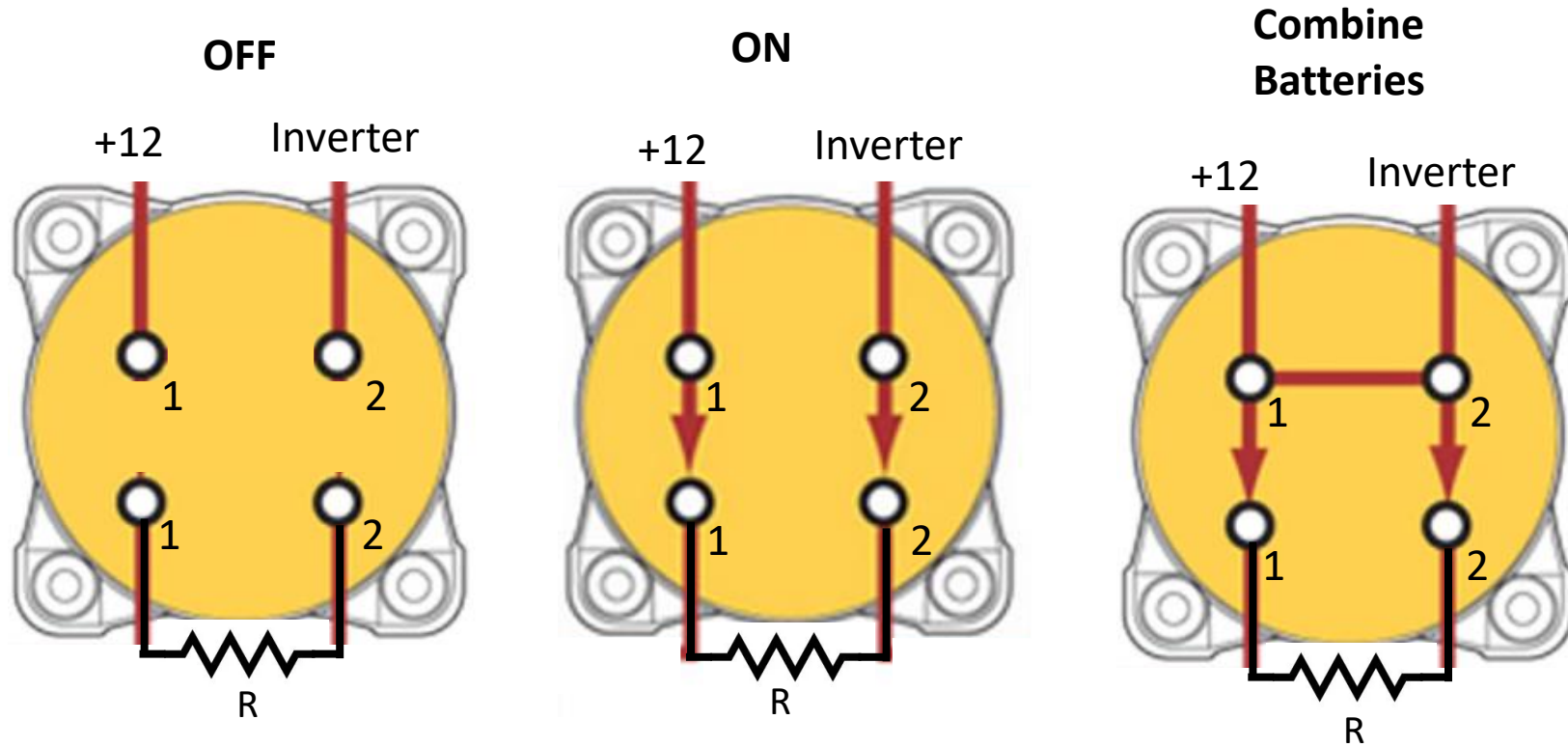
European members of the forum have commented that the Perko Switch is not available to them. I found a Blue Sea switch that should work.

WARNING: I have not built and tested this design. I have not even purchased one of the switches. (If you build this, please let me know the result)



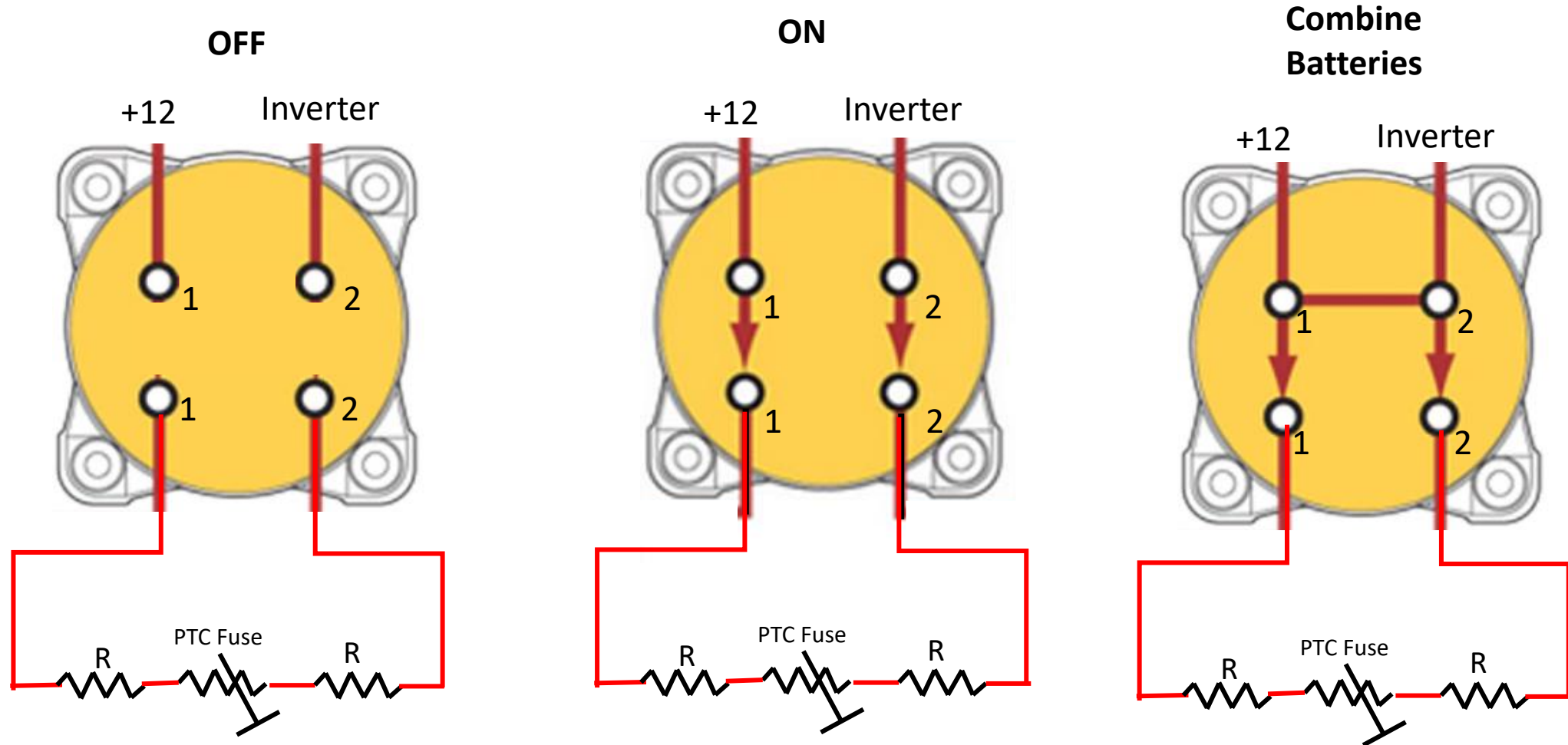
Please see [THIS PAGE](#) for discussion on the use of the PTC Fuse

Switch Logic – NO PTC



12V Systems: $R \approx 12 \text{ ohm}$, 25W
24V Systems: $R \approx 8 \text{ ohm}$, 25W

Switch Logic – With PTC



12V: R = 3 ohm, 25W
24V: R = 8 ohm, 25W

There are two versions of the Blue Sea Switch. The difference is the current rating. Either should work.

1. **e-Series Dual Circuit Plus™ Battery Switch (5511e)** - 350Amps
[https://www.blueseas.com/products/5511e/e-Series Dual Circuit Plus Battery Switch](https://www.blueseas.com/products/5511e/e-Series%20Dual%20Circuit%20Plus%20Battery%20Switch)
2. **M-Series Dual Circuit Plus™ Battery Switch (5511m)** - 300Amps
[https://www.blueseas.com/products/6011/m-Series Mini Dual Circuit Plus Battery Switch - Red](https://www.blueseas.com/products/6011/m-Series%20Mini%20Dual%20Circuit%20Plus%20Battery%20Switch%20-%20Red)

I do not have a European sales link for these switches. However, I did find equivalent (?) knock off switches on Ali Express:

<https://www.aliexpress.us/item/3256803782356056.html>

or

<https://www.aliexpress.us/item/3256804755965733.html> (Select the one with OFF-ON-Combine)

PTC Resistor: Bourns MF-R040 restable fuse.

<https://www.mouser.com/ProductDetail/Bourns/MF-R040?qs=sGAEpiMZZMsxiS4eJwGuBqUpv762iJwX>

3 ohm 25W resistor

<https://www.amazon.com/Xiaoyztan-Aluminum-Shell-Wirewound-Resistors/dp/B08X37W7H1/>

8 ohm 25W resistor

<https://www.amazon.com/TOUHIA-Aluminum-Housing-Wirewound-Resistor/dp/B07VSZC6NN>

12 ohm 25W resistor

<https://www.amazon.com/Arcol-Aluminum-Mil-Spec-Wirewound-Resistor/dp/B074Q64YNP>

Part 3: 48V systems

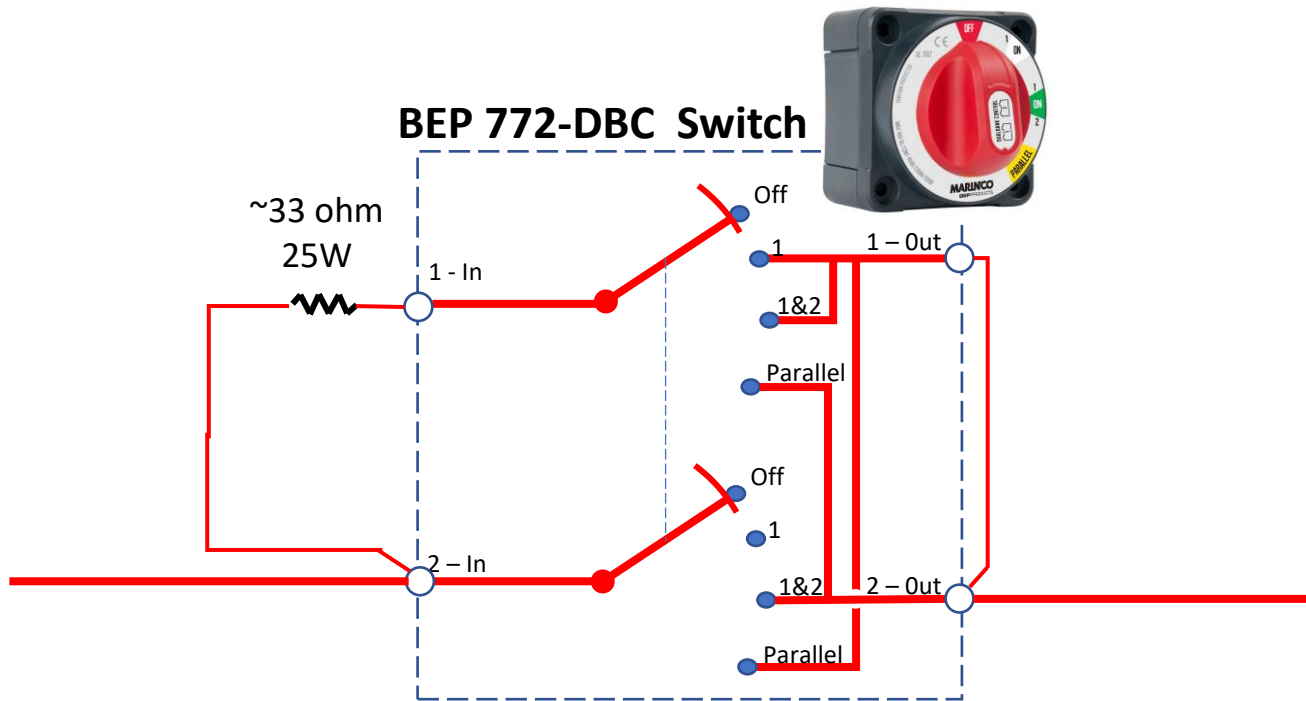
I did this design at the request of forum members, but I have not built and tested it.

The Perco switch used in the 12 & 24V system is not rated for 48V systems so a different switch is needed. The Marinco/BEP 772-DBC Dual Bank Control Switch - switch used in the following design is rated for 48V systems but requires different wiring than the Perko Switch and is more expensive.

NOTE: People have commented that the Marinco/BEP 772-DBC is not available in Europe. Unfortunately, I am not aware of an equivalent 48V capable switch available in Europe.

48V SYSTEM

(**Warning:** I have only lab tested this design. I have not tested it with an inverter)



Operation:

Turn ON

1. Ensure inverter is off
2. Turn switch to position '1' for ~2 second
3. Turn switch to position '1&2' or 'Parallel'
4. Turn on inverter

Turn Off

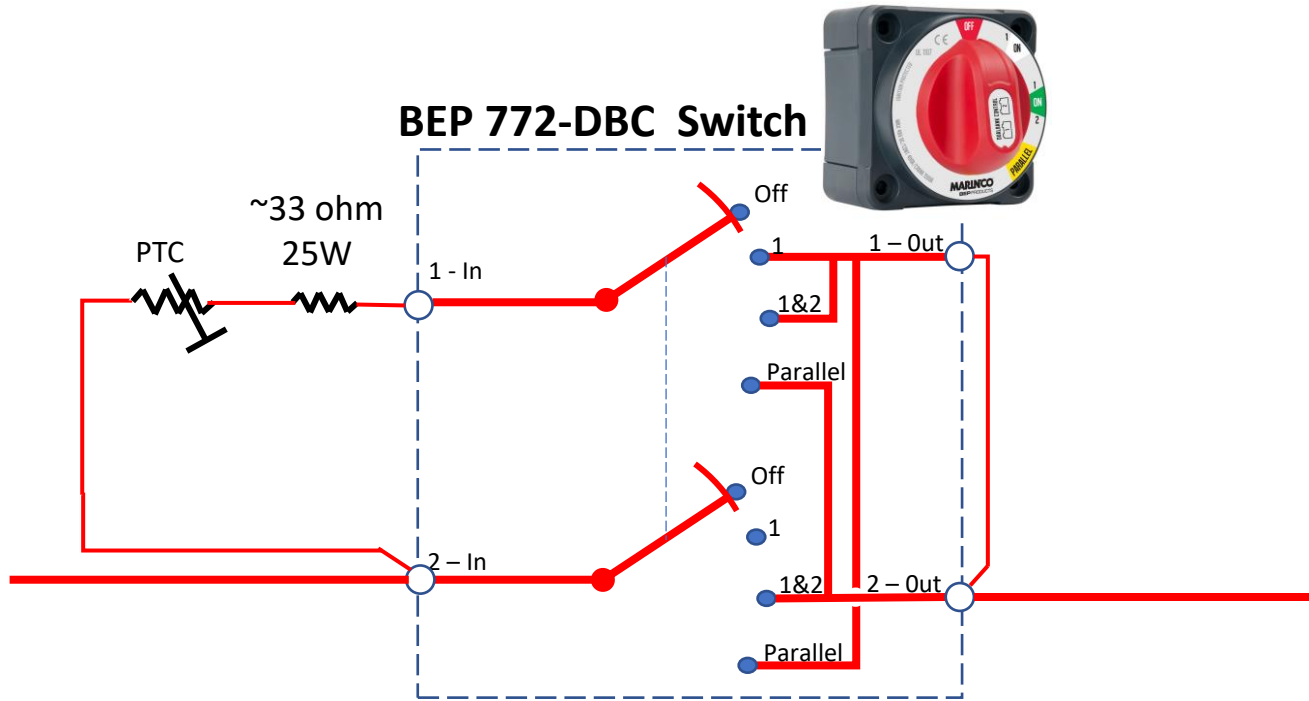
1. Turn off Inverter.
2. Turn Disconnect switch to 'Off' position.

Note: The resistor can be mounted behind the switch just like with the Perko switch

48V SYSTEM (With Safety PTC)

(Warning: I have only lab tested this design. I have not tested it with an inverter)

It is probably not needed for most inverters, but if you find the resistor gets excessively hot if left in the '1-on' or 'Pre-charge' position while the inverter is on, a PTC resistor can be added for safety. The PTC may get very hot but it can handle it and the current will be limited to a few hundred mA. If the sequence is used properly, this condition should never happen, but if the user does the sequence wrong and leaves it in the wrong position for an extended time, this will prevent a problem of the main resistor overheating.



Sequence:

Turn ON

1. Ensure inverter is off
2. Turn switch to position '1' for ~2 second
3. Turn switch to position '1&2' or 'Parallel'
4. Turn on inverter

Turn Off

1. Turn off Inverter.
2. Turn Disconnect switch to 'Off' position.

(Note: The resistor and PTC can be mounted behind the switch just like with the Perko switch

Parts for 48V Precharge switch

Switch: Marinco Part # 772-DBC

<https://www.satpro.tv/bepproinstaller400adualbankcontrolswitch-mc10.aspx>

33 Ohm 25W Resistor:

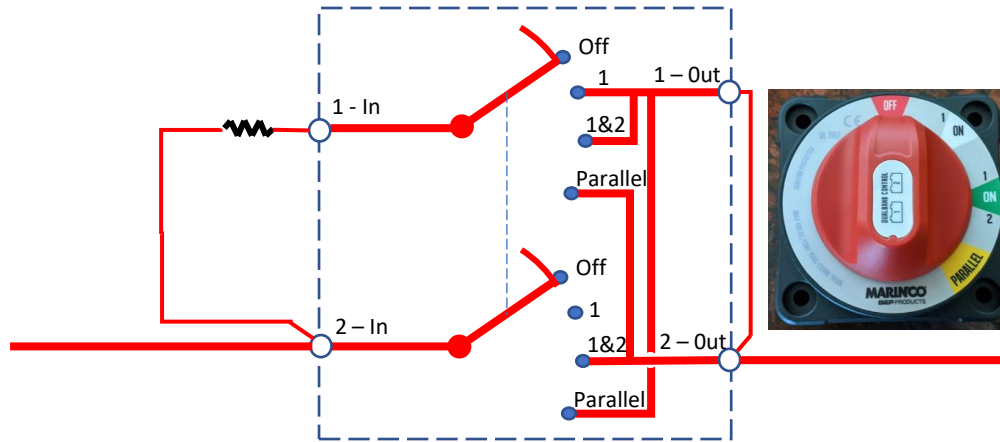
<https://www.amazon.com/uxcell-Aluminum-Resistor-Wirewound-Resistors/dp/B07D218RZ1>

PTC Resistor: Bourns MF-R040 restable fuse.

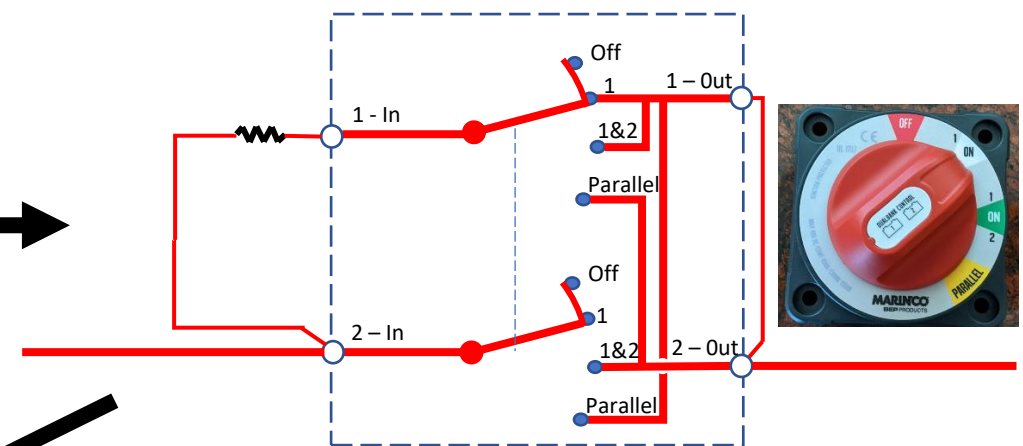
<https://www.mouser.com/ProductDetail/Bourns/MF-R040?qs=sGAEpiMZZMsxiS4eJwGuBqUpv762iJwX>

BEP/Marinco 772-DBC Switch Positions (Schematic View)

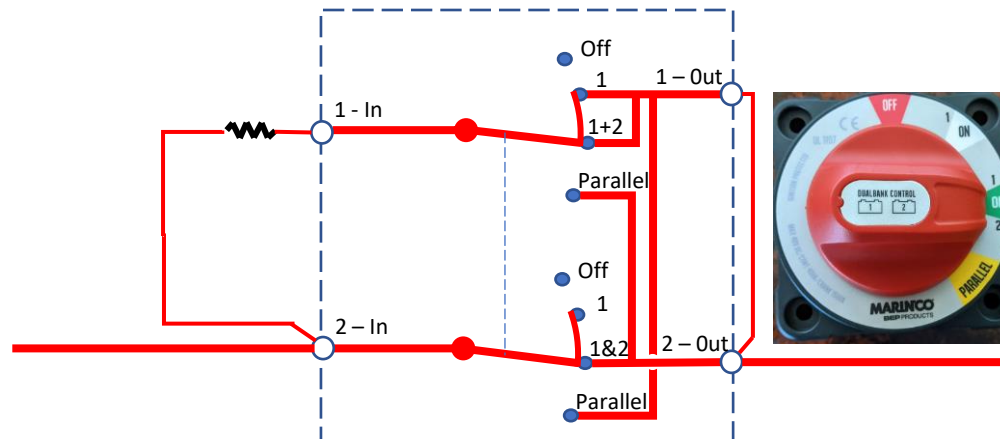
Position: Off



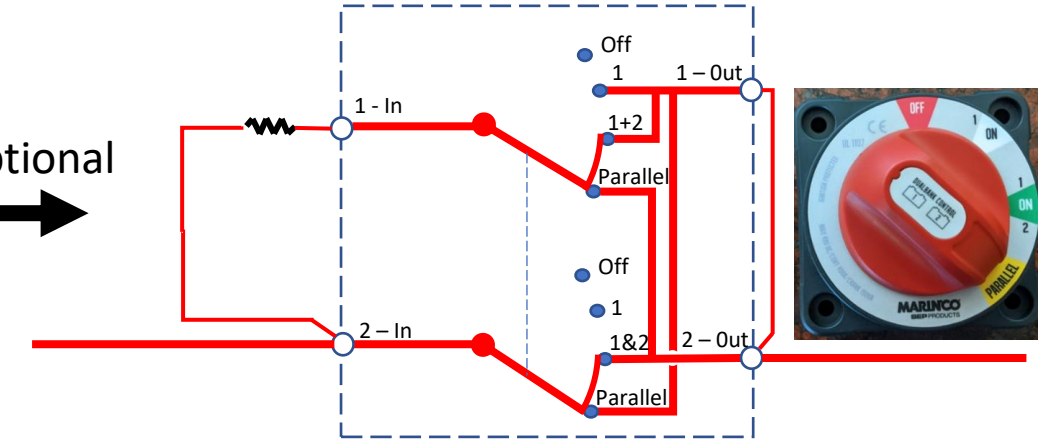
Position: 1 ON = Pre-charge



Position: 1&2 ON = Full On



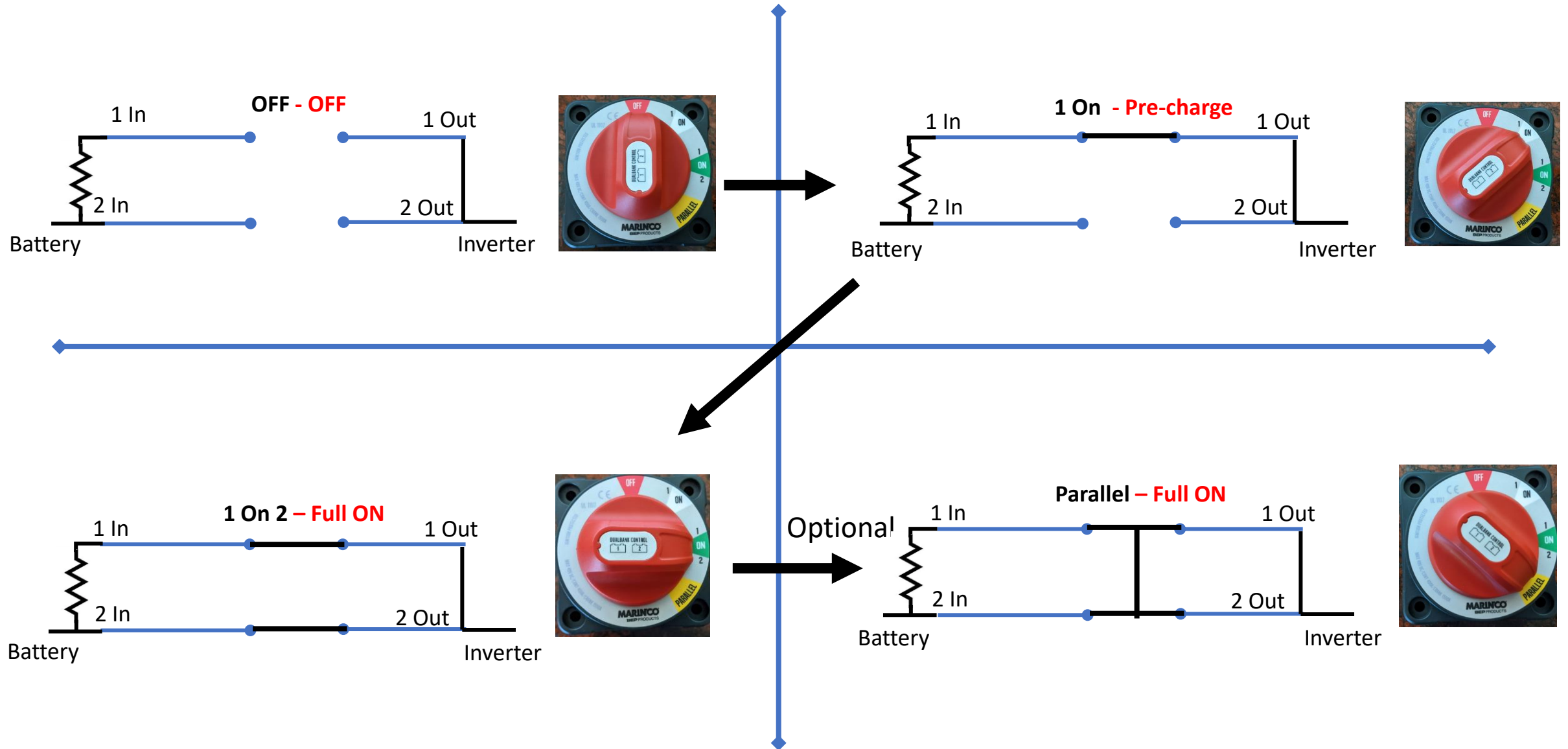
Position: Parallel = Full On



Optional

BEP/Marinco 772-DBC Switch Positions

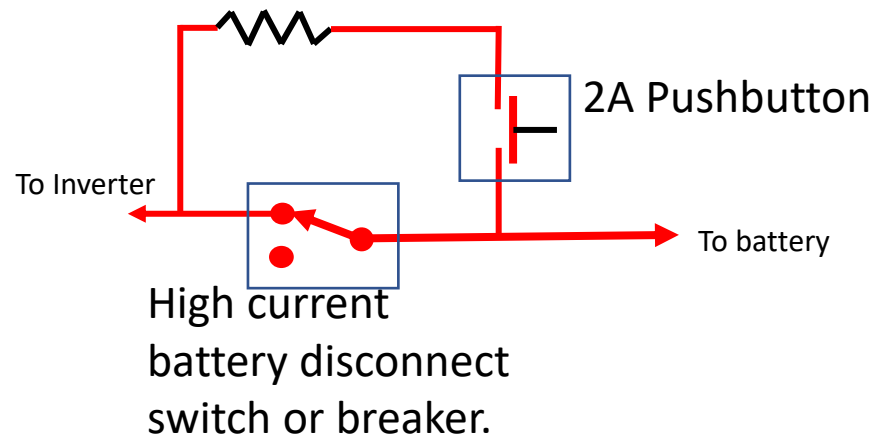
(A **logic view** that might be easier to understand)



Part 4: Alternate Pushbutton design.

This is a simpler design, but the user must remember to push the button. (In the rotary switch design, the pre-charge will happen no matter what.)

12V: 6 ohm(min) -15 ohm, 25W
24V: 15 ohm (min) -30 ohm, 25W
48V: 30 ohm (min) - 60 ohm, 25W



48V Pushbutton: <https://www.mouser.com/ProductDetail/E-Switch/PV2S240NN?qs=IhAPX%252BE7qEbJWopo6g%2FZbw%3D%3D>

6 Ohm 25W resistor: <https://www.amazon.com/uxcell-Aluminum-Resistor-Wirewound-Resistors/dp/B07D21K5FL>

15 Ohm 25W Resistor: <https://www.amazon.com/uxcell-Aluminum-Resistor-Wirewound-Resistors/dp/B07D21LWN4>

33 Ohm 25W Resistor: <https://www.amazon.com/uxcell-Aluminum-Resistor-Wirewound-Resistors/dp/B07D218RZ1>

The reason for the minimum resistance is that the 48V pushbutton is only rated for 2A. The 48V pushbutton will work for 12 & 24 volt, but there are many higher current 12 & 24V pushbuttons available. With the higher current pushbuttons, the resistance can be reduced for faster pre-charge

History

26 June 2020 update:

- At request of a forum member I added a circuit design for 48 volts.
Warning: I have not built/tested the 48 Volt design.
- Added comments on how to build the circuit without the PTC thermistor.

28 July 2020 update

- Expanded on building the circuit without the PTC thermistor. (It is not needed in many (Most?) situations)

8 August 2020 update

- Updated link to PTC in the parts list.

5 October 2020 update

- Added slide showing the connections in the four different switch states. (this helps explain how the circuit works)
- Added label and printing instructions for Perco 8511 switch.

6 October 2020 update

- Added discussion of Battery Disconnect Vs Inverter Disconnect.

11 November 2020 update

Added assembly picture for assembling w/o the PTC

20 January 2021 Update

- Totally redid 48V design with BEP/Marinco MC12 Switch