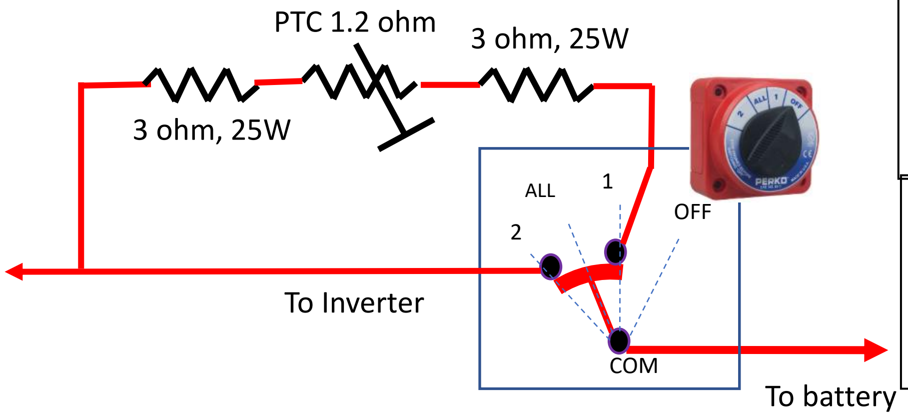
Inverter Disconnect with pre-charge

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

12V SYSTEM



@ 14.6V
Imax = 2.02A
Ihold = 140mA
Phold = 2W
Trigger time =~15sec

@ 12
Imax = 1.41A
Ihold = 140mA
Phold = 1.9W
Trigger time =~15sec

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

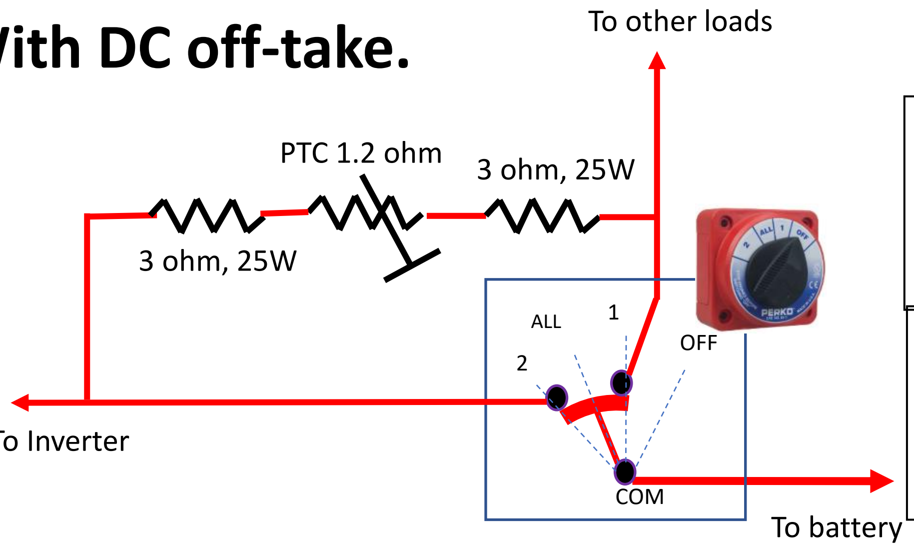
PTC specs

Bulk Part Number / Taping Part Number	Max. voltage	*1 Resistance Value at+25 °C	*2 Max. Current	*3 Hold Current		*4 Trip current		Dimensions (mm)		
				+105°C	+85°C	-10°C	-40°C	D	H	d
PTGLCSAS1R2K3B51B0 PTGLCSAS1R2K3B51A0	D.C. 51V	1.2ohm±10%	5.0A	315mA	449mA	1168mA	1270mA	11.5	16.5	0.6

Note: The PTC 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 several seconds. If the switch is used properly, this should never happen and there will be almost no heat build-up.

Some (Many? Most?) Inverters are such that they would not cause this heat buildup ant the PTC is not needed. See the last two slides of this deck for details:

12V SYSTEM
With DC off-take.



@ 14.6V
Imax = 2.02A
Ihold = 140mA
Phold = 2W
Trigger time =~15sec

@ 12
Imax = 1.41A
Ihold = 140mA
Phold = 1.9W
Trigger time =~15sec

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

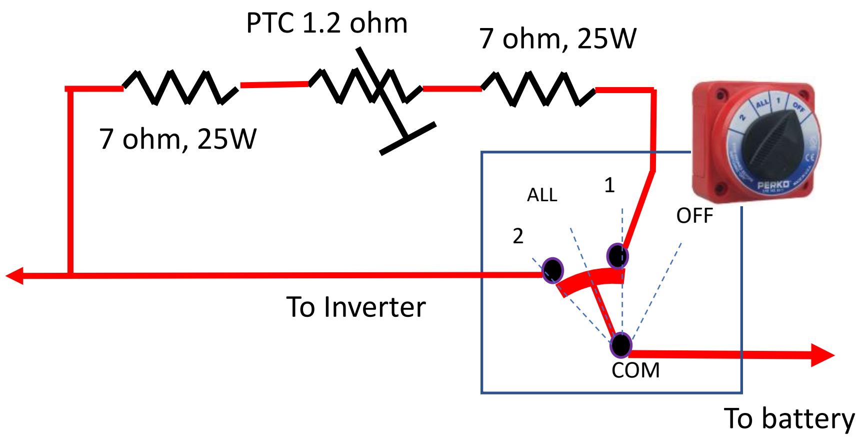
PTC specs

Bulk Part Number / Taping Part Number	Max. voltage	*1 Resistance Value at+25 ºC	*2 Max. Current	*3 Hold Current		*4 Trip current		Dimensions (mm)		
				+105ºC	+85ºC	-10ºC	-40ºC	D	H	d
PTGLCSAS1R2K3B51B0 / PTGLCSAS1R2K3B51A0	D.C. 51V	1.2ohm±10%	5.0A	315mA	449mA	1168mA	1270mA	11.5	16.5	0.6

Note: The PTC 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 several seconds. If the switch is used properly, this should never happen and there will be almost no heat build-up.

Some (Many? Most?) Inverters are such that they would not cause this heat buildup ant the PTC is not needed. See the last two slides of this deck for details:

24V SYSTEM



@ 29.2V
Imax = 1.76A Ihold = (80mA) Phold = 2.3W Trigger time =~10sec
@ 24.0V
Imax = 1.45A Ihold = (90mA) Phold = 2.2W Trigger time =~25 sec

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

Turn Off

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

PTC specs

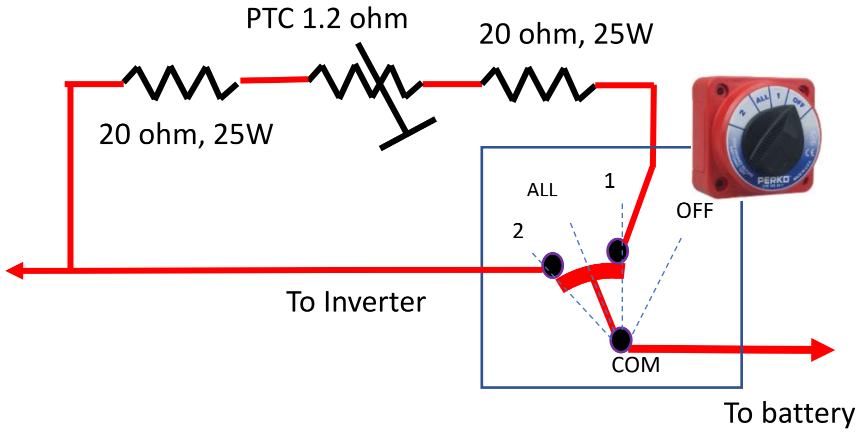
Bulk Part Number / Taping Part Number	Max. voltage	*1 Resistance Value at+25 ºC	*2 Max. Current	*3 Hold Current		*4 Trip current		Dimensions (mm)		
				+105ºC	+85ºC	-10ºC	-40ºC	D	H	d
PTGLCSAS1R2K3B51B0 PTGLCSAS1R2K3B51A0	D.C. 51V	1.2ohm±10%	5.0A	315mA	449mA	1168mA	1270mA	11.5	16.5	0.6

Note: The PTC 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 several seconds. If the switch is used properly, this should never happen and there will be almost no heat build-up.

Some (Many? Most?) Inverters are such that they would not cause this heat buildup ant the PTC is not needed. See the last two slides of this deck for details.

48V SYSTEM

(Warning: I have <u>not</u> built/tested this design)



@ 58.4V
Imax = 1.42A
Ihold =
Phold =
Trigger time =

@ 48.0V
Imax = 1.17A
Ihold =
Phold =
Trigger time =

Operation:

Turn ON

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

Turn Off

1. Turn off Inverter.
2. Turn Disconnect switch to ‘Off’ position.

PTC specs

Bulk Part Number / Taping Part Number	Max. voltage	*1 Resistance Value at+25 ºC	*2 Max. Current	*3 Hold Current		*4 Trip current		Dimensions (mm)		
				+105ºC	+85ºC	-10ºC	-40ºC	D	H	d
PTGLCSAS1R2K3B51B0 PTGLCSAS1R2K3B51A0	D.C. 51V	1.2ohm±10%	5.0A	315mA	449mA	1168mA	1270mA	11.5	16.5	0.6

Notice that this circuit requires a minimum of .185 amps during ‘ptc hold’ if the user leaves the inverter on and the switch in the ‘1’ position. Otherwise the voltage on the PTC could exceed the spec of the device. The math works out that this should be OK, but I would feel a bit more comfortable with a higher max voltage spec on the PTC.

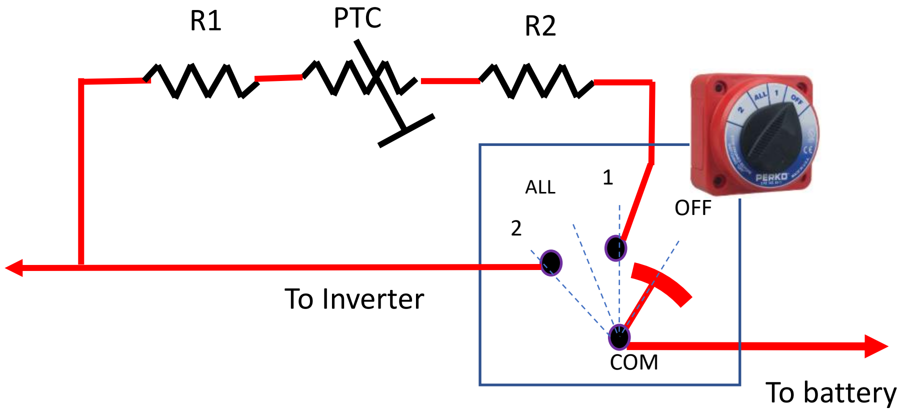
Some (Many? Most?) Inverters are such that they would not cause this heat buildup ant the PTC is not needed. See the last two slides of this deck for details:

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

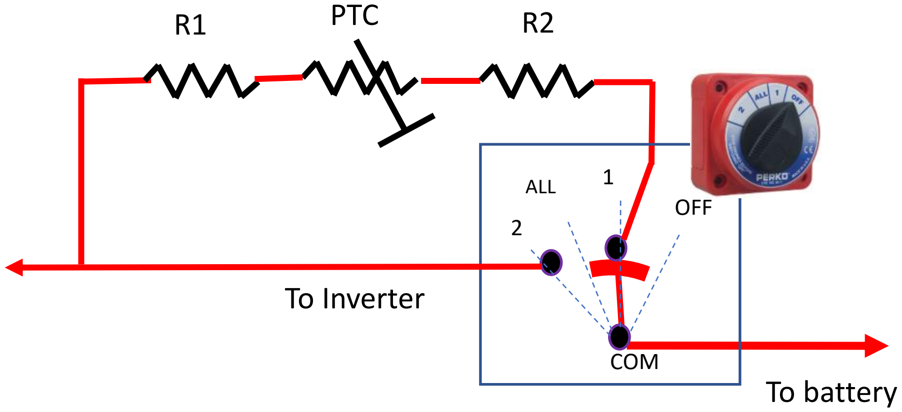
SWITCH in ‘OFF’ Position:

Pre-charge Disconnected, Inverter Disconnected



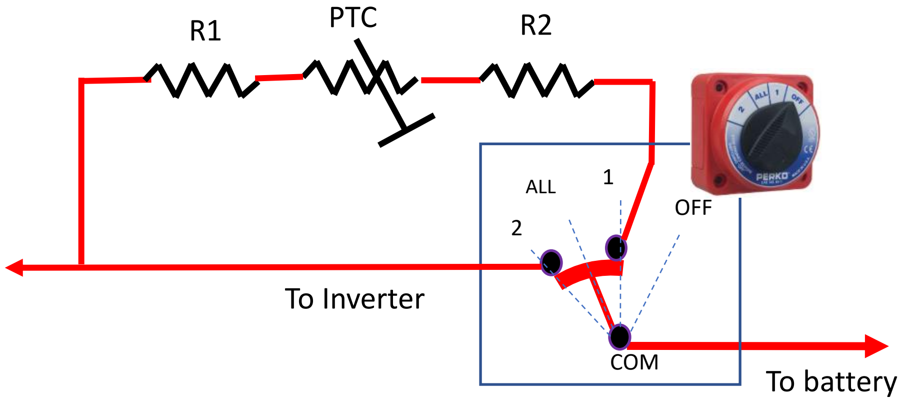
SWITCH in ‘1’ Position:

Pre-charge connected, Inverter Disconnected



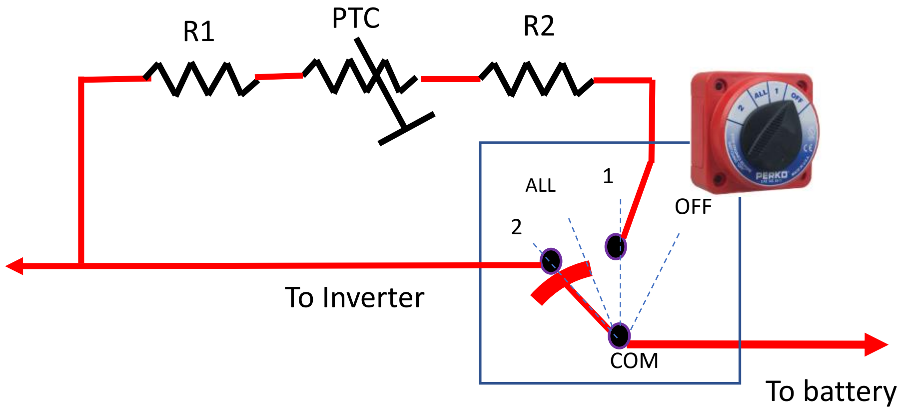
SWITCH in ‘ALL’ Position:

Inverter Connected, Pre-charge bypassed.



SWITCH in ‘2’ Position:

Inverter Connected, Pre-charge Disconnected

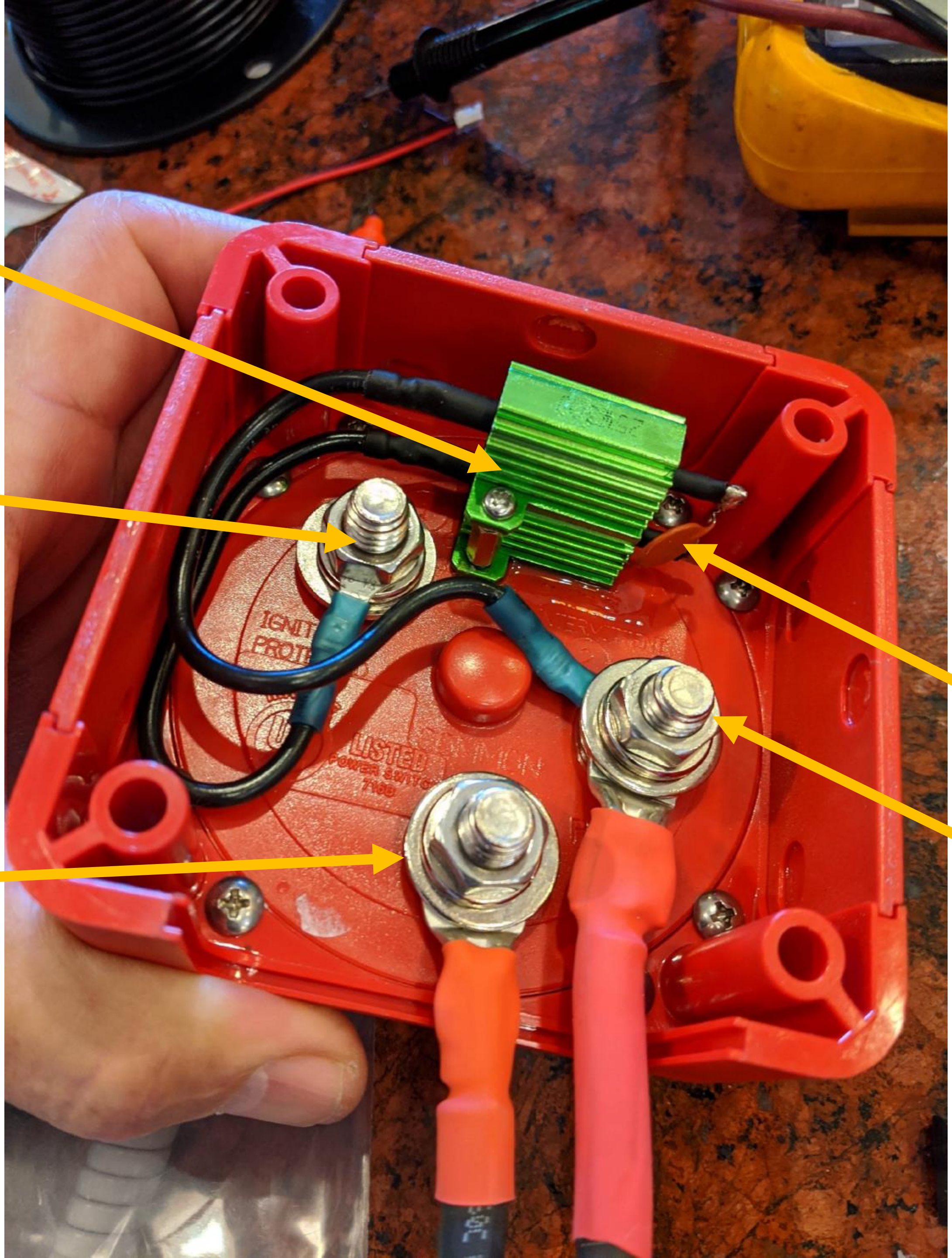


Assembly

Two 25W resistors
Stacked and glued

Post 1

Common



PTC resistor
soldered between
resistors

Post 2

Parts

Perko Switch:
https://www.ebay.com/p/1122213842
Or
https://www.ebay.com/itm/Perko-8511DP-Compact-Battery-Switch-7411/362536682888

PTC Resistor: 1.2ohm, 5 Amp.
https://www.mouser.com/ProductDetail/81-PTGLCSAS1R2K3B5A0

3 ohm 25W resistor (12 V System)
https://www.ebay.com/itm/25W-3ohm-Wirewound-Power-Resistor-Aluminum-Hosing-Chasis-Mount/401838767539

7 ohm 25W resistor (24 V System)
https://www.ebay.com/itm/US-Stock-2x-7-ohm-7R-25W-Watt-Aluminum-Housed-Metal-Case-Wirewound-Resistors/401396173511

7/28/2020 UPDATE:
Note about the Positive Temperature Coefficient (PTC) resistor in the designs.

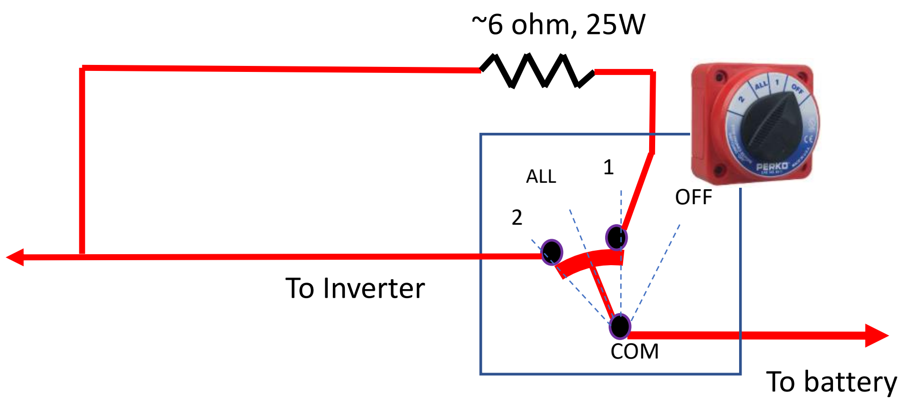
When I first developed this design, I was concerned about the case where someone leaves the switch in the "pre-charge" position and leaves the inverter on. The concern being that so much current would flow through the pre-charge resistors that they would over-heat. That led me to add the PTC as a way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

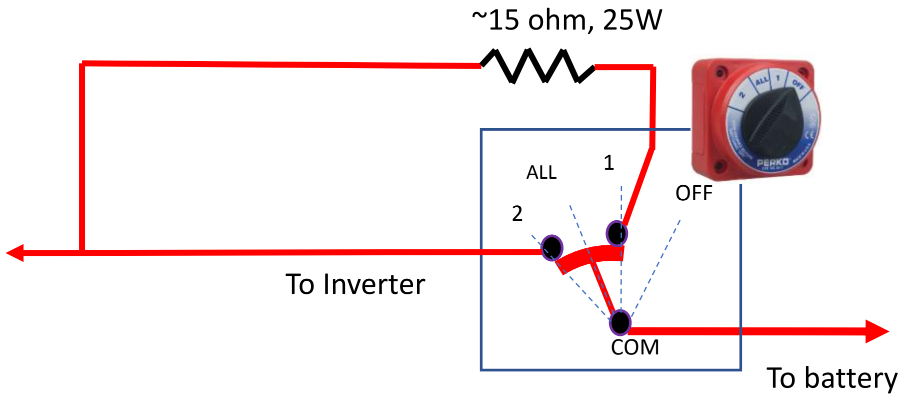


Operation:

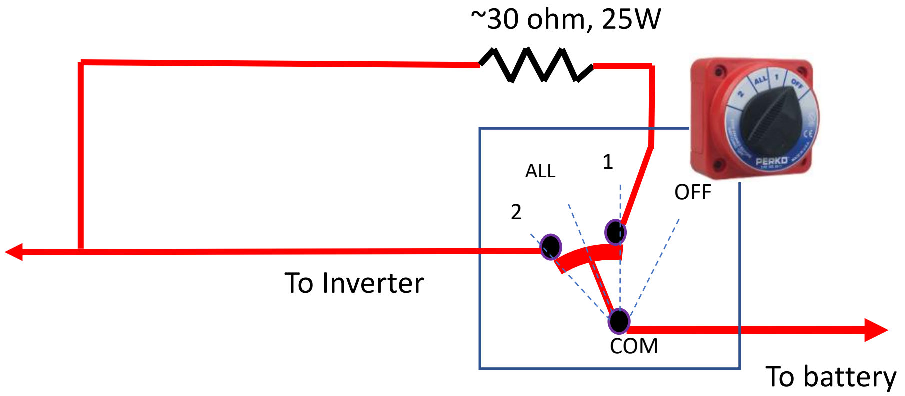
Turn ON

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)

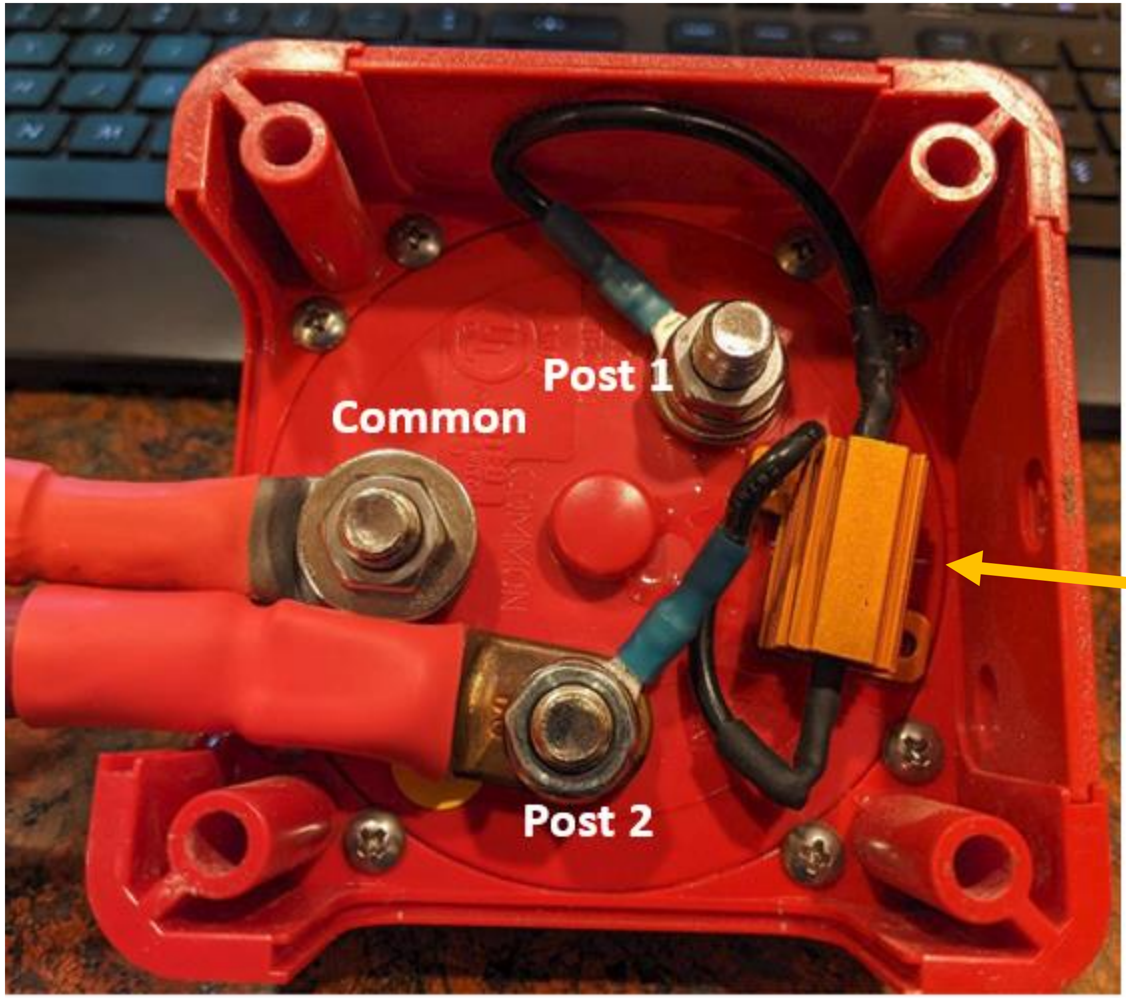


48V SYSTEM (No PTC)



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 for any of the 3 voltages. I chose these values to keep the pre-charge very fast while keeping the peak surge to 2 or 3 amps.

Assembly W/O PTC

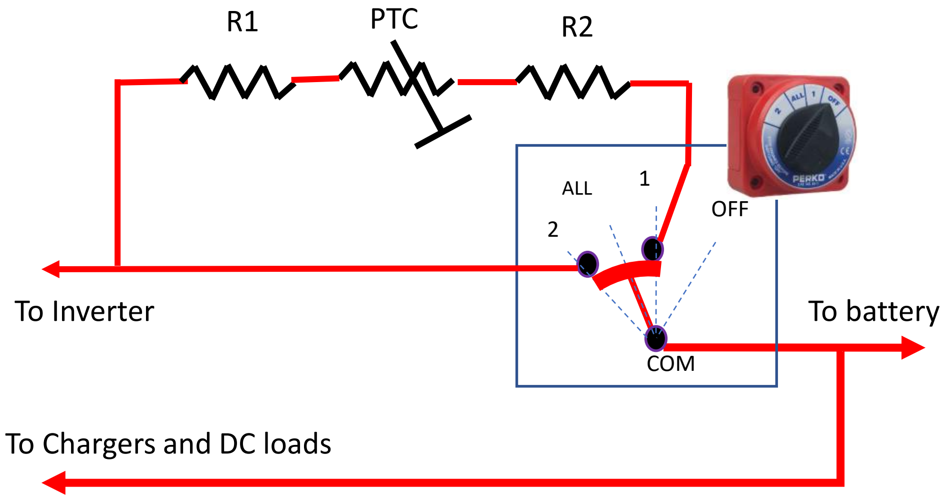


One 25W resistor glued in

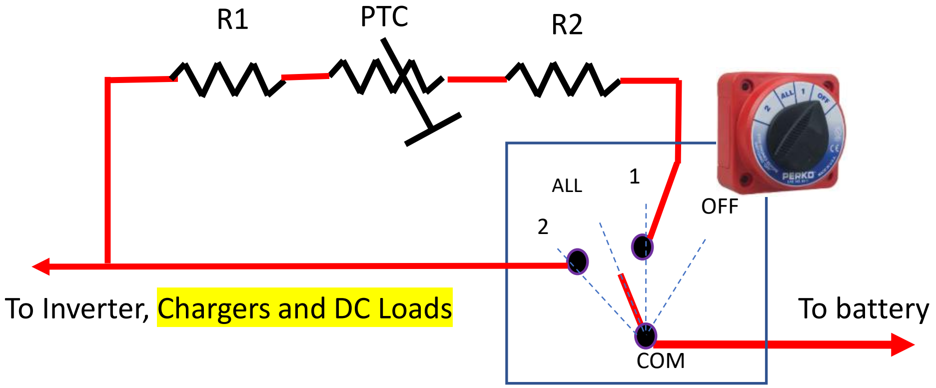
Inverter Disconnect Vs Battery Disconnect.

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.

Inverter Disconnect



Battery Disconnect

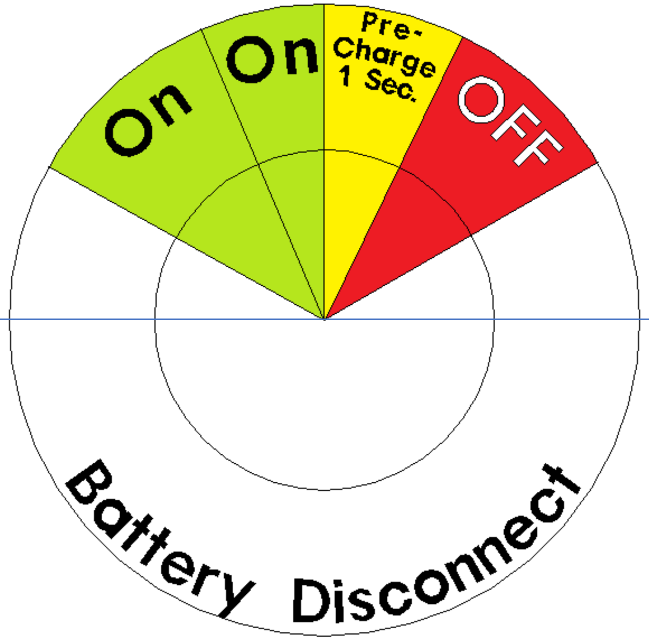


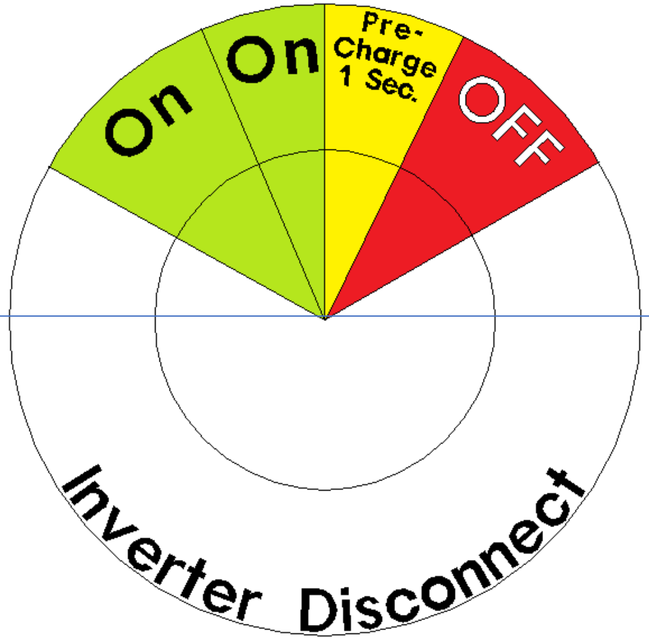
Either placement works fine. However, in the case of the Battery Disconnect, the PTC should be considered mandatory if there are loads other than the inverter.

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

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