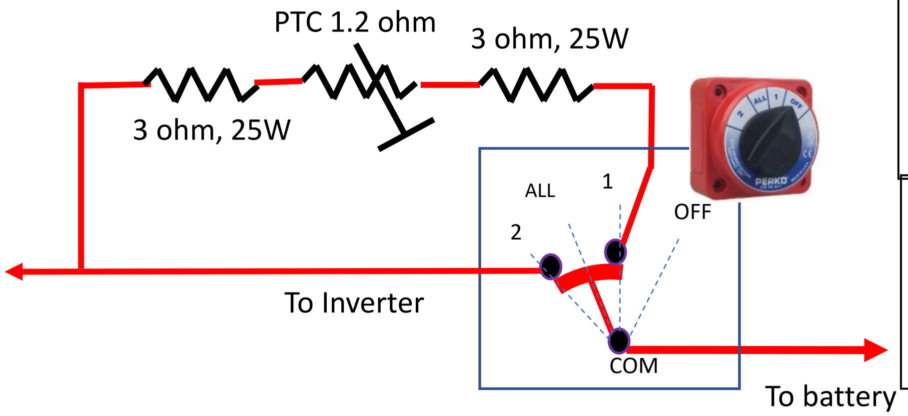
Inverter Disconnect with pre-charge

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

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

Operation:

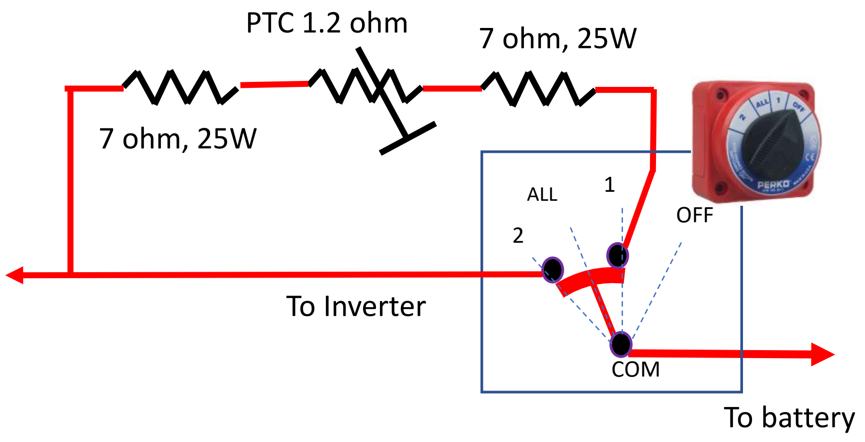
Turn ON

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 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

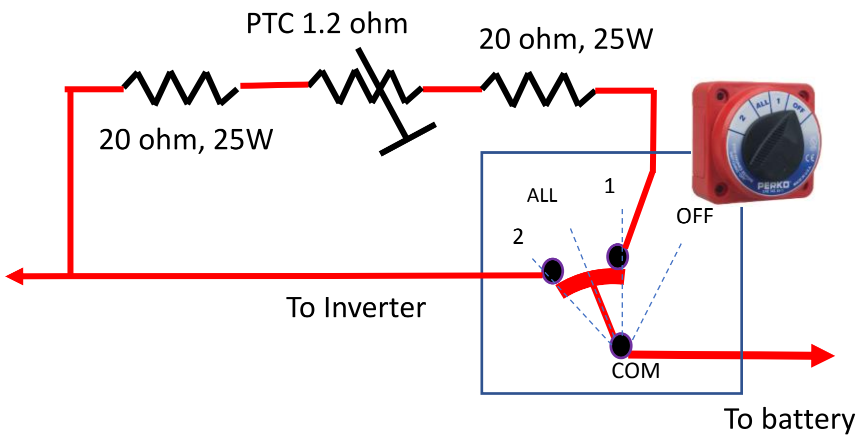
Bulk Part Number / Taping Part Number	Max. voltage	*1 Resistance Value at+25 °C	*2 Max. Current	*3 Hold Current		*4 Trip current		Dimensions (mm)		
				+105°C	+85°C	-10°C	-40°C	D	H	d
PTGLCSAS1R2K3B51B0 / PTGLCSAS1R2K3B51A0	D.C. 51V	1.2ohm±10%	5.0A	315mA	449mA	1168mA	1270mA	11.5	16.5	0.6

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.

48V SYSTEM

(Warning: I have not 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

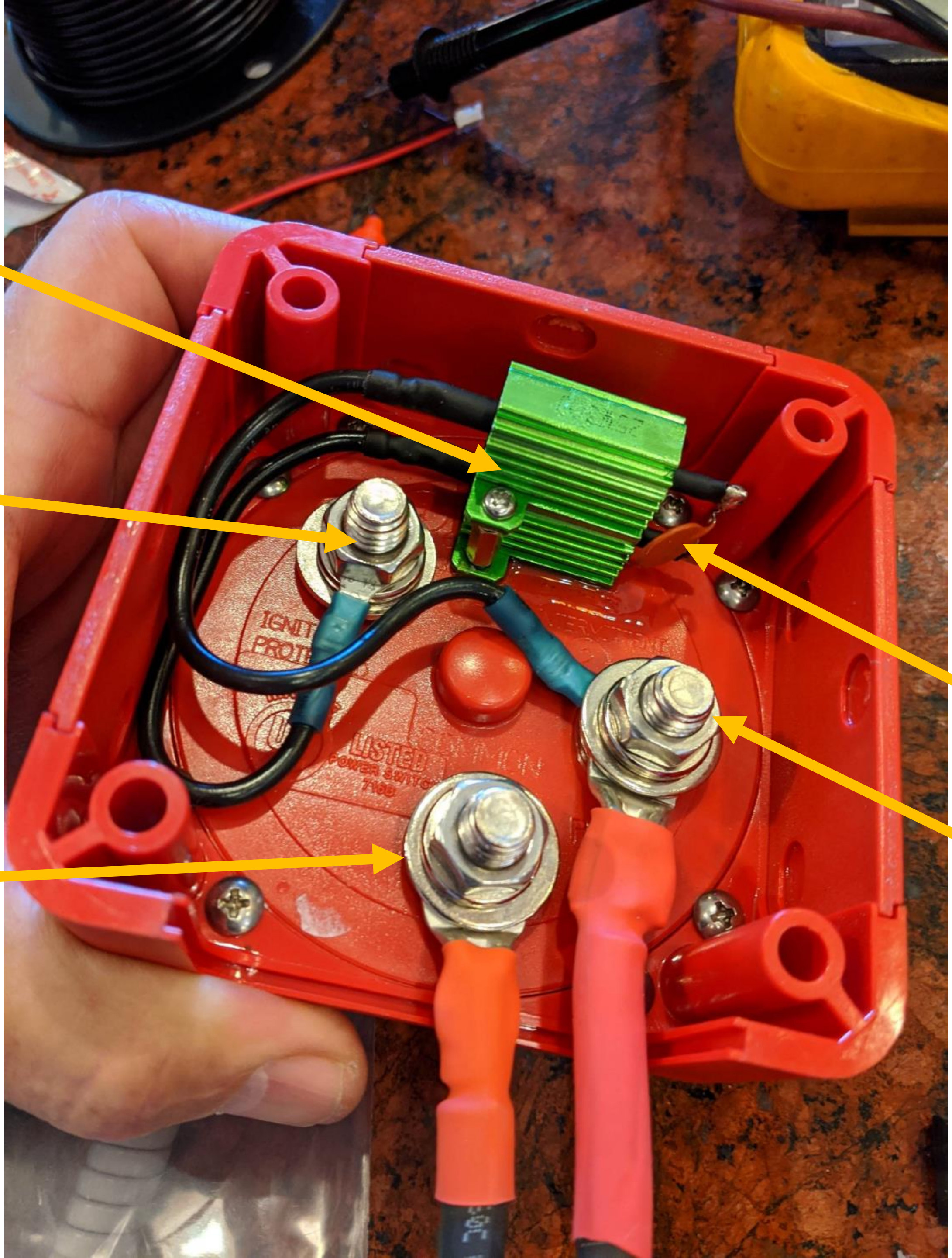
Notice that this circuit requires a minimum of .185 amps during ‘ptc hold’ if the user leaves the inverter on and the switch in the ‘1’ position. Otherwise the voltage on the PTC could exceed the spec of the device. The math works out that this should be OK, but I would feel a bit more comfortable with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

Assembly

Two 25W resistors
Stacked and glued

Post 1



PTC resistor
soldered between
resistors

Common

Post 2

Label to help instruct the user

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/Murata-Electronics/PTGLCSAS1R2K3B51B0?qs=%2Fha2pyFadujTRLKUrNbfYMT8Oi18lPe7Yz7BN1JQeEARp4ZwI8415G5DFLgXHwgW/

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.

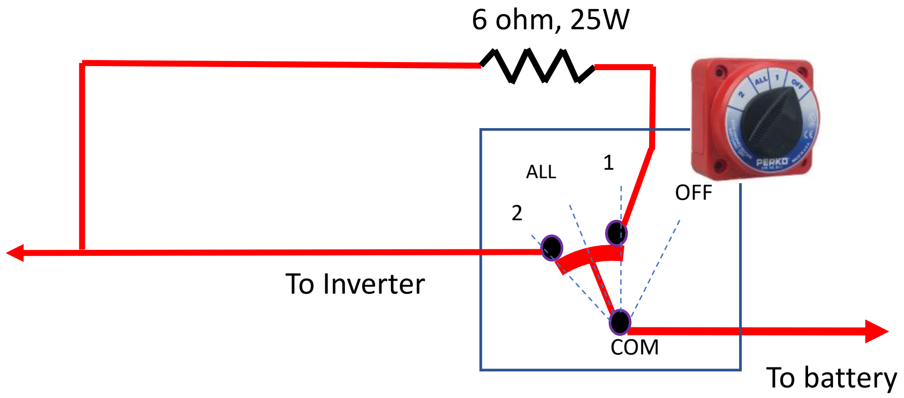
When I first developed this design, I was concerned about the case where someone leaves the switch in the "pre-charge" position and leaves the inverter on. The concern being that so much current would flow through the pre-charge resistors that they would over-heat. That led me to add the PTC as a way 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 do not know if all inverters will act like the 3 I have tested this with. Consequently I can not say the PTC is never needed.

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.

12V SYSTEM (No PTC)

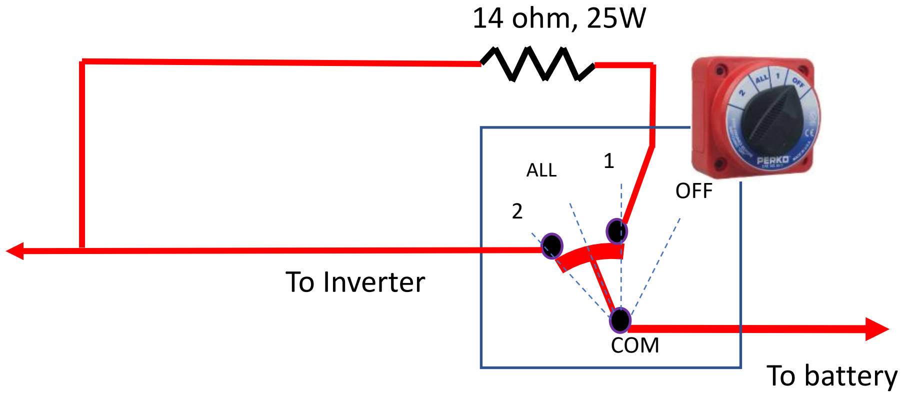


Operation:

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)



24V SYSTEM (No PTC)