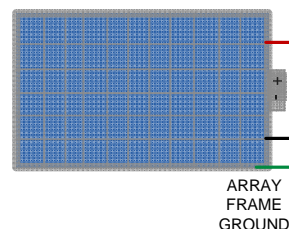


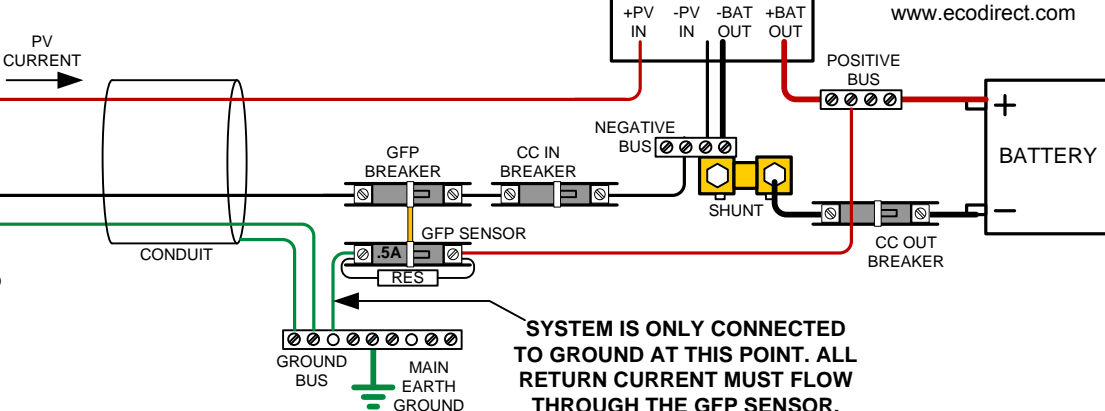
# GROUND FAULT PROTECTION – POSITIVE GROUND SYSTEMS – HOW IT WORKS

## NORMAL OPERATING CONDITION

PV MODULE OR ARRAY WITH COMBINER BOXES



SIMPLIFIED POSITIVE GROUND PV SYSTEM



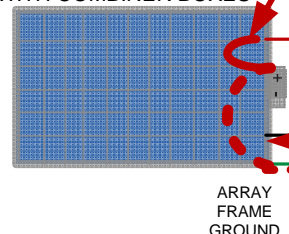
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SYSTEM IS ONLY CONNECTED TO GROUND AT THIS POINT. ALL RETURN CURRENT MUST FLOW THROUGH THE GFP SENSOR.

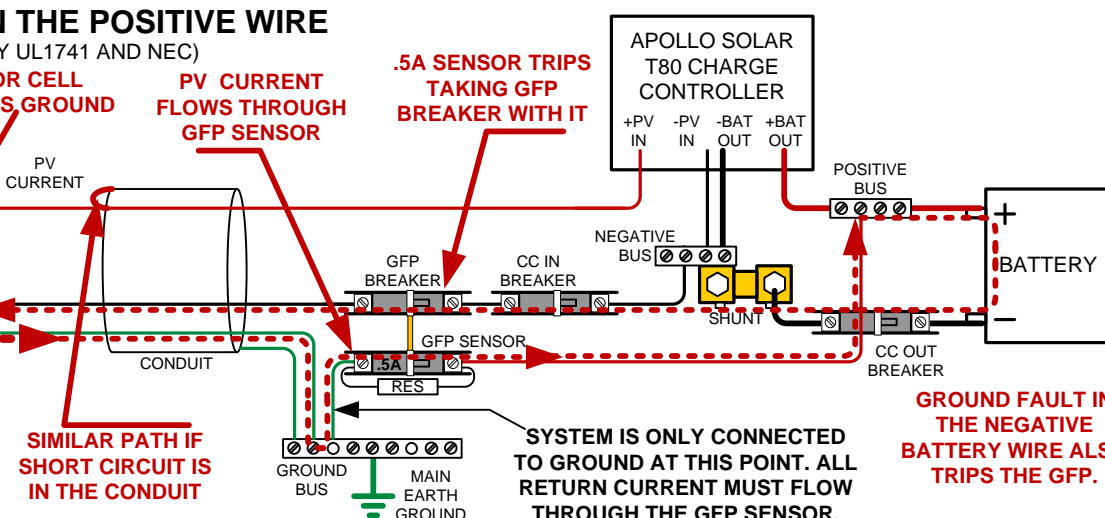
## GROUND FAULT IN THE POSITIVE WIRE

(PROTECTION REQUIRED BY UL1741 AND NEC)

PV MODULE OR ARRAY WITH COMBINER BOXES



SIMPLIFIED POSITIVE GROUND PV SYSTEM



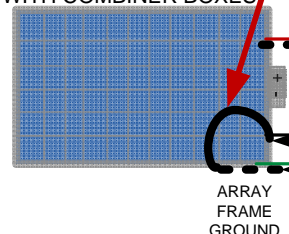
SYSTEM IS ONLY CONNECTED TO GROUND AT THIS POINT. ALL RETURN CURRENT MUST FLOW THROUGH THE GFP SENSOR.

GROUND FAULT IN THE NEGATIVE BATTERY WIRE ALSO TRIPS THE GFP.

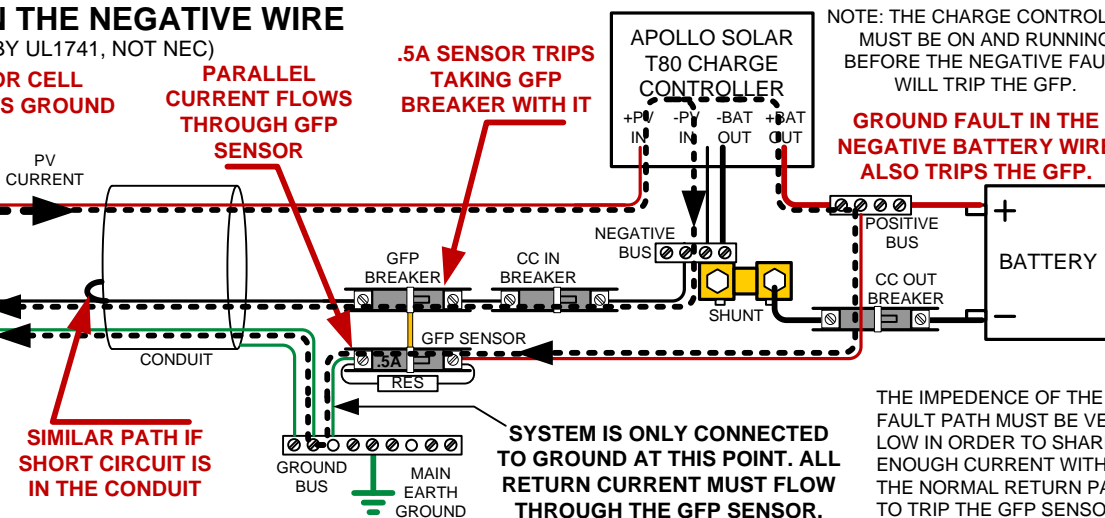
## GROUND FAULT IN THE NEGATIVE WIRE

(PROTECTION REQUIRED BY UL1741, NOT NEC)

PV MODULE OR ARRAY WITH COMBINER BOXES



SIMPLIFIED POSITIVE GROUND PV SYSTEM



SYSTEM IS ONLY CONNECTED TO GROUND AT THIS POINT. ALL RETURN CURRENT MUST FLOW THROUGH THE GFP SENSOR.

NOTE: THE CHARGE CONTROLLER MUST BE ON AND RUNNING BEFORE THE NEGATIVE FAULT WILL TRIP THE GFP.

GROUND FAULT IN THE NEGATIVE BATTERY WIRE ALSO TRIPS THE GFP.

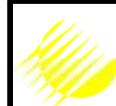
THE IMPEDENCE OF THE FAULT PATH MUST BE VERY LOW IN ORDER TO SHARE ENOUGH CURRENT WITH THE NORMAL RETURN PATH TO TRIP THE GFP SENSOR.

NEC 690.5 states that the Ground Fault Protection device must:

- 1) Detect a ground fault
- 2) Interrupt the fault current
- 3) Indicate that there was a ground fault
- 4) Open the ungrounded PV conductors

The drawing shows that each of the NEC requirements are satisfied with this GFP device.

The GFP may be tested by forcing a short to ground wire near the PV array. It is wise to use a current limiting resistor to create the short to limit damage to the wires. Be careful of high PV voltage.



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**POSITIVE GROUND SYSTEMS  
GROUND FAULT PROTECTION**

9-JULY-10

J. PFEIFER