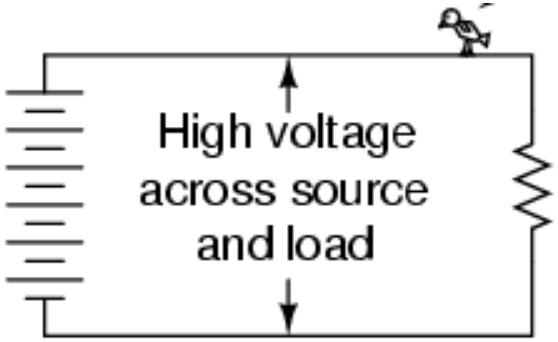
AMERICAN RIVER COLLEGE

Final Review

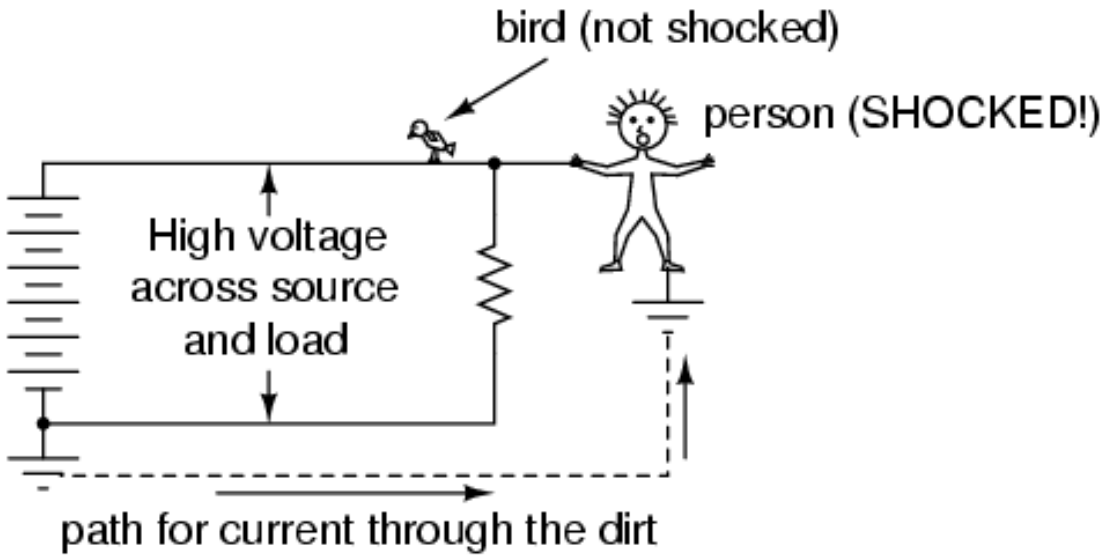
Grounding Concepts

The shocking truth….

- A bird on a wire



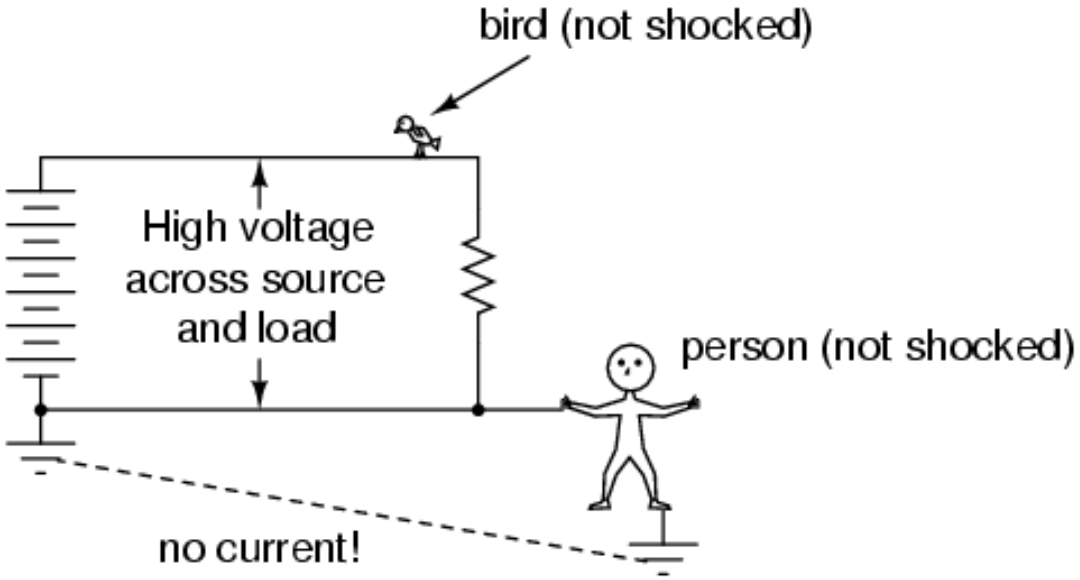
- A grounded circuit, man + hot wire



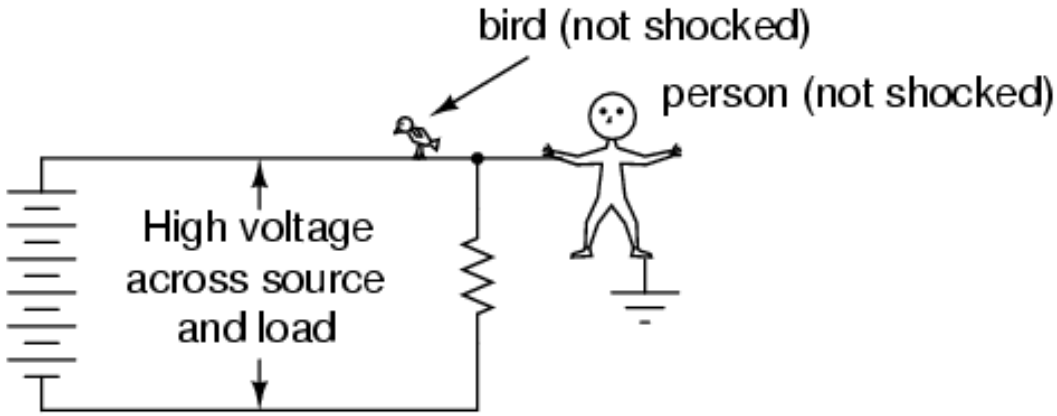
Grounding Concepts

The shocking truth..

- A grounded circuit, man + neutral wire



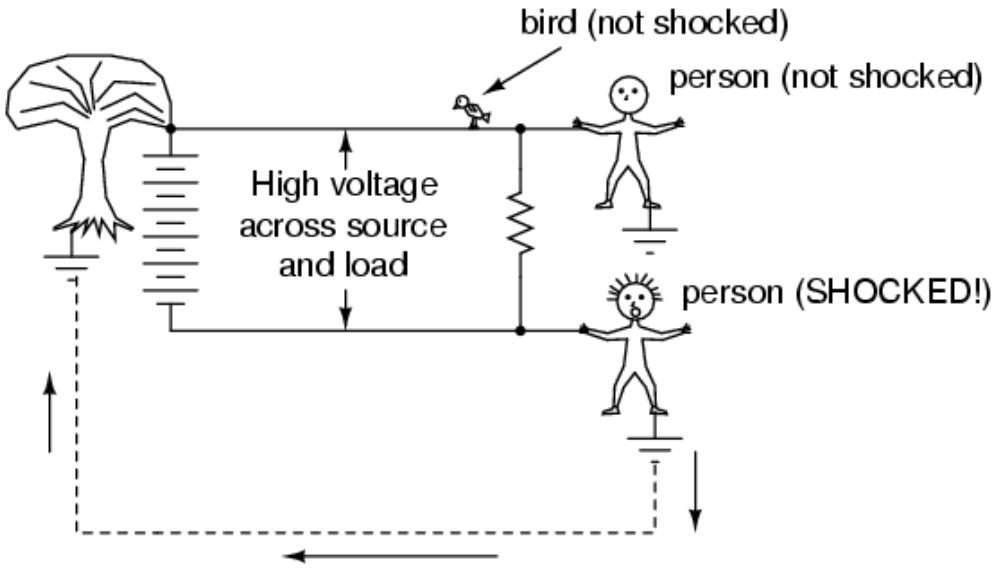
- Ungrounded circuit, man + hot wire



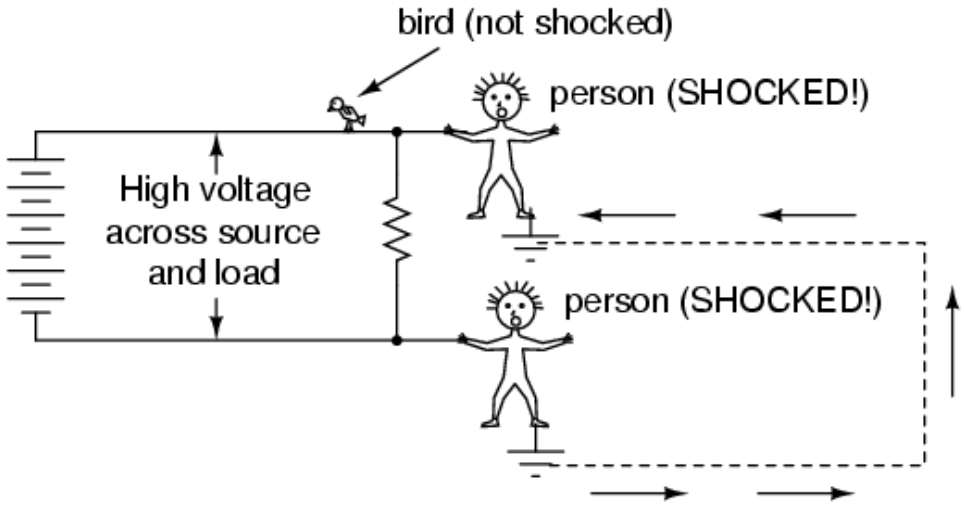
Grounding Concepts

The shocking truth..

- Accidental ground path
  2 men + 2 wires



- Ungrounded circuit,
  2 men + 2 wires



Grounding Concepts

Definitions

- GROUNDED
  - Means connected to the earth
- GROUNDING CONDUCTOR
  - Conductor that does not normally carry current and is used to connect all exposed, noncurrent-carrying metal surfaces of PV equipment to earth
  - Conductor that does not normally carry current and is used to connect the grounded conductor to the grounding electrode (rod) or grounding electrode system--also known as the Grounding Electrode Conductor.
- GROUNDED CONDUCTOR
  - System conductor that normally carries current and is intentionally grounded.
- BONDED
  - Means electrically connected

Grounding Concepts

Requirements

- All PV systems must have an equipment grounding system whether or not one of the current-carrying conductors is grounded
  - Grounding all exposed metal surfaces creates a barrier between the live conductors and the user
  - Since all surfaces are connected together and to earth, the voltage between them and earth even when a fault occurs remains near zero
  - This minimizes the shock potential and is a requirement for any PV system

- PV systems with open circuit voltages > 50 volts are required to have one conductor grounded

- The size of the equipment grounding wire must be at least as big as the current carrying conductors between the two pieces of equipment being connected.
  - It can have a current-carrying capacity (ampacity) no less than the ampacity of the overcurrent device protecting the circuit.

Grounding Concepts

Requirements cont.

- The equipment grounding conductors must at some point be connected directly to the grounding electrode
  - Grounding electrode is 5/8" metal rod driven at least 8 feet into the earth
  - Grounding electrode conductor should be the same size as the largest equipment grounding conductor in the system

- For grounded systems, the grounded conductor must also be connected to the grounding electrode
  - Grounding electrode conductor must be as large as the largest current-carrying conductor in the system
  - Should be attached to the end of the largest negative conductor nearest the PV array
  - There must be only one connection between the negative current-carrying conductor and the grounding electrode
  - There can be no splices in the grounding electrode conductor

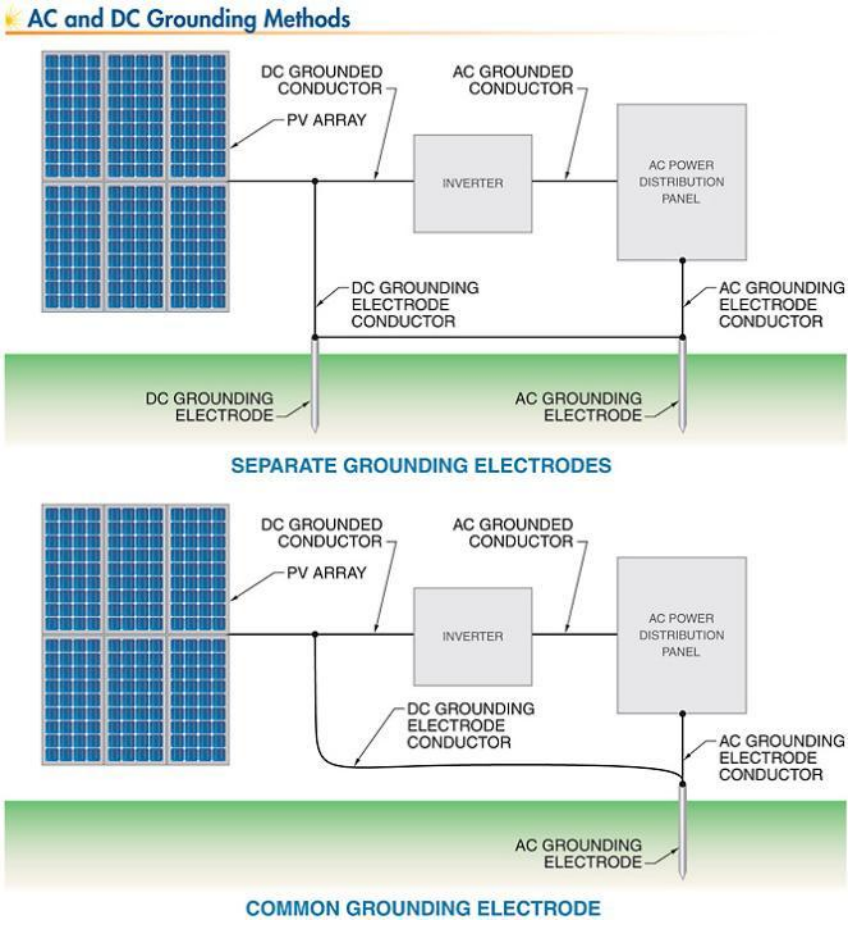
Requirements

- NEC 250.122
  - Copper, aluminum, or copper-clad aluminum equipment grounding conductors fo the wire type shall not be smaller than shown in Table 250.122
  - But in no case shall they be required to be larger than the circuit conductors supplying the equipment.

Equipment-Grounding Conductor Size

Overcurrent Device Size (Amps)	*Conductor Size (AWG)*
15	14
20	12
30	10
40	10
60	10
100	8
200	6
300	4
400	3
500	2

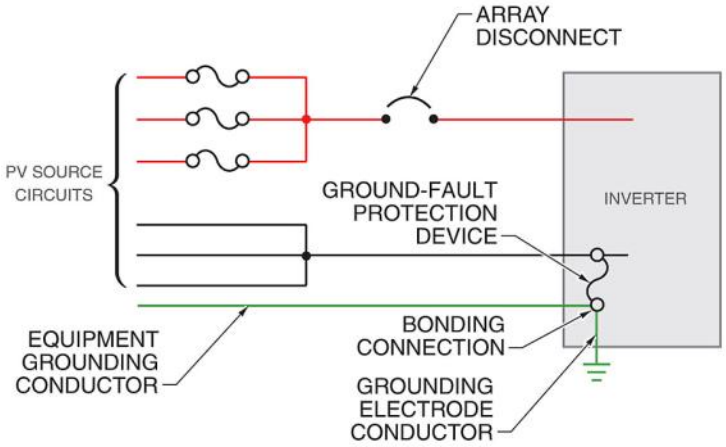
Grounding Concepts



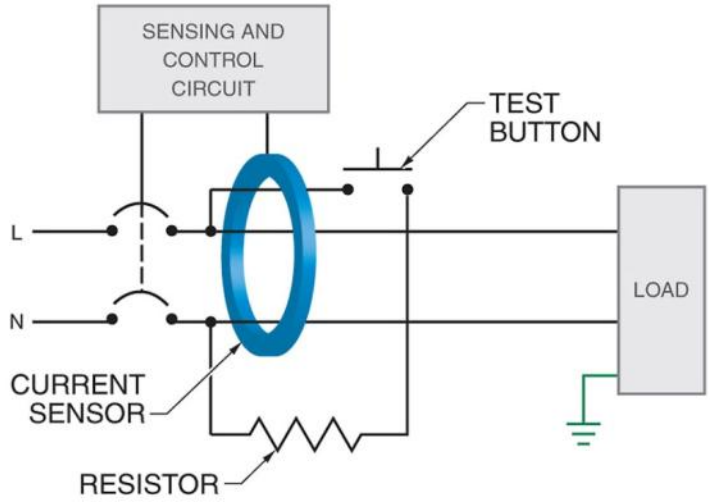
- There are two acceptable methods of grounding both the AC and DC sides of a PV system.

Grounding Concepts

Array Ground-Fault Protection with Inverter Fuse



Ground-Fault Circuit Interrupter

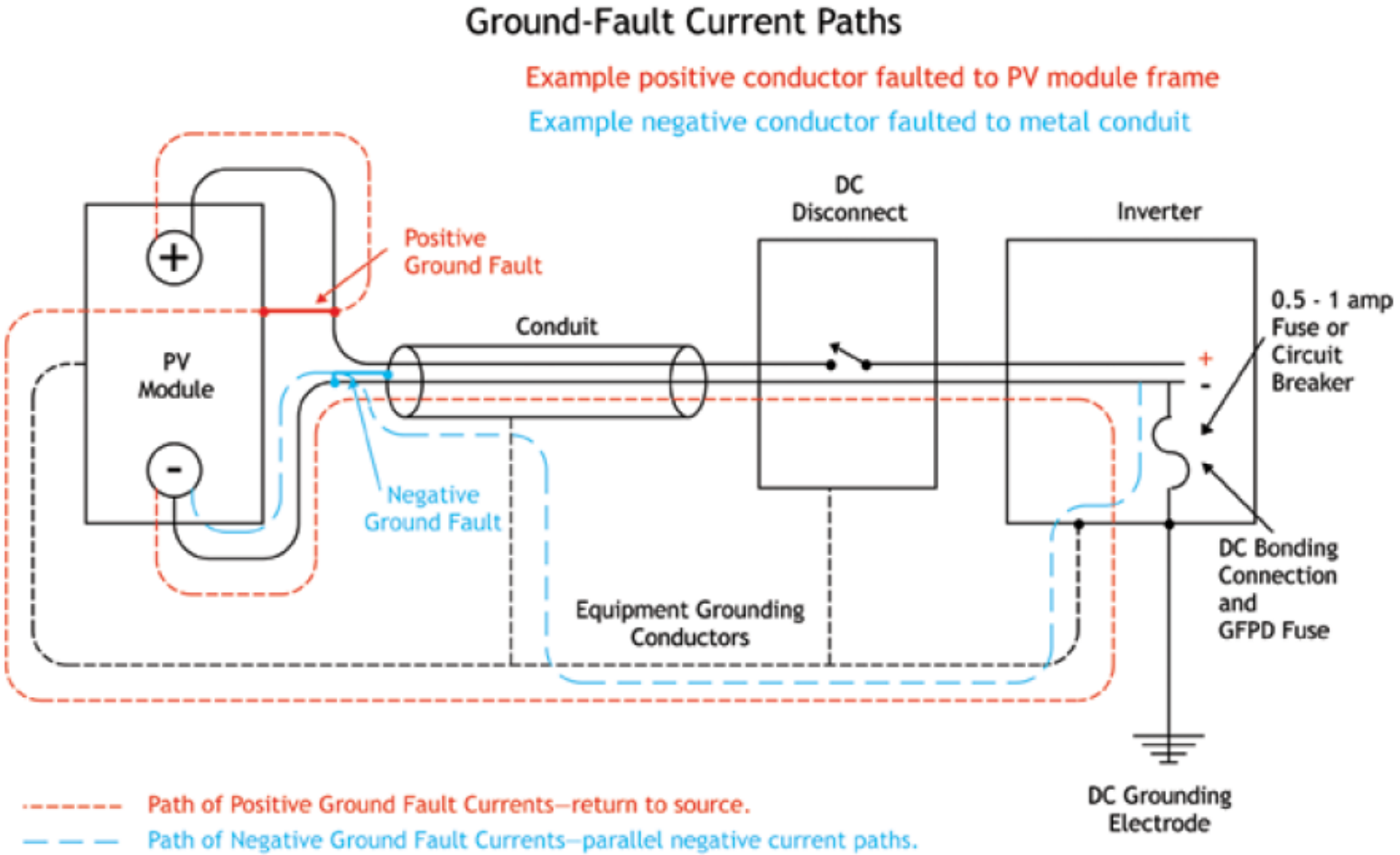


- A ground-fault circuit interrupter (GFCI) senses differences between the current in the grounded and ungrounded conductors, indicating a ground fault, and opens the circuit in response.

Grounding Concepts

Energy Instructor
www.energyinstructor.info

Definitions



Final Exam Review

- 50 questions
- Same format as the midterm
- 70% midterm material / 30% rest of class material (see below)
- Open book / open notes
- Topics
  - Electrical Safety
  - Ampacity Calculations (same ten step format as midterm)
  - Voltage Drop Calculation
  - 3 phase power, wiring, inverters used in 3-phase systems
  - Transformers
  - Conduit, types, bending, sizing
  - Grounding concepts, grounding definitions, GFI versus GFCI
  - PV ground requirements, grounding design
  - Site assessment, design parameters, equipment