SIERRA COLLEGE

Class 13

Lesson Plan

- Grounding discussion

AC Design Requirements

Need to

- Determine conductor type, size, length, color

The 8AWG THWN-2	**10ft**	**Black, White, Red, Green (or bare)**
The 4AWG THWN-2	**10ft**	**Black, White, Red, Blue, Green (or bare)**

- Determine conduit type, size, length

EMT ½ inch from inverter to sub panel	**20ft**
EMT 1” inch from sub panel to feeder	**20ft**

- Determine fuse and breaker requirements

3x 2 pole 40amp circuit breakers in the inverter sub panel

Need a 3 phase MLO load center, 125A, 12 slot, NEMA 3R

1x 3 pole 70amp circuit breaker in the supply panel

Inverter data sheet

	SB 5000US	SB 6000US	SB 7000US
Recommended Maximum PV Power (Module STC)	6250 W	7500 W	8750 W
DC Maximum Voltage	600 V	600 V	600 V
Peak Power Tracking Voltage	250–480 V	250–480 V	250–480 V
DC Maximum Input Current	21 A	25 A	30 A
Number of Fused String Inputs	3 (inverter), 4 x 20 A (DC disconnect)	3 (inverter), 4 x 20 A (DC disconnect)	3 (inverter), 4 x 20 A (DC disconnect)
PV Start Voltage	300 V	300 V	300 V
AC Nominal Power	5000 W	6000 W	7000 W
AC Maximum Output Power	5000 W	6000 W	7000 W
AC Maximum Output Current (@ 208, 240, 277 V)	24 A, 21 A, 18 A	29 A, 25 A, 22 A	34 A, 29 A, 25 A
AC Nominal Voltage Range	183 – 229 V @ 208 V 211 – 264 V @ 240 V 244 – 305 V @ 277 V	183 – 229 V @ 208 V 211 – 264 V @ 240 V 244 – 305 V @ 277 V	183 – 229 V @ 208 V 211 – 264 V @ 240 V 244 – 305 V @ 277 V
AC Frequency: nominal / range	60 Hz / 59.3 – 60.5 Hz	60 Hz / 59.3 – 60.5 Hz	60 Hz / 59.3 – 60.5 Hz
Power Factor (Nominal)	0.99	0.99	0.99
Peak Inverter Efficiency	96.8%	97.0%	97.1%
CEC Weighted Efficiency	95.5% @ 208 V 95.5% @ 240 V 95.5% @ 277 V	95.5% @ 208 V 95.5% @ 240 V 96.0% @ 277 V	95.5% @ 208 V 96.0% @ 240 V 96.0% @ 277 V
Dimensions: W x H x D in inches	18.4 x 24.1 x 9.5	18.4 x 24.1 x 9.5	18.4 x 24.1 x 9.5
Weight / Shipping Weight	141 lbs / 148 lbs	141 lbs / 148 lbs	141 lbs / 148 lbs
Ambient Temperature Range	–13 to 113 °F	–13 to 113 °F	–13 to 113 °F
Power consumption at night	0.1 W	0.1 W	0.1 W

Inverter data sheet

Topic: DC Input Current Ratings for Sunny Boy Inverters

SUMMARY

The technical data in the SMA product data sheets is specified for nominal operating conditions. The specified DC maximum input current refers to the actual continuous input current recommended for an optimum energy yield of the system.

Inverter model	Rated DC maximum input current I_{MP} (continuous)	Maximum short circuit current of connected PV strings I_{SC} (considering 125% NEC factor)
SB 3000US	17 Amp	22 Amp
SB 4000US	18 Amp	23 Amp
SB 5000US	21 Amp	27 Amp
SB 6000US	25 Amp	32 Amp
SB 7000US	30 Amp	38 Amp

Inverter data sheet

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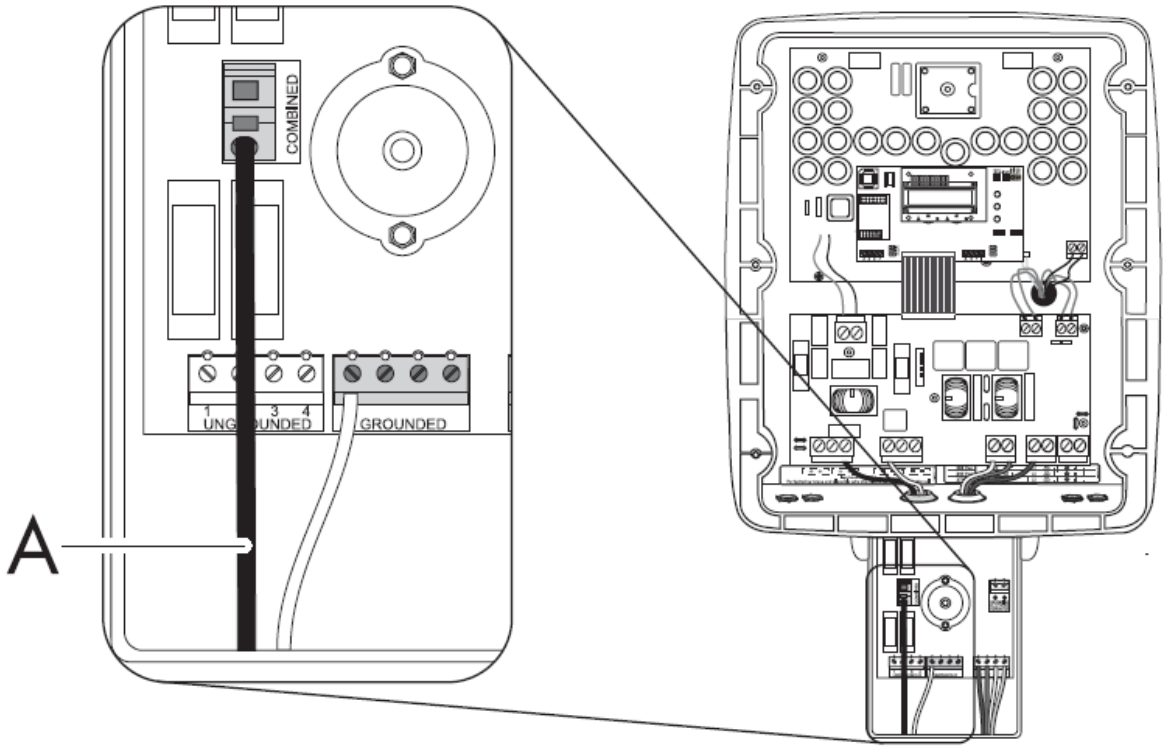
Inverter data sheet

The maximum string fuse rating of the SMA DC disconnect unit is 20 Amp. The NEC requires that all fuses and wiring be sized for a minimum of 1.56 times the I_{SC} of the PV module used in the system. Consequently, the maximum short circuit current per string can be up to 12.8 Amp.

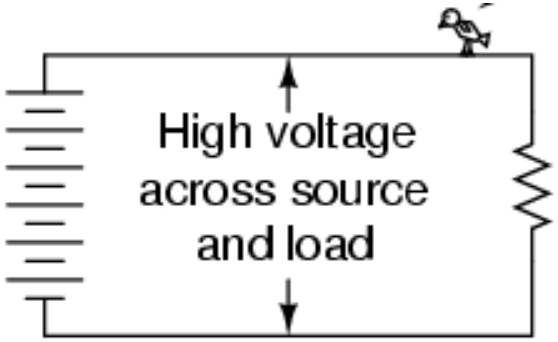
The maximum operating current of the DC disconnect unit (all parallel strings combined) is 34 Amp.



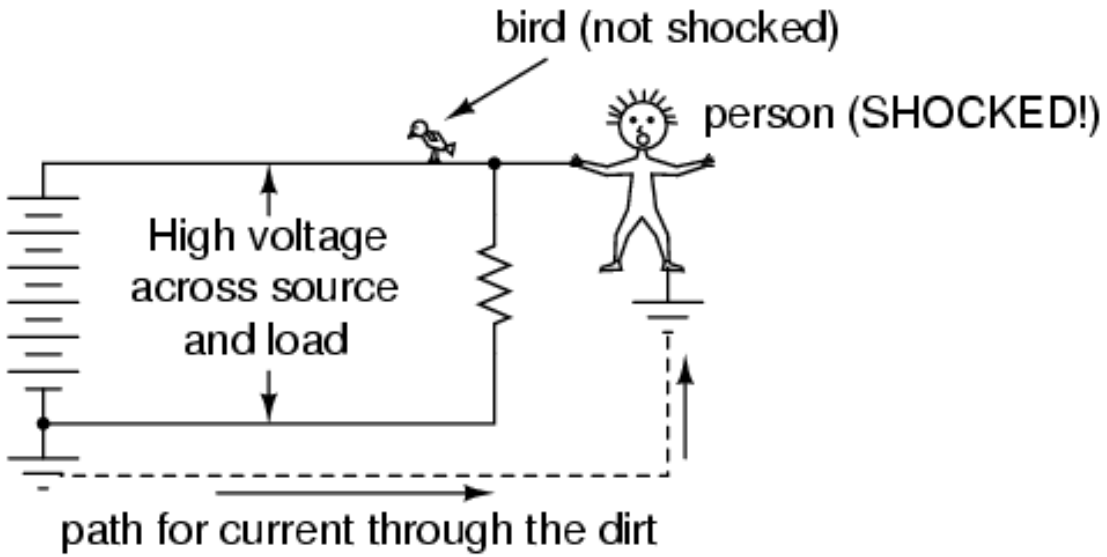
Grounding Concepts

The shocking truth….

- A bird on a wire



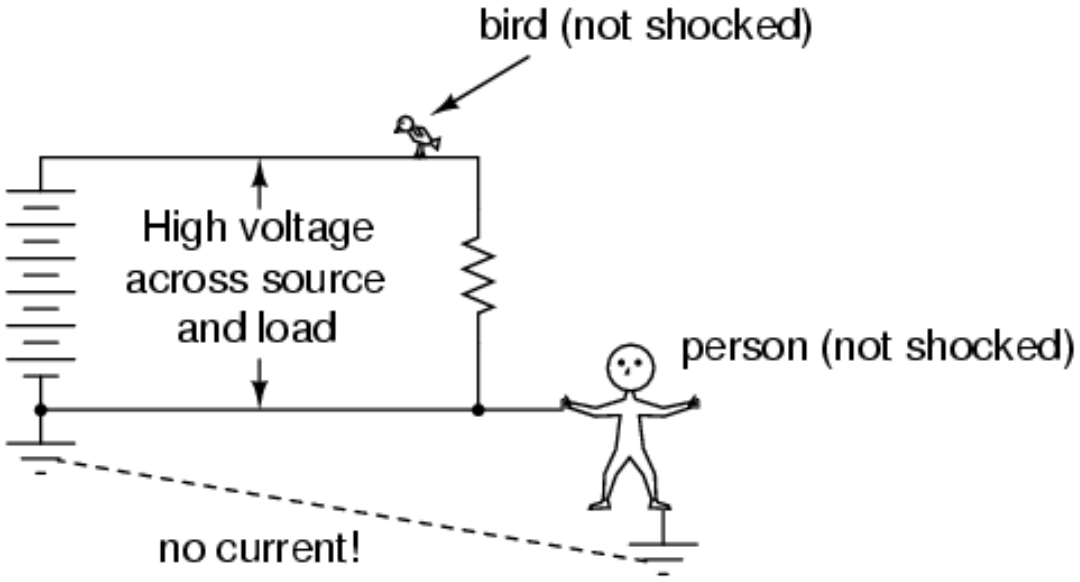
- A grounded circuit, man + hot wire



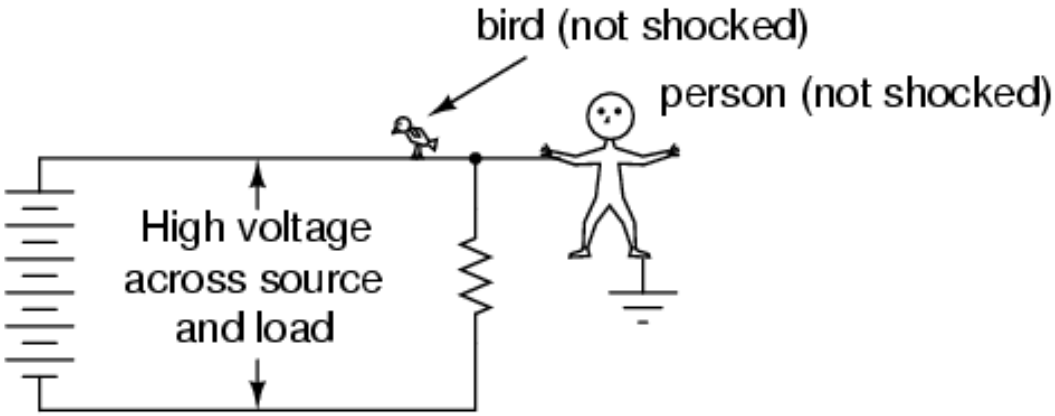
Grounding Concepts

The shocking truth..

- A grounded circuit, man + neutral wire



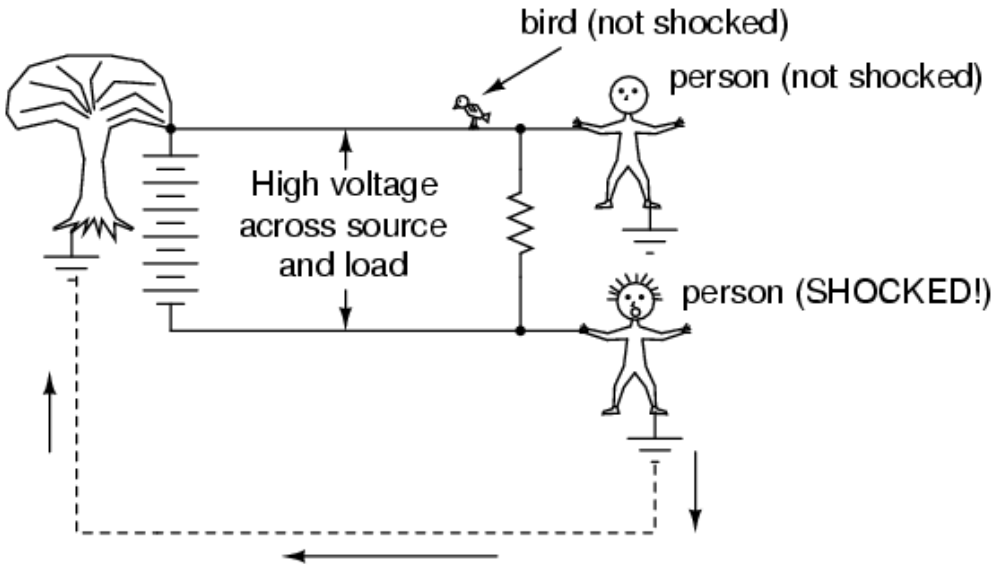
- Ungrounded circuit, man + hot wire



Grounding Concepts

The shocking truth..

- Accidental ground path
  2 men + 2 wires



- Ungrounded circuit,
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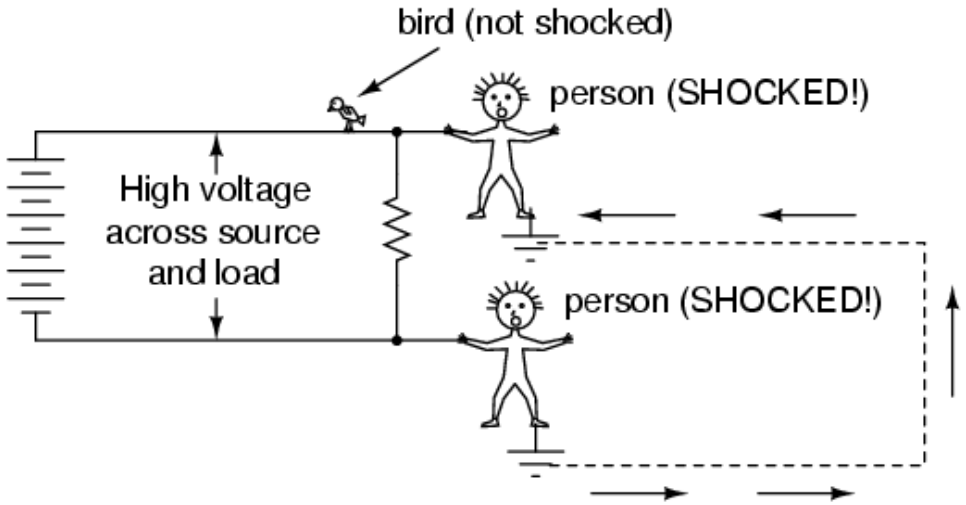


Grounding Concepts

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.

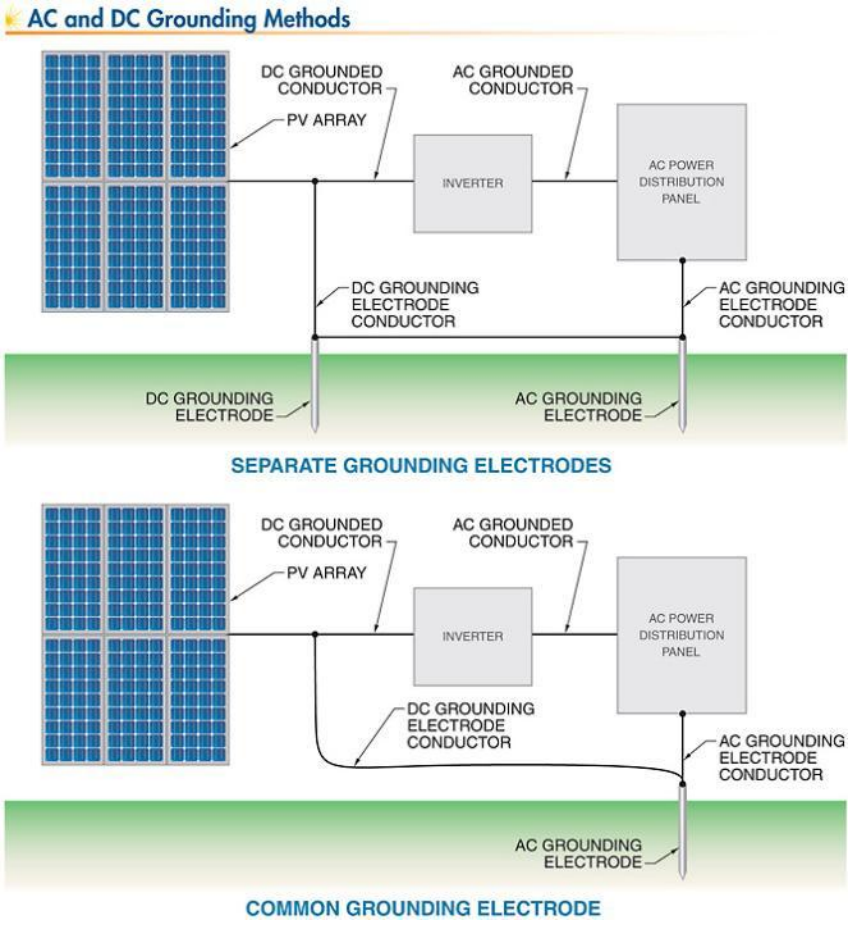
Grounding Concepts

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

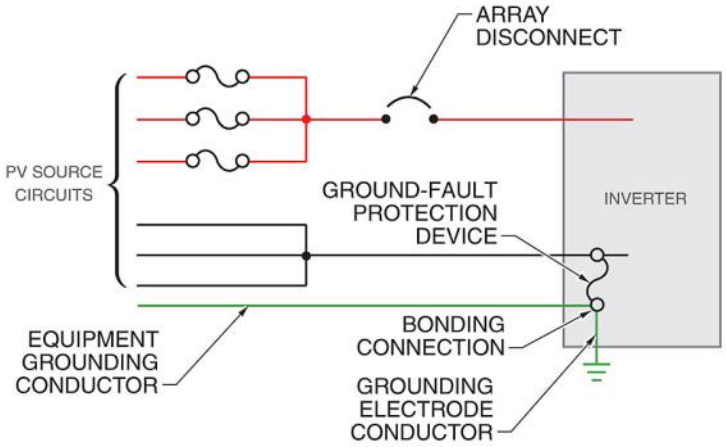
Grounding Concepts



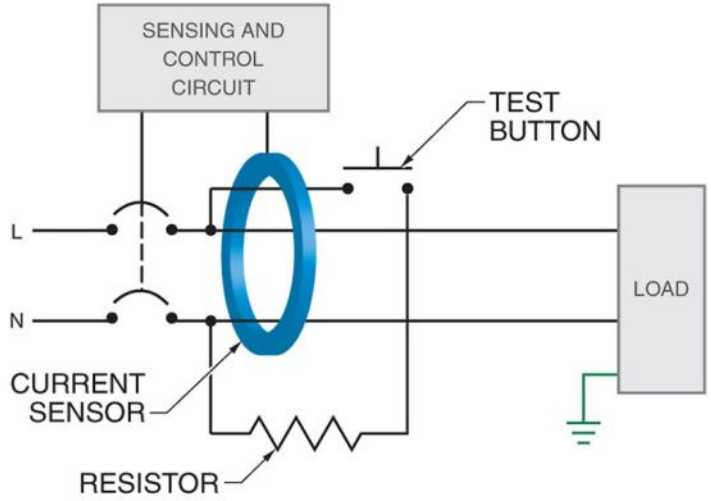
- There are two acceptable methods of grounding both the AC and DC sides of a PV system.

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

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Definitions