



TOPIC OF STUDY

Solar Installation



KEY TERMS

AC disconnect
DC disconnect
label
operating voltage
open circuit voltage
operating current
short circuit current
NEC
rapid shutdown

LESSON

Equipment Labeling for Commissioning and Certification

BIG IDEA(S)

Buildings with PV systems need permanent labels located at each service equipment location to which the PV systems are connected or at an approved readily visible location and also at rapid shutdown initiation devices.

OBJECTIVES

Students will be able to:

- Determine the max voltage, operating voltage, fault current, and operating current of the system by reviewing spec sheets and performing calculations
- In the classroom solar array setup, have students apply labels
- List the steps for a rapid shutdown procedure

TASK LIST SUBCATEGORY

510 Students will be able to properly label a solar array

OVERVIEW

Students will be taught the importance of labels, that they are required by code, and understand the calculations needed to label voltage and current properly.

STANDARDS

PA/SDP

- 3.4.12.B1.** Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of technologies.
- 3.4.12.B2.** Illustrate how, with the aid of technology, various aspects of the environment can be monitored to provide information for decision making.
- 3.4.10.B1.** Compare and contrast how the use of technology involves weighing the trade-offs between the positive and negative effects.

INSTRUCTIONAL

TEXT/REFERENCES

SEI Solar Electric Handbook, p. 250
NEC Articles 690.54, 690.56(B), 690.4(D), 690.13(B), 690.53, 690.31(D)(2), 690.15, 690.56(C)

MATERIALS NEEDED

Teacher Prep:

NEC Articles 690.54, 690.56(B), 690.4(D), 690.13(B), 690.53, 690.31(D)(2), 690.15, 690.56(C)
<https://www.purepower.com/blog/2017-nec-690.12-rapid-shutdown-important-changes>

MATERIALS

Label maker
Preprinted PV stickers (purchase at <https://www.pvlabels.com/>)



INSTRUCTIONAL - CONTINUED

Technology:

[NEC labeling guide](#)

[Solar Best Practices in Applying Labels](#)

IMPLEMENTATION (LESSON PLAN)

ENGAGE

- Review the [Hellerman Titan labeling guide](#) and watch the [labeling video](#) (11 minutes)

EXPLORE/EXPLAIN

- Have students determine the max voltage, operating voltage, fault current, and operating current of the system by reviewing spec sheets and performing calculations where necessary:
 - Ex: Enphase micro inverters max output current is 1.1 amps. If there are 10 microinverters wired in parallel what is the max current? $10 \times 1.1 = 11$.
 - Ex. Enphase systems are typically 240V systems so the operating voltage is 240V.
 - If using DC optimizers the operating and max voltage can be found on the spec sheet and, when wired in series, the operating current is the current of the solar panel.
- Have students print labels, it is a code violation to hand write on labels.
- If your classroom has a solar array setup, have students apply labels as required.

EXTEND

- Discuss Rapid Shutdown, why is it important? What does it do?
 - <https://www.purepower.com/blog/2017-nec-690.12-rapid-shutdown-important-changes>
 - [Rapid Shutdown For Solar](#)
 - Rapid shutdown is to protect first responders from electrical shock.
 - It de-energizes a solar array at the panel level. Before rapid shutdown strings of panels would remain energized even when the disconnect was in the off position.
 - It only applies to roof mounted systems.

HOMEWORK

Find the operating current and voltage for 9 Enphase IQ7+ microinverters wired in parallel.

MEETING INDIVIDUAL NEEDS

Hands on learners can print labels and go around and stick them in the proper locations.

RESOURCES/LINKS

[Solar Installation Labeling Requirements for Permit Inspection. DIY solar installation](#)

[Solar Best Practices in Applying Labels](#)

[Solar Labeling Requirements](#)

