

String Combiners in SolarEdge Systems, North America

Introduction

In a SolarEdge system, the PV modules are isolated from the DC output circuit by the power optimizer. There is no risk of exceeding the PV module maximum fuse rating current as a result of a fault in the DC output circuit. The inverter has been verified to contribute zero current to a faulted DC output circuit. The only sources of current to consider are the DC output circuits. A faulted string could be subjected to the combined currents of the other connected strings, which is $15 \text{ amps} \times N-1$, where N is the number of strings. For 3 strings or less, the maximum combined current is 30 amps, which does not exceed the current rating of the power optimizer output cables and of the 10 gauge 90°C output circuit conductors. Some jurisdictions will require fused string combiners for systems with 3 strings.

For PV systems using the SolarEdge SE3000A-US through the SE7600A-US single phase inverters, and systems using the SE9kUS, SE10kUS, and SE20kUS three phase inverters, it is possible to fully load the inverters with a DC to AC ratio of 125%, with 2 strings or less. There are 2 scenarios where a third string would be required.

1. The SE10000A-US or the SE11400A-US single phase inverter with more than 10500 watts STC.
2. The SE20kUS three phase inverter with more than 25000 watts STC

A PV system with more than 2 strings connected in parallel should be evaluated to ensure that available current sources do not exceed the current rating of any conductors or components in a fault condition. The purpose of this Application Note is to provide guidelines for selecting fused string combiners when required.

NEC Requirements

NEC article 690.9 outlines the overcurrent protection requirements for photovoltaic source circuits. The intent is to provide overcurrent protection for circuits connected to more than one electrical source. All sources of current need to be considered: multiple series strings of PV modules connected in parallel to the inverter as well as the string inverter itself. SolarEdge inverters have been verified to provide zero backfeed current to the input source circuits.

When overcurrent protection is required, NEC Article 240.15 states that an overcurrent protection device shall be connected in series with each ungrounded conductor.

Applicability to SolarEdge systems

SolarEdge inverters are non-isolated or transformer-less, so they must operate with ungrounded photovoltaic source and output circuits.

A string combiner for a SolarEdge system would require fusing in both the positive and negative conductors.

The SolarEdge optimizers limit current in DC output circuits to 15 amps per string. Using the NEC correction factor of 1.25, results in a string current of $15 \text{ amps} \times 1.25 = 18.75 \text{ amps}$. Therefore an individual string fuse rating of 20 amps is needed.

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China	City Center, 100 Zunyi Road, Building A, Unit 1204, Shanghai 200051

SolarEdge Power Optimizers

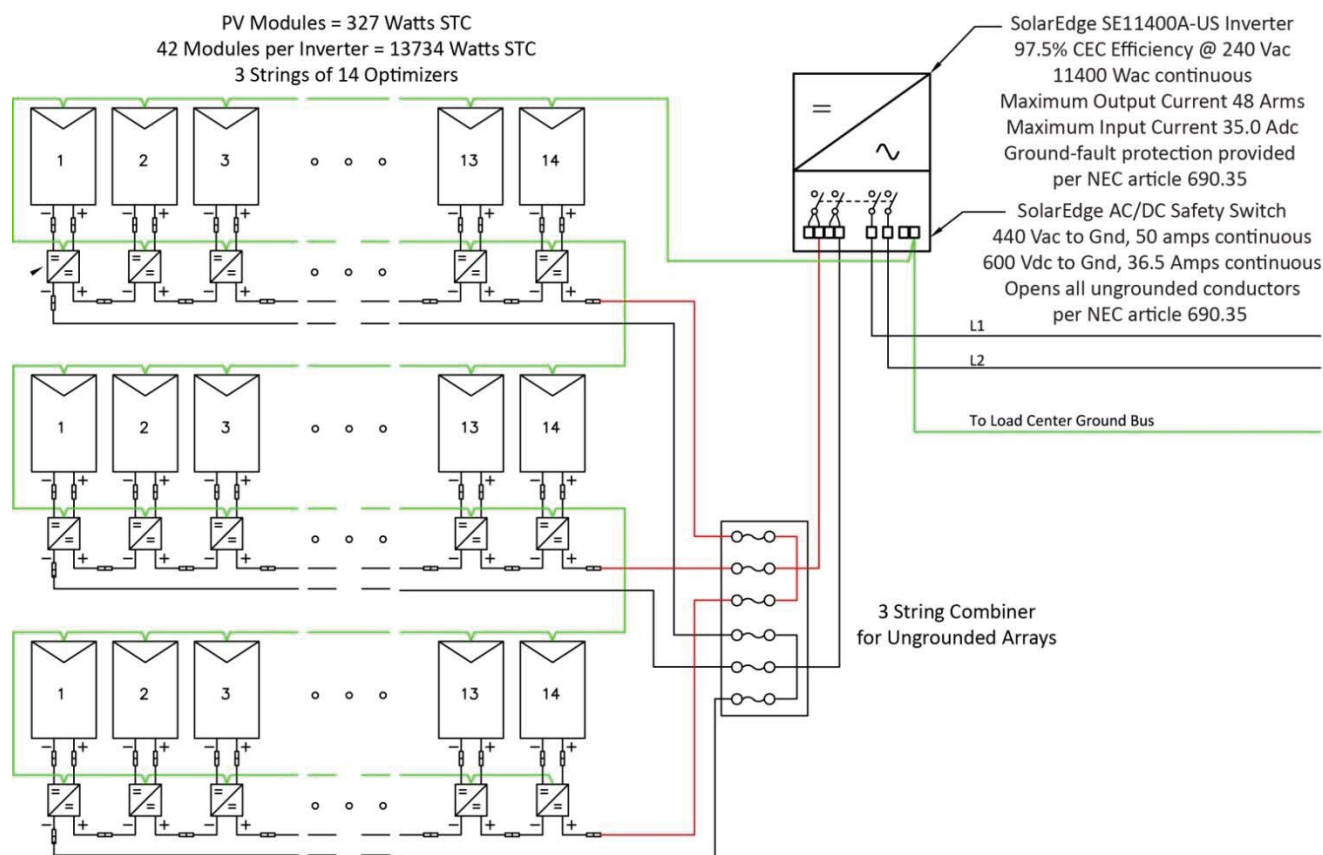
SolarEdge power optimizers provide internal current limitation as described in NEC article 690.8(B)(2). The power optimizers limit current at the optimizer DC output circuit to 15 amps. The maximum current value of 15 amps x the NEC correction factor of 1.25 should be used to determine DC output circuit conductor size and overcurrent protection requirements. SolarEdge power optimizers are constructed with 10 gauge PV wire output cables.

SolarEdge Inverters

The DC input terminal blocks in the SE10000A-US, SE11400A-US, and the SE20kUS inverters support up to a #6 AWG conductor. A #6 AWG conductor is more than adequate to handle the combined current of 3 strings and allow for voltage drop in longer DC output circuits.

Example

The following diagram illustrates the connection of 3 strings to the SE11400A-US inverter using a fused string combiner.



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Recommended 3 string combiner specifications for SE10000A-US and SE11400A-US inverters

1. Max voltage: 600V
2. Number of inputs: 6 - 3 x Plus and 3 x Minus
3. Fuses: on the positive and negative (6 fuses); 20A fuses
4. Input wire range: 14-6AWG
5. Output wire range: 14-6AWG
6. Equipment grounding wire range: 12-10AWG
7. Enclosure: NEMA 3R

Recommended 3 string combiner specifications for SE20kUS inverters

1. Max voltage: 1000V
2. Number of inputs: 6 - 3 x Plus and 3 x Minus
3. Fuses: on the positive and negative (6 fuses); 20A fuses
4. Input wire range: 12-6AWG
5. Output wire range: 12-6AWG
6. Equipment grounding wire range: 12-8AWG
7. Enclosure: NEMA 3R