

# Application Note: SolarEdge AU Compliance to AS/NZS 5033:2021

November 2021

## AS/NZS 5033:2021

19th November 2021 AS/NZS 5033:2021 was published with a six month deadline to which the 2014 will be withdrawn. Implementation of the 2021 is now mandatory throughout Australia.

This application note sets out to clarification the practical application of the following clauses which relate to SolarEdge products.

- Calculation of potential fault currents originating at PV modules
  - Clause 3.3.3.1 (c) - Calculation of maximum string current
- Protection against overcurrent.
  - Clause 3.3.2 – Potential fault currents not originating at PV modules
- Requirements for overcurrent protection.
  - Clause 3.3.4.1 – Strings
- PV array maximum voltage calculation.
  - Clause 4.2.1.3.3 - Systems containing DCUs on all modules
- Requirements for selection of cables
  - Clause 4.4.2.1 General.
- Requirements for overcurrent protection.
  - Clause 4.5.1 – Selection of power conversion equipment's (PCEs).

## Calculation of potential fault currents originating at PV modules

**Clause 3.3.3.1 (c)** - Calculation of maximum string current states the following:

The value of  $I_{F\text{ STRINGS}}$  depends on the PV array system configuration, and is calculated as—

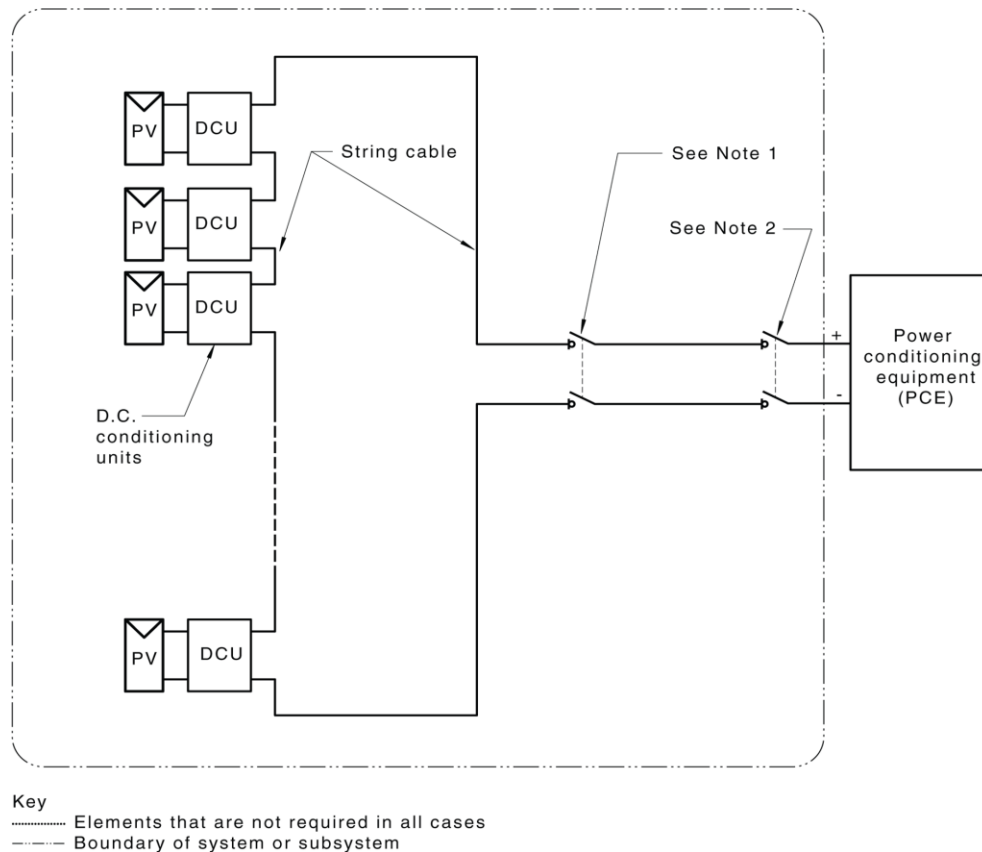
Where parallel strings contain strings with DCUs on all modules

$$I_{F\text{ STRING MAX}} = I_{DCU\text{ string max}}$$

Whereby:  $I_{F\text{ STRING MAX}}$  = potential fault current in a string from other parallel strings

$I_{DCU\text{ string max}}$  = DCU maximum overcurrent protection on the DCU string side

AS/NZS 5033:2021 states that module(s) on the input side of the DCUs are not considered to be an individual PV array. They are deemed to be a part of the PV array. DCUs may either be connected to all PV modules (see Figure 2.7) or to some PV modules (partial DCU strings, see Figure 2.8). Therefore, the string side of the DCU is the output of the DCU string.



### Conclusion:

The potential fault current in a string equal to the DCU maximum overcurrent protection on the DCU string side (output side). For all SolarEdge optimizers refer to the stated 'Maximum Output Current' for the value of  $I_{F\text{ STRINGS}}$ .

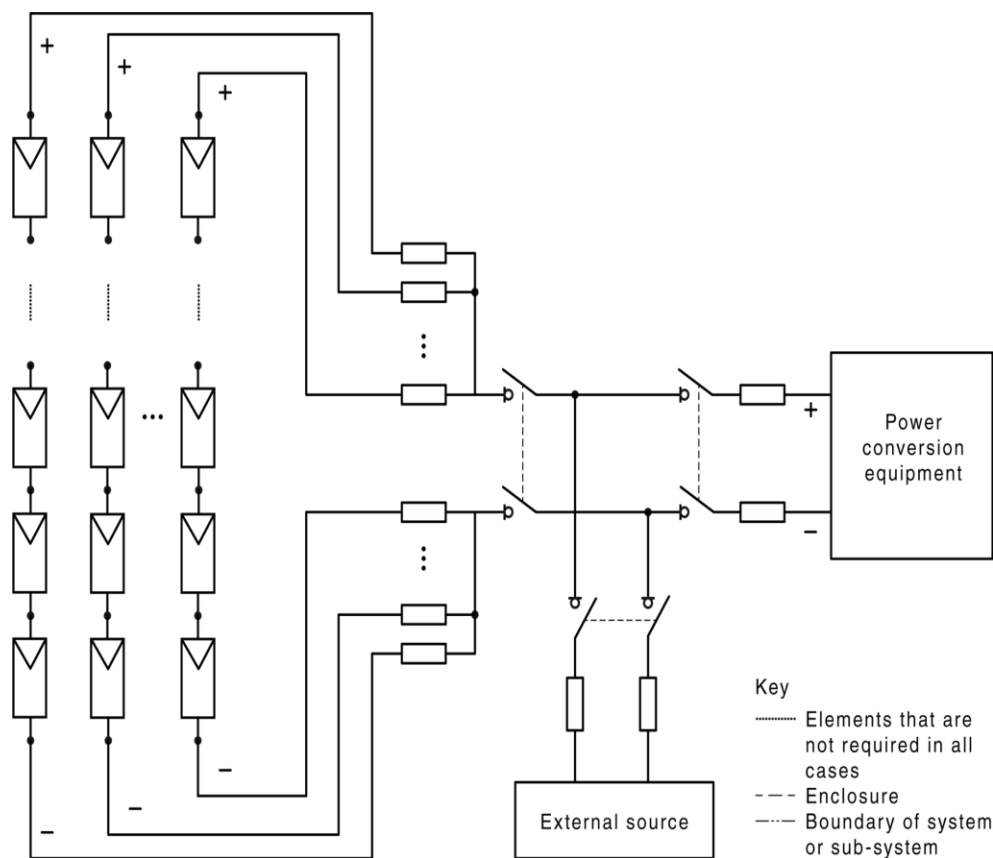
## Protection against overcurrent

**Clause 3.3.2** – Potential fault currents not originating at PV modules states the following:

*All cables and components (including, but not limited to, array cables, sub-array cables, string cables and PV modules) in a PV system shall be protected from currents not originating at the PV modules.*

*$I_{BF\ TOTAL}$  is the sum of all backfeed sources of current not originating at the PV modules, such as from PCE/s or other external sources that are directly connected to the array.*

**NOTE:** *The value of backfeed short-circuit current available from the PCE should be documented in installation information.*



### Conclusion:

When batteries are being installed as part of a SolarEdge system overcurrent protection is required as the output current of the battery will in most cases exceed the DCU maximum overcurrent protection of the string. The SolarEdge DC Combiner includes fusing (overcurrent protection) on both + and – conductors as defined by the Standard. If the SESTI products are being used for battery installation then we recommend external fusing (overcurrent protection) by installed as part of the system installation.

## Requirements for overcurrent protection

**Clause 3.3.4.1** – Strings states the following:

*For strings connected in parallel, overcurrent protection shall be provided when—*

$$I_{F \text{ STRINGS}} + I_{BF \text{ TOTAL}} > I_{MOD \text{ MAX OCPR}}$$

*Where overcurrent protection is required, see Clause 3.3.5 for rating of the overcurrent protection devices.*

Whereby:  $I_{F \text{ STRINGS}}$  = Potential fault current in a string from other parallel strings

$I_{BF \text{ TOTAL}}$  = Total continuous backfeed current from all sources not originating at the PV modules

$I_{MOD \text{ MAX OCPR}}$  = PV module maximum overcurrent protection rating as determined by IEC 61730-2

### Conclusion:

If the Potential fault current in a string from other parallel strings, plus the total continuous backfeed current from all sources not originating at the PV modules is greater than the PV module maximum overcurrent protection rating as determined by IEC 61730-2, then overcurrent protection shall be required.

The potential fault current in a string from other parallel strings is equal to the DCU maximum overcurrent protection from any one string as the current will always be equal across the strings on the DCU string side (output side). For all SolarEdge optimizers refer to the stated 'Maximum Output Current' for the value of  $I_{F \text{ STRINGS}}$ .

With SolarEdge systems sources not originating at the PV modules will only refer to batteries. Overcurrent protection is required as the output current of the battery will in most cases exceed the DCU maximum overcurrent protection of the string. The SolarEdge DC Combiner includes fusing (overcurrent protection) on both + and – conductors as defined by the Standard. If the SESTI products are being used for battery installation then we recommend external fusing (overcurrent protection) be installed as part of the system installation.

As the PV module has the overcurrent protection by the DCU between it and the rest of the String  $I_{MOD \text{ MAX OCPR}}$  does not apply as technically every module has overcurrent protection from the DCU itself.

For PV only installations  $I_{F \text{ STRINGS}} + I_{BF \text{ TOTAL}}$  refer to the stated 'Maximum Output Current' for the SolarEdge optimizers being used, additional overcurrent protection is not required.

## PV array maximum voltage calculation

**Clause 4.2.1.3.3** - Systems containing DCUs on all modules, states the following:

*PV array maximum voltage calculation applied to system containing DCUs ( $V_{\text{DCU string max}}$ ) on all modules shall be calculated as:*

- (a)  $V_{\text{DCU string max}} = V_{\text{DCU max}} \times \text{number of DCUs in series}$*
- (b) Calculated in accordance with IEC 62548*

Whereby:  $V_{\text{DCU string max}} = \text{DCU string maximum output voltage}$

$V_{\text{DCU max}} = \text{DCU maximum output voltage}$

The defined test requirements of IEC 62548 are as follows:

### Conclusion:

All SolarEdge Optimizer, Inverter (PCE) combinations, as defined within the SolarEdge published documentation have satisfied the requirements of IEC 62548 testing procedures and as such the PV array maximum voltage threshold shall be taken as the maximum DC input threshold of the given inverter therefore  $V_{\text{DCU string max}}$  shall be specified by the inverter max Vdc input threshold and no string calculation is required.

## Requirements for selection of cables

**Clause 4.4.2.1** General, states the following:

*The requirements for the selection of cables in this Clause relates to PV d.c. cables. For the selection of earth cables and other cables, refer to AS/NZS 3000.*

*PV d.c. cables shall:*

(a) *have a voltage rating greater than or equal to the calculated PV d.c. circuit maximum voltage in accordance with Clause 4.2.1.3-*

*(i) for all installations, between the positive conductor and negative conductor; and*

*(ii) for non-separated PCE and functionally earthed installations, between any conductor and earth;*

*NOTE 1 Examples of cable manufacturers' methods to specify rating are 0.6/1kVAC 0.9/1.5kVDC.*

*This indicates:*

*(a) a 600V conductor to earth AC voltage rating and a 1000V conductor to conductor AC voltage*

*(b) a 900V conductor to earth d.c. voltage rating and a 1800V conductor to conductor d.c. voltage rating*

(b) *conform to IEC 62930 where not installed underground;*

*NOTE 2 For cable that installed underground, see Clause 4.4.2.5.*

(c) *be suitable for d.c. application;*

(d) *have each conductor double insulated for where the calculated PV d.c. circuit maximum voltage is above 35 V, see Figure 4.4:*

*NOTE 3 For cables directly terminated to plugs, socket and connectors, see Clause 4.3.8.*

(e) *have a temperature rating appropriate for the application; and*

(f) *if exposed to the environment, be UV-resistant, or be protected from UV light by appropriate protection.*

### Conclusion:

All new installation in accordance to AS/NZS 5033:2021 need to be installed with cable certified and labelled to the new requirements.

For inverter replacements (like for like system replacements / upgrades) then the existing cable can be utilized without the need for upgrading the cable.

When additional PV modules are added, so the overall power rating of the string / array is increased the whole array will need to comply with the requirements of the current standard and therefore the PV array cable will need to be upgraded to the current requirements of the Standard.

## Requirements for overcurrent protection

**Clause 4.5.1** – Selection of power conversion equipment's (PCEs) states the following:

*The voltage rating of the PV input of the PCE shall be at least the voltage of the circuit they will be fitted to according to Clause 4.2.1.3.*

*The current rating of the PV input of the PCE ( $I_{sc\ PV}$ ) shall be at least the current rating of the circuit they will be fitted to according to Clause 4.2.2.*

*Clause 4.2.2 PV d.c. circuit current calculation, and 4.2.2.1 General states that:*

*The amount of current in electrical equipment associated with PV arrays depends on the configuration of the PV arrays .*

*Individual PV modules are current-limited sources. However, because they can be connected in parallel, and connected to external sources (see Clause 3.3), the maximum current in the circuits of the PV system may be much higher and shall be calculated in accordance with Table 4.2.*

*Components and cables shall be rated to carry currents according to this Clause.*

Table 4.2 Note (a) states See Clause 3.3,3 1 for calculation of  $I_{STRING\ MAX}$  in a single string array.

### Conclusion:

SolarEdge compliance / calculations relating to Clause 3.3,3 1 for calculation of  $I_{STRING\ MAX}$  in a single string array has been addressed in this document.

Please Note:

Clause 4.3.10.3 d.c. conditioning units

The following Clause is taken from IEC 62548 ed.1.0, Copyright@ 2016 IEC Geneva, Switzerland.

DCUs shall conform to IEC 62109-1 and any other applicable Part of the IEC 62109 series.

The PV input of DCUs shall be rated for the input circuit calculated PV d.c. circuit maximum voltage.

The PV d.c. circuit of the input of a DCU typically consists of modules only. See Clause 4.2.1.3.1 for calculation of PV d.c. circuit maximum voltage based no the number of modules in the DCU input circuit.

The PV input of DCUs shall have an  $I_{sc\ PV}$  rating of at least  $1.25 \times I_K \times I_{sc\ MOD}$  except where overcurrent protection is provided that is rated to protect the DCU.

All of the SolarEdge optimisers have inbuilt overcurrent protection as detailed on their respective datasheets therefore the products are exempt from the  $I_{sc\ PV}$  rating of at least  $1.25 \times I_K \times I_{sc\ MOD}$  requirement.