Best Practice Isolator Sizing and Installation

Contents

This document has been written to provide CitiSolar contractors with a best practice interpretation of the PGK isolator data sheets in order to install the correct isolator configuration that will meet the Australian Standards. This document is not an accreditation or certification of the PGK isolator brand or product.

Definitions

The term '**poles**' have been commonly used to refer to the positive and negative terminals of an electrical device. For PV systems, this term is used to describe both the isolator terminals and, according to AS/NZS 5033:2014, the array poles, i.e. the PV string conductors. To remove confusion, in this document the term **pole** (or **poles**) is used to describe one switching contact on the isolator, whereas the positive and negative sides of the PV string are referred to as the **'positive circuit'** and **'negative circuit'.** This means that there can be one or a number of **poles** connected together (in series or parallel configuration) that make up the **positive circuit** at the isolator. The same can be said on the negative connection at the isolator. In Figure 1, this terminology is used to explain the internal connections of a common DC isolator. The bottom diagram indicates the wiring configuration and how each pole is wired within the positive or negative circuit. The diagram on the top shows the physical layout within the actual switch.

According to Clause 1.4.74 AS/NZS 5033: 2014 "**Switch disconnector**" means a "mechanical switching device capable of making, carrying and breaking currents in normal circuit conditions and, when specified, in given operating overload conditions." For the purpose of this document the term **isolator** will refer to **switch disconnector**.

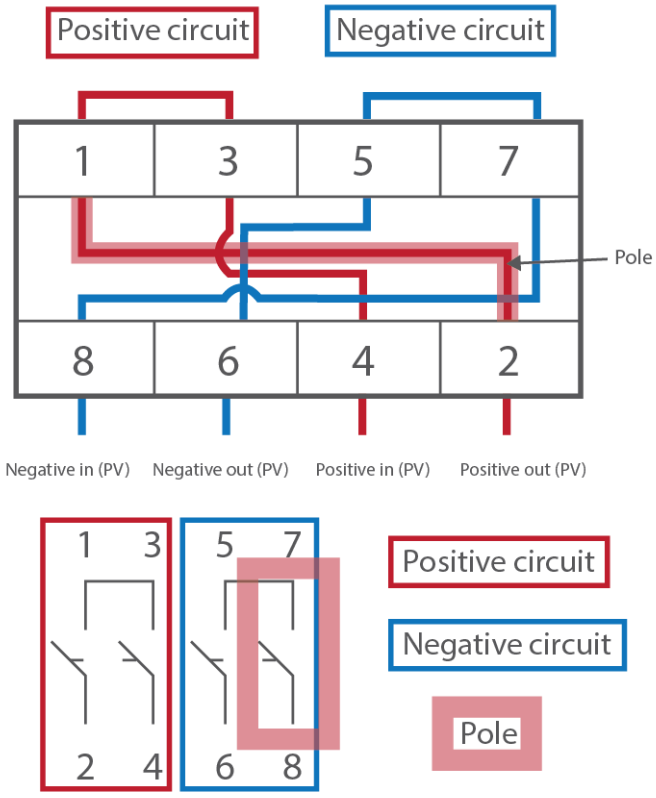


Figure 1. Circuit and Pole Terminology: This is an example of a common isolator configuration of two poles in series for both the positive circuit and the negative circuit.

Isolator Rating Requirements According to AS/NZS5033: 2014 Amendment 2

The required isolator rating will be determined by the type of inverter installed and whether functional earthing is present. For an explanation as to why the isolator requirement is determined this way, please see the GSES document *AS/NZS 5033:2014 Amendment 2 Changes to Isolator Sizing*, which is available on the GSES website https://www.gses.com.au/technical-articles/a-guide-to-as-nzs-50332014-amendment-2-changes-to-isolator-sizing/.

AS/NZS 5033:2014 Amendment 2 applies from 28th June 2019. This means that the applicable isolator utilisation category is now DC-PV2.

Isolators should be rated such that at a voltage rating equal or greater than PV array maximum voltage:

- The thermal current rating corresponding to the isolator's installation location (indoors/outdoors shaded/ outdoors under sun) is greater than the string/array I_{SC} × 1.25 (and any other requirement called up by Table 4.2)
- The I_e current rating for the overall circuit configuration is greater than the string/array I_{SC} × 1.25 (and any other requirement called up by Table 4.2)
- For isolators connected to non-isolated (transformerless) inverters, the $I_{(make)}$ and $I_{c(break)}$ current rating for the positive and negative circuit configuration is greater than string/array I_{SC} × 1.25 (and any other requirement called up by Table 4.2)

This document refers to non-isolated (transformerless) PV systems unless otherwise stated.

Table 1. A summary of DC isolator rating requirements under current standards (AS/NZS 5033:2014 + A2).

Array configuration	Non-isolated PV system*	Isolated PV system†
Isolator rated voltage (U_e)	Equal to or greater than PV array maximum voltage‡	
Isolator rated current (I_e)	Equal to or greater than I_{SC} × 1.25§, for the whole circuit (i.e. positive and negative circuit combined)	
Isolator rated $I_{(make)}$ and $I_{c(break)}$ current	Equal to or greater than I_{SC} × 1.25§, for the positive circuit and the negative circuit individually	Not applicable

*A non-isolated PV system is a system that has a transformerless (non-separated) inverter.
†An isolated PV system is a system using a transformer (separated) inverter.
‡PV array maximum voltage is the maximum system V_{OC} at minimum temperature. Clause 4.2 AS/NZS 5033:2014
§Applicable for the majority of systems, but not all. Clause 4.3.5.1 and Table 4.2 AS/NZS 5033:2014
NOTE: Systems with functional earthing require the same isolator ratings as non-isolated PV systems.

Examples of Applying the Standard and Selecting the Isolator Configuration

This document covers the application of the standard once the PV Array maximum voltage and maximum current have been calculated. The PV array maximum voltage and maximum short circuit voltage values will be assumed to be the following:

Example	PV Array Maximum Voltage (Voc x 1.1, or calculate using local minimum condition)	Maximum Short Circuit Current (Isc × 1.25)
One	450V	14.8A
Two	935V	22.5A
Three	550V	12.25A

Please note that there is more than one correct solution for each example. The primary purpose of these examples is to highlight the methodology that must be applied to determine the appropriate isolator model and configuration for safe operation in fault conditions.

Calculating PV array maximum voltage

To calculate PV array maximum voltage, apply the site-specific voltage correction factor to the array open circuit voltage (Voc). AS5033:2014 Table 4.1 can be used to calculate the PV array maximum voltage. An extract of the table is reproduced below.

VOLTAGE CORRECTION FACTORS FOR CRYSTALLINE AND MULTI-CRYSTALLINE SILICON PV MODULES

Lowest expected operating temperature °C	Correction factor
19 to 15	1.04
14 to 10	1.06
9 to 5	1.08
4 to 0	1.10
−1 to −5	1.12
−6 to −10	1.14
−11 to −15	1.16
−16 to −20	1.18

Calculating PV array maximum voltage using AS5033:2014 Table 4.1

If an array comprises a string of 22 modules, each having a nameplate Voc of 38.64V and Isc of 9.6A at STC, and the lowest temperature of the site is 3°C, the PV array maximum voltage is calculated as follows:

From the table provided, the derating factor of 1.1 is appropriate.

PV array maximum voltage = 22 × 38.64V × 1.1 = 935.09V

PV array maximum short circuit current = 9.6 × 1.25 = 12A

Example One

For this array, the calculated array maximum voltage and short circuit current values are 450V and 14.8A. The isolator at the specified configuration must have a minimum rating larger than these values.

This is an example of a residential system. A single string of modules is connected to the rooftop isolator, the ground isolator and the transformerless inverter. The PGK SE030A isolator, which is rated up to 1000V, is considered for the rooftop isolator. The installer intends to use all four poles of the isolator.

From the datasheet:

		U_e rated operational voltage DC Volts	I_e; DC-PV2 rated operational current Amps	$I_{(make)}$ and $I_{c(break)}$ DC-PV2 4 x I_e Amps
I_{the} solar current value outdoors at 60°C shade ambient air temperature (see D.8.3.11,table D3), with solar effects in a specific dedicated enclosure rated IP66NW	Step 1 29 amps			
2 pole	(1/2/__)	≤500	32	128 Step 3
		600	13	52
		800	9	36
		1000	9	36
4 pole	(1/2/3/4/__)	Step 2 ≤500	32	128
		600	32	128
		800	32	128
		1000	32	128

Step 1: Check current carrying capacity against the appropriate thermal current rating.

As the rooftop isolator will be in the sun, use the I_{the} value rated at 60°C with solar effects (note: the isolator is shaded by its enclosure and a metallic shroud, which is why the rating is for 'shade ambient air temperature). This value is 29A, which is greater than the required 14.8A.

Step 2: Check the overall current rating is below the rated operational current.

The system voltage is below 500V. When arranged **four poles in series**, the isolator is capable of breaking 32A, which is greater than the required 14.8A.

Step 3: Check the $I_{(make)}$ and $I_{c(break)}$ current rating for the positive and negative circuits individually.

The intended arrangement is to wire **two poles of the isolator in series** for the positive circuit and **two poles of the isolator in series** for the negative circuit. This means that under fault conditions, only two poles of the isolator would be used to break the fault current and voltage.

At 500V, when two of the isolator poles are wired in series, they are capable of breaking 128A under $I_{(make)}$ and $I_{c(break)}$ conditions. This is greater than the required 14.8A.

All three requirements are satisfied. Therefore a 4-pole in series configuration can be used for the proposed array.

Example Two

This example is a large commercial PV system where there are two strings of modules connected in parallel to a transformerless inverter. The calculated maximum voltage and current of this system is 935V and 22.5A. The isolator at the specified configuration must have a minimum rating larger than these values.

The PGK SE030C which is rated up to 1200V, is considered for the isolator adjacent to the array. The installer intends to use all four poles of the isolator.

From the datasheet:

		U_e rated operational voltage DC Volts	I_e; DC-PV2 rated operational current Amps	$I_{(make)}$ and $I_{c(break)}$ DC-PV2 4 x I_e Amps
I_{the} solar current value outdoors at 60°C shade ambient air temperature (see D.8.3.11,table D3), with solar effects in a specific dedicated enclosure rated IP66NW	Step 1 29 amps			
2 pole	(1/2/__)	≤600	32	128
		800	13	52
		1000	9	36 Step 3
		1200	9	36
4 pole	(1/2/3/4/__)	≤600	32	128
		800	32	128
	Step 2	1000	32	128
		1200	32	128

Step 1: Check current carrying capacity against the appropriate thermal current rating.

As the isolator will be in the sun, use the I_{the} value rated at 60°C with solar effects (note: the isolator is shaded by its enclosure, which is why the rating is for 'shade ambient air temperature). This value is 29A, which is greater than the required 22.5A

Step 2: Check the overall current rating is below the rated operational current.

The system voltage is below 1000V. When arranged **four poles in series**, the isolator is capable of breaking 32A at 1000V, which is greater than the required 22.5A.

Step 3: Check the $I_{(make)}$ and $I_{c(break)}$ current rating for the positive and negative circuits individually.

The intended arrangement is to wire **two poles of the isolator in series** for the positive circuit and **two poles of the isolator in series** for the negative circuit. This means that under fault conditions, only two poles of the isolator would be used to break the fault current and voltage.

At 1000V, when two of the isolator poles are wired in series, they are capable of breaking 36A under $I_{(make)}$ and $I_{c(break)}$ conditions. This is greater than the required 22.5A.

All three requirements are satisfied. Therefore a 4-pole in series configuration can be used for the proposed array.

Example Three

A residential sub-array has a calculated maximum array voltage of 550V and a calculated maximum current of 12.25A (adjustment factors applied).

The PGK SE030A which is rated up to 1000V, is considered for use as the isolator adjacent to the inverter, located indoors within the garage and within its own enclosure. The installer intends to use only two poles of the isolator.

From the datasheet:

I_{th} rated thermal current, unenclosed, at 40°C shade ambient air temperature	Step 1 32 amps		
I_{the} rated thermal current, indoors, at 40°C shade ambient air temperature, in a specific dedicated enclosure	32 amps		
I_{the} rated thermal current outdoors at 40°C shade ambient air temperature without solar effects in a specific dedicated enclosure rated IP66NW	32 amps		
I_{the} solar current value outdoors at 60°C shade ambient air temperature (see D.8.3.11,table D3), with solar effects in a specific dedicated enclosure rated IP66NW	29 amps		
	U_e rated operational voltage DC Volts	I_e; DC-PV2 rated operational current Amps	$I_{(make)}$ and $I_{c(break)}$ DC-PV2 4 x I_e Amps
2 pole (1/2/)	≤500	32	128
	Step 2 600	13	52
	800	9	36
	1000	9	36
4 pole (1/2/3/4/)	≤500	32	128
	600	32	128
	800	32	128
	1000	32	128

Main Contacts		Type		Appendix B5
Rated thermal current I_{the}		A	32	Making &
Rated insulation voltage U_i		V	1200	Breaking
Distance of contacts (per pole)		mm	8	5x
Rated operational current Ie (**DC-PV2**)				operations
1 pole 1 (1/)	300V	A	25	100
	400V	A	10	40
	500V	A	8	32
	600V	A	8	32 Step 3
	800V	A	3	12
	1000V	A	2	8

Step 1: Check current carrying capacity against the appropriate thermal current rating.

As the isolator will be indoors, use the I_{the} value rated at 40°C with solar effects (note: the isolator is shaded by its enclosure, which is why the rating is for 'shade ambient air temperature). This value is 32A, which is greater than the required 12.25A

Step 2: Check the overall current rating is below the rated operational current.

The system voltage is below 600V. When arranged **two poles in series**, the isolator is capable of breaking 13A at 600V, which is greater than the required 12.25A.

Step 3: Check the $I_{(make)}$ and $I_{c(break)}$ current rating for the positive and negative circuits individually.

The intended arrangement is to wire **a single pole of the isolator** for the positive circuit and **a single pole of the isolator** for the negative circuit. This means that under fault conditions, only one pole of the isolator would be used to break the fault current and voltage.

At 600V, when only a single pole of the isolator is used, the isolator is capable of breaking 32A under $I_{(make)}$ and $I_{c(break)}$ conditions. This is greater than the required 12.25A.

Note that the single pole information is available on the last page of the datasheet in a separate table.

All three requirements are satisfied. Therefore a 2-pole in series configuration can be used for the proposed sub-array.

Interpreting the PGK Manufacturer Data Sheets

Isolator best practice:

1. The positive and negative circuits of an array cannot be connected to separate switches, as switch-disconnectors shall interrupt all live conductors simultaneously. If the isolator selected does not meet the PV Array Max Voltage and Maximum current ratings of the array, a higher rated isolator is required. (reference: AS5033:2014 A2 Clause 4.3.5.2 (c))
2. AS/NZS 5033:2014 Clause 4.3.3.1 states “Cables and conduits shall not enter the top entry face of the enclosure.” It is required that all cable entries are made through the bottom entry where practicable; side entry is only allowed where entry points are supplied by the enclosure and where bottom entry is not possible.
   To maintain this IP rating, it is recommended that the supplied mounting brackets are used to avoid penetration of the isolator enclosure (Figure 2) and the isolator is mounted in an appropriate location. Stainless steel screws should be used to avoid corrosion of attachment points.

Figure 2. Rear photograph of the PGK isolator. The attachment points using the supplied bracket are clearly marked.

3. The maximum permissible PV system voltage for a residential solar system is 600V. Higher voltage is allowed for commercial systems, but there must now be adequate restricted access to the isolators (Reference: AS/NZS5033: 2014 Clause 3.1.)
4. Take note of the installation location of the isolator to determine the appropriate rated thermal current (I_{the}) to use:
   a. If installed indoors, use I_{the} rated thermal current **indoor** at **40°C shade** ambient air temperature in a specific dedicated enclosure
   b. If installed outdoors under shade, use I_{the} rated thermal current **outdoor** at **40°C shade** ambient air temperature **without solar effects,** in a specific dedicated enclosure
   c. If installed outdoors exposed to sunlight, use I_{the} solar current value **outdoor** at **60°C shade** ambient air temperature **with solar effects** in a specific dedicated enclosure.

Connection diagrams are provided by the manufacturers to illustrate the isolator’s internal connections and isolator ratings for different configurations. However, these diagrams should not be used to determine the isolator rating, as **the description matching the connection diagrams do not describe all the cases that need to be considered for non-isolated PV systems.** This problem is explained with Figure 3 and Figure 4.

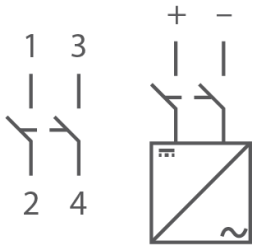


Figure 3: A typical 'two poles in series' connection diagram provided by a manufacturer.

Manufacturers may provide the connection diagram shown in Figure 3 for two poles in series. When the isolator is connected to a non-isolated system, the **single pole** rating, as well as the two poles in series rating, must be used to meet the isolator rating requirements. This is because only one pole is being used per string conductor for the positive and negative circuit. The single pole ratings of the isolator must be used to assess the isolator's rating under fault condition.

Similarly, consider the typical manufacturer-provided connection diagram in Figure 4.

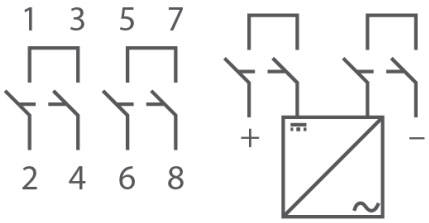


Figure4: A typical 'four poles in series' connection diagram provided by a manufacturer.

When a non-isolated system is connected as shown in Figure 4, **the two poles in series** rating, as well as the four poles in series rating, must be considered because each string conductor uses two poles of the isolator.

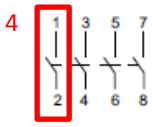
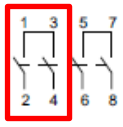
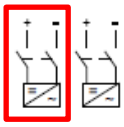
SE030A Isolator Data Sheet and Wiring Configurations

Technical Specifications

Technical Specifications		
Type		1 SE030A, SE030B, SE030E, SE042E, SE042B, SE042H
Function		Isolator, Control
Standard		IEC60947-3, AS60947.3
Utilization category		2 DC-PV2 / DC-21B
Pole		4P
Rated frequency		DC
Rated operational voltage (U_e)		3 500V, 600V, 800V, 1000V
Rated operational current (I_e)		See the next page
Rated insulation voltage (U_i)		1200V
Conventional free air thermal current(I_{th})		//
Conventional enclosed thermal current(I_{the})		Same as I_e
Rated short-time withstand current (I_{cw})		1kA, 1s (4, 4S,4B); 1.7kA, 1s (2H)
Rated short-time making capacity (I_{cm})		1.7kA (4, 4S,4B); 3kA (2H)
Rated conditional short-circuit current (I_{cn})		3kA
Rated impulsed withstand voltage (U_{imp})		8.0kV
Overvoltage category		II
Suitability for isolation		Yes
Polarity		No polarity, "+" and "-" polarities could be interchanged.
Mechanical		15000
Electrical		1000
Ingress Protection	Enclosure	IP66
	Switch body	IP20
Storage Temperature		-5°C ~ +85°C
Mounting Type		Vertically or horizontally
Pollution degree		3
Suitable environment		Outdoor / Indoor

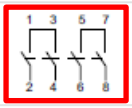
1. Isolator's catalogue number identification.
2. Utilization Category. All isolators must be rated DC-PV2 according to AS 60947.3
3. Rated Operational Voltage (U_e).
    - This voltage refers to the voltage range the isolator is able to break. To size the isolator, the current rating corresponding to the required voltage rating must be met for normal operating condition and fault conditions.

Switching Configurations

Type	4-pole	4-pole with Input and Output bottom
/	4	4B
Contacts Wiring graph	4 	6 
Switching example	5 	7 

4. Single pole configuration for both positive and negative circuit
5. Overall configuration uses two-poles in series per inverter. the positive circuit passes through a single pole and the negative circuit also passes through a single pole. Note that while all four poles are utilised in this arrangement, the overall configuration for each inverter is **two poles in series**, and for each inverter entry, the positive circuit passes through a single pole and the negative circuit also passes through a single pole.
6. Two poles in series configuration for both the positive and negative circuit.
7. Overall configuration uses **four-poles in series** per inverter. The positive circuit passes through two poles and the negative circuit also passes through two poles.

Wiring Diagram for Rated operational voltage Ue (V) & Rated operational current Ie (A)

Contacts wiring diagram	8 300V	500V	600V	800V	1000V	9 Poles in series	Number of Strings	Type Number
10 	11 32A	32A	13A	9A	9A	2	2	4
12 	13 32A	32A	32A	32A	32A	4	1	4B

8. Selected operating voltages of the Isolator. Note the maximum is 1000V
9. "Poles in Series" represents the overall number of poles used in the "Contact Configuration", the round trip from the positive conductor at the inverter, through the isolator to the array, then from the negative conductor back through the isolator to the inverter.

   Note: the configuration that corresponds to manufacturer's description of four poles in series should also be rated to the two poles in series configuration under fault condition. Similarly, the configuration described as two poles in series should also be rated to the single pole rating under fault condition.
10. Two poles in series comprising a single pole in the positive circuit and a single pole in the negative circuit
11. I_e operation current rating of two poles in series for a range of voltage
12. Four poles in series comprising two poles in the positive circuit and two poles in the negative circuit
13. I_e operation current rating of four poles in series for a range of voltage

Rated Thermal Current

I_{th} rated thermal current, unenclosed, at 40°C shade ambient air temperature	32 amps 14
I_{the} rated thermal current, indoors, at 40°C shade ambient air temperature, in a specific dedicated enclosure	32 amps 15
I_{the} rated thermal current outdoors at 40°C shade ambient air temperature without solar effects in a specific dedicated enclosure rated IP66NW	32 amps 16
I_{the} solar current value outdoors at 60°C shade ambient air temperature (see D.8.3.11,table D3), with solar effects in a specific dedicated enclosure rated IP66NW	29 amps 17

The applicable rated thermal current differs depending on the condition.

14. The rated thermal current if the isolator is installed indoors and not within its own dedicated enclosure (e.g. sharing a switchboard with multiple other isolators)
15. The rated thermal current if the isolator is installed indoors and within its own dedicated enclosure (e.g. each isolator installed within its own case)
16. The rated thermal current if the isolator is installed outdoors within its own dedicated enclosure and not exposed to direct sunlight (e.g. Isolator installed on South-facing wall outdoors under eave)
17. The rated thermal current if the isolator is installed outdoors within its own dedicated enclosure and exposed to direct sunlight (e.g. Isolator installed on roof, isolator installed on east-facing wall outdoors which is exposed to direct sunlight until noon)

Single Pole Rating for PGK SE030A

Main Contacts		**Type**		**Appendix B5**
Rated thermal current I_{the}		A	32	Making &
Rated insulation voltage U_i		V	1000	Breaking
Distance of contacts (per pole)		mm	8	5x
Rated operational current Ie (**DC-PV2**)				operations
1 pole 1	300V	A	25	100
	400V	A	10	40
1	500V	A	8	32
	600V	A	8	32
	800V	A	3	12
	1000V	A	2	8

Note: The definition of $I_{(make)}$ and $I_{c(break)}$ for utilisation category DC- PV2 according to AS60947.3 is four times the I_e voltage rating

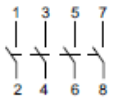
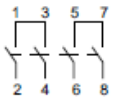
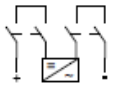
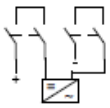
SE030C Switch Disconnector Data Sheet and Wiring Configurations

Technical Specifications

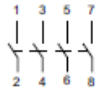
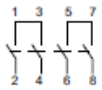
Technical Specifications		
Type		18 SE030C, SE030D, SE030F, SE042F, SE042D, SE042I SE030N, SE030M
Function		Isolator, Control
Standard		IEC60947-3, AS60947.3
Utilization category		19 DC-PV2 / DC-21B
Pole		4P
Rated frequency		DC
Rated operational voltage (U_e)		20 600V, 800V, 1000V, 1200V
Rated operational current (I_e)		See the next page
Rated insulation voltage (U_i)		1200V
Conventional free air thermal current(I_{th})		//
Conventional enclosed thermal current(I_{the})		Same as I_e
Rated short-time withstand current (I_{cw})		1kA,1s (4, 4S,4B); 1.7kA, 1s (2H)
Rated short-time making capacity (I_{cm})		1.7kA (4, 4S,4B); 3kA (2H)
Rated conditional short-circuit current (I_{cn})		3kA
Rated impulsed withstand voltage (U_{imp})		8.0kV
Overvoltage category		II
Suitability for isolation		Yes
Polarity		No polarity, "+" and "-" polarities could be interchanged.
Mechanical		15000
Electrical		1000
Ingress Protection	Enclosure	IP66
	Switch body	IP20
Storage Temperature		-5°C ~ +85°C
Mounting Type		Vertically or horizontally
Pollution degree		3
Suitable environment		Outdoor / Indoor

18. Isolator's catalogue number identification.
19. Utilization Category. All isolators must be rated DC-PV2 according to AS 60947.3
20. Rated Operational Voltage (U_e).
    - This voltage refers to the voltage range the isolator is able to break. To size the isolator, the current rating corresponding to the required voltage rating must be met for normal operating condition and fault conditions.

Switching Configurations

Type	4-pole	4-pole with Input and Output bottom	
/	4	4B	
Contacts Wiring graph			
Switching example			

Note: the SE030C isolator offers the same pole and leg configurations as the SE030A

Contacts wiring diagram	21 300V	600V	800V	1000V	1200V	Poles in series	Number of Strings	Type Number
	32A	32A	13A	9A	9A	2	2	4
	23 32A	32A	32A	32A	32A	4	1	4B
						22		

21. Selected operating voltages of the isolator. Maximum voltage rating of the SE030C isolator is 1200V.
22. "Poles in Series" represents the overall number of poles used in the "Contact Configuration", the round trip from the positive conductor at the inverter, through the isolator to the array, then from the negative conductor back through the isolator to the inverter.
23. I_e operation current rating for the number of poles in series. Configuration and current rating for the SE030C at 1200V is similar to the 1000V SE030A isolator. Note that the isolator SE030C has improved current rating at higher voltages (e.g. 800V).

Rated Thermal Current

The SE030C isolator offers the same thermal current ratings as the SE030A.

Single Pole Rating for PGK SE030C

Main Contacts		Type		Appendix B5
Rated thermal current I_{the}		A	32	Making &
Rated insulation voltage U_i		V	1200	Breaking
Distance of contacts (per pole)		mm	8	5x
Rated operational current Ie (**DC-PV2**)				operations
1 pole 1 1	300V	A	25	100
	400V	A	10	40
	500V	A	8	32
	600V	A	8	32
	800V	A	3	12
	1000V	A	2	8

Note: The definition of $I_{(make)}$ and $I_{c(break)}$ for utilisation category DC- PV2 according to AS60947.3 is four times the I_e voltage rating

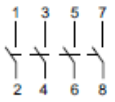
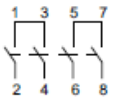
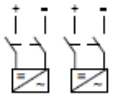
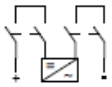
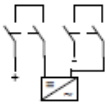
SE030G Isolator Data Sheet and Wiring Configurations

Technical Specifications

Technical Specifications		
Type		24 SE030G, SE030L, SE030K
Function		Isolator, Control
Standard		IEC60947-3, AS60947.3
Utilization category		25 DC-PV2 / DC-21B
Pole		4P
Rated frequency		DC
Rated operational voltage (U_e)		26 300V, 600V, 1000V,1200V, 1500V
Rated operational current (I_e)		See the next page
Rated insulation voltage (U_i)		1500V
Conventional free air thermal current(I_{th})		//
Conventional enclosed thermal current(I_{the})		Same as I_e
Rated short-time withstand current (I_{cw})		1.5kA,1s
Rated short-time making capacity (I_{cm})		2kA
Rated conditional short-circuit current (I_{cn})		3kA
Rated impulsed withstand voltage (U_{imp})		8.0kV
Overvoltage category		II
Suitability for isolation		Yes
Polarity		No polarity, "+" and "-" polarities could be interchanged.
Mechanical		10000
Electrical		1000
Ingress Protection	Enclosure	IP66
	Switch body	IP20
Storage Temperature		-5°C ~ +85°C
Mounting Type		Vertically or horizontally
Pollution degree		3
Suitable environment		Outdoor / Indoor

24. Isolator's catalogue number identification.
25. Utilization Category. All isolators must be rated DC-PV2 according to AS 60947.3
26. Rated Operational Voltage (U_e).
    - This voltage refers to the voltage range the isolator is able to break. To size the isolator, the current rating corresponding to the required voltage rating must be met for normal operating condition and fault conditions.

Switching Configurations

Type	4-pole	4-pole with Input and Output bottom	
/	4	4B	
Contacts Wiring graph			
Switching example			

Note: the SE030G isolator offers the same pole and leg configurations as the SE030A and SE030C.

Wiring Diagram for Rated operational voltage Ue (V) & Rated operational current Ie (A)

Contacts wiring diagram	300V	600V	1000V	1200V	1500V	Poles in series	Number of Strings	Type Number
	50A	50A	50A	32A	16A	2	2	4
	50A	50A	50A	50A	35A	4	1	4B

27

29

28

27. Selected operating voltages of the Isolator. Note the maximum voltage is 1500V
28. "Poles in Series" represents the overall number of poles used in the "Contact Configuration", the round trip from the positive conductor at the inverter, through the isolator to the array, then from the negative conductor back through the isolator to the inverter.

    The configuration that corresponds to manufacturer's description of four poles in series should also be rated to the two poles in series configuration under fault condition. Similarly, the configuration described as two poles in series should also be rated to the single pole rating under fault condition.
29. I_e operation current rating for the number of poles in series. Configuration for the SE030G is similar to the other models, however this isolator has a much higher current rating for the given range of rated operational voltages.

Rated Thermal Current

I_{th} rated thermal current, unenclosed, at 40°C shade ambient air temperature	50 amps 30
I_{the} rated thermal current, indoors, at 40°C shade ambient air temperature, in a specific dedicated enclosure	50 amps 31
I_{the} rated thermal current outdoors at 40°C shade ambient air temperature without solar effects in a specific dedicated enclosure rated IP66NW	50 amps 32
I_{the} solar current value outdoors at 60°C shade ambient air temperature (see D.8.3.11,table D3), with solar effects in a specific dedicated enclosure rated IP66NW	50 amps 33

The applicable rated thermal current differs depending on the condition.

30. The rated thermal current if the isolator is installed indoors and not within its own dedicated enclosure (e.g. sharing a switchboard with multiple other isolators)
31. The rated thermal current if the isolator is installed indoors and within its own dedicated enclosure (e.g. each isolator installed within its own case)
32. The rated thermal current if the isolator is installed outdoors within its own dedicated enclosure and not exposed to direct sunlight (e.g. Isolator installed on South-facing wall outdoors under eave)
33. The rated thermal current if the isolator is installed outdoors within its own dedicated enclosure and exposed to direct sunlight (e.g. Isolator installed on roof, isolator installed on east-facing wall outdoors under eave which shades the inverter but not the isolator)

Single Pole Rating for PGK SE030G

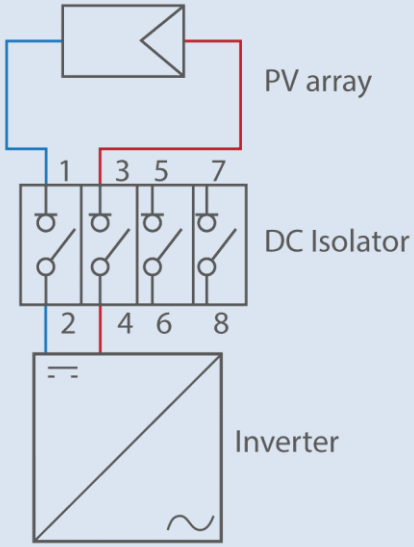
Main Contacts		Type		Appendix B5
Rated thermal current I_{the}		A	32	Making &
Rated insulation voltage U_i		V	1200	Breaking
Distance of contacts (per pole)		mm	8	5x
Rated operational current Ie (**DC-PV2**)				operations
1 pole 1	300V	A	25	100
	400V	A	10	40
1	500V	A	8	32
	600V	A	8	32
	800V	A	3	12
	1000V	A	2	8

Note: The definition of $I_{(make)}$ and $I_{c(break)}$ for utilisation category DC- PV2 according to AS60947.3 is four times the I_e voltage rating.

Australian Standard and CEC Guideline Compliant PGK Isolator Installation Guide

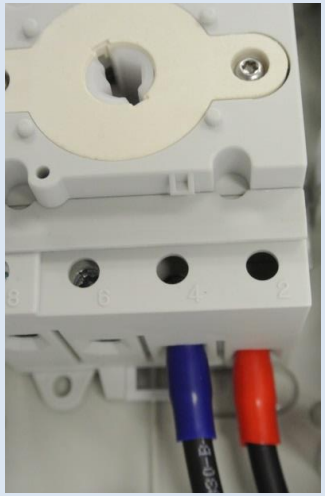
**Note The thermal current rating I_{the} is not reproduced here. The system designer must refer to the I_{the} which best fits the installation location of the isolator. These ratings should be used in conjunction with array voltage and current ratings outlined in AS5033:2014.*

SE030A 1000V 32A

Configuration	Electrical Wiring	Isolator Wiring Picture	Configuration Voltage and Current Rating
One pole used for positive and negative circuit.		 Top View	Applicable I_e current rating

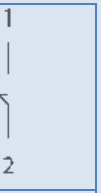
Overall Circuit Configuration	
250V	32A
500V	32A
600V	13A
800V	9A
1000V	9A

Front View

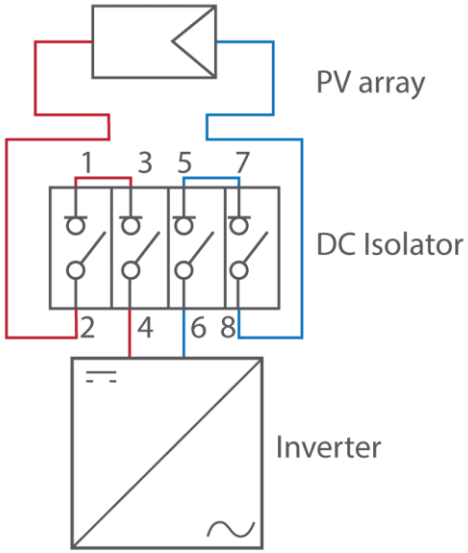


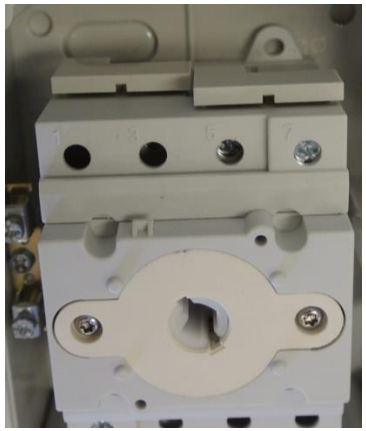
Bottom View

Applicable $I_{(make)}$ and $I_{c(break)}$ current rating

Positive/ Negative Circuit Configuration	
250V	32A
500V	13A
600V	10A
800V	5A
1000V	2.5A

Two poles in series for both positive and negative circuit

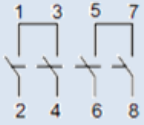


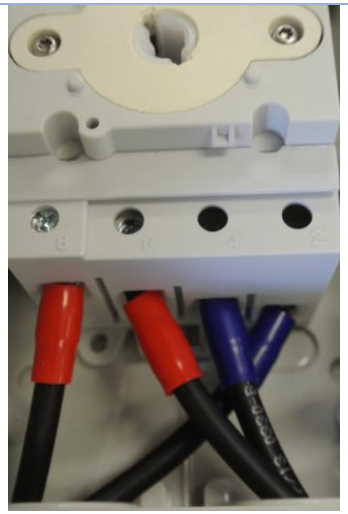


Top View

Front View

Applicable I_e current rating

Overall Circuit Configuration	
500V	32A
600V	32A
800V	32A
1000V	32A

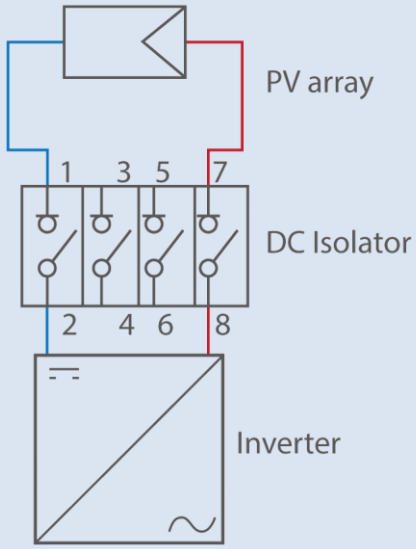


Bottom View

Applicable $I_{(make)}$ and $I_{c(break)}$ current rating

Positive/ Negative Circuit Configuration	
500V	128A
600V	52A
800V	36A
1000V	36A

SE030C 1200V 32A

<table>
<tr><th>Configuration</th><th>Electrical Wiring</th><th>Isolator Wiring Picture</th><th>Configuration Voltage and Current Rating</th></tr>
<tr>
<td>One pole used for positive and negative circuit.</td>
<td> 
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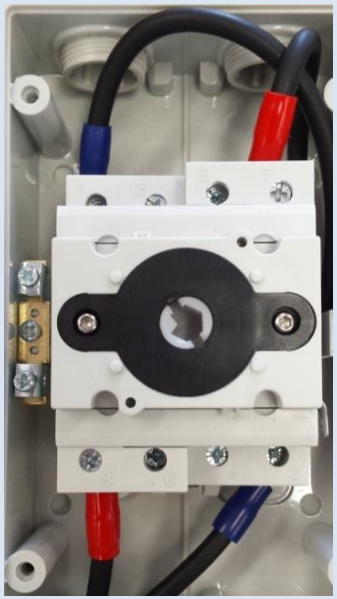
<td> 
Front view</td>
<td>Applicable I_e current rating
<table>
<tr><th>Overall Circuit Configuration</th><td> 
</td></tr>
<tr><td>600V</td><td>32A</td></tr>
<tr><td>800V</td><td>13A</td></tr>
<tr><td>1000V</td><td>9A</td></tr>
<tr><td>1200V</td><td>9A</td></tr>
</table>
Applicable $I_{(make)}$ and $I_{c(break)}$ current rating
<table>
<tr><th>Positive/ Negative Circuit Configuration</th><td> 
</td></tr>
<tr><td>600V</td><td>32A</td></tr>
<tr><td>800V</td><td>12A</td></tr>
<tr><td>1000V</td><td>8A</td></tr>
<tr><td>1200V</td><td>Not available</td></tr>
</table></td>
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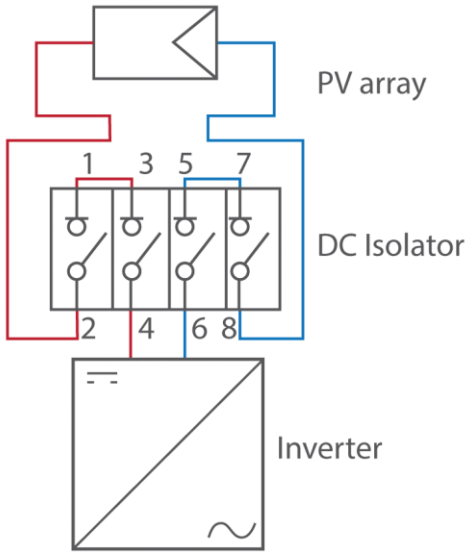
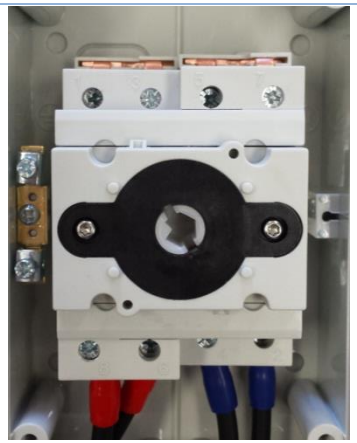
</table>

Two poles in series for both positive and negative circuit

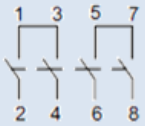




Front View

Bottom View

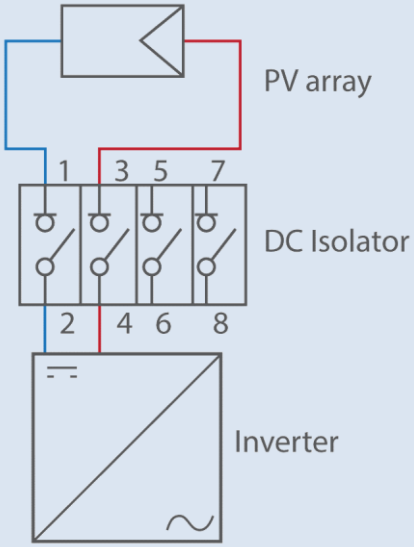
Applicable I_e current rating

Overall Circuit Configuration	
600V	32A
800V	32A
1000V	32A
1200V	32A

Applicable $I_{(make)}$ and $I_{c(break)}$ current rating

Positive/ Negative Circuit Configuration	
600V	32A
800V	13A
1000V	9A
1200V	9A

SE030G 1500V 32A

<table>
<tr><th>Configuration</th><th>Electrical Wiring</th><th>Isolator Wiring Picture</th><th>Configuration Voltage and Current Rating</th></tr>
<tr>
<td>One pole used for positive and negative circuit.</td>
<td> 
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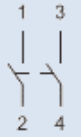
<td> 
Front View</td>
<td>
Applicable I_e current rating
<table>
<tr><th>Overall Circuit Configuration</th><th> 
</th></tr>
<tr><td>300V</td><td>50A</td></tr>
<tr><td>600V</td><td>50A</td></tr>
<tr><td>1000V</td><td>50A</td></tr>
<tr><td>1200V</td><td>32A</td></tr>
<tr><td>1500V</td><td>16A</td></tr>
</table>
Applicable $I_{(make)}$ and $I_{c(break)}$ current rating
<table>
<tr><th>Positive/ Negative Circuit Configuration</th><th> 
</th></tr>
<tr><td>300V</td><td>100A</td></tr>
<tr><td>600V</td><td>32A</td></tr>
<tr><td>1000V</td><td>8A</td></tr>
<tr><td>1200V</td><td>Not available</td></tr>
<tr><td>15000V</td><td>Not available</td></tr>
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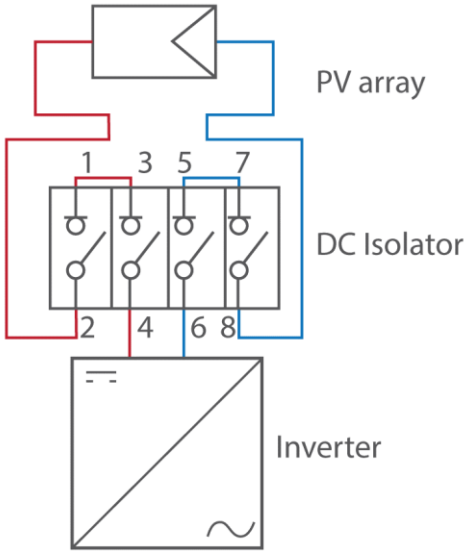
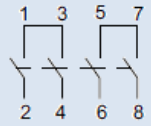
Two poles in series for both positive and negative circuit



Top View

Front View

Applicable I_e current rating

Overall Circuit Configuration 	
300V	50A
600V	50A
1000V	50A
1200V	50A
1500V	35A

Applicable $I_{(make)}$ and $I_{c(break)}$ current rating

Positive/ Negative Circuit Configuration 	
300V	200A
600V	200A
1000V	200A
1200V	128A
15000V	64A

		 Bottom View	