Samil Power
Expert for PV Grid-tied Inverters

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Frequency Asked Questions

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1 Question: What's PV inverter?

1.1 Answer:

Inverter is a device that converts DC electricity from PV panels into AC electricity. It is equipment that converts direct current from the array field to alternating current. The electric equipment used to convert electrical power into a form or forms of electrical power suitable for subsequent use by the electric utility.

2 Question: What is the task of an MPP Tracker?

2.1 Answer:

Depending on the solar irradiation and the module temperature, the PV array provides varying power. The MPP Tracker of the inverter ensures that despite varying array values (voltage and current), the point of highest power can be detected and configured at all times. This therefore influences the yield of a PV plant. MPP is the abbreviation for Maximum Power Point. This is the point at which the product of current and voltage is at a maximum.

3 Question: What is meant by the MPP voltage range?

3.1 Answer:

The MPP voltage range denotes the voltage range of an inverter in which the MPP Tracker of an inverter can set the maximum power point in order to operate the PV modules at maximum power.

MPP is the abbreviation for Maximum Power Point. This is the point at which the product of current and voltage is at a maximum.

4 Question: From what plant size is lightning protection needed?

4.1 Answer:

This depends on different plan size. In principle, a distinction must be made between public and private buildings. The plant size is also a factor.

On public buildings (schools, for example), the building ordinance in the region in question governs the installation of lightning protection systems to the required standard. The electrically qualified person needs to design and install the lightning protection system, or contract a suitable lightning protection company to do so. Thus, the electrically qualified person can be held liable for proper installation. The associated provisions can be found in standard VDE0185, Parts 1-4.

For plants on private buildings with a power below 10 kWp, the plant operator can decide whether or not to install lightning protection.

The VDS (German Property Insurers' Association) often stipulates internal and external lightning protection as of a plant size of 10 kWp. If this requirement is not met, the insurance company may decline to provide insurance coverage for the plant.

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5 Question: Can the noise generation of our inverters be a disturbance in everyday life?

5.1 Answer:

Because conversion is not entirely without noise, please take the installation site into consideration. Unfortunately, the conversion of direct current into alternating current cannot be performed without any noise. Therefore, we recommend not installing the inverters directly in the living area, but rather in a protected area outdoors, a garage, or in a suitable cellar space.

Further information on the installation site requirements can be found in the installation manual that is included with every inverter. Alternatively, the manuals are also available on the SamilPower website, in the download area for the relevant inverter.

As a rule, the relevant values of all our inverters comply with or are even below the permissible limiting values for noise emissions.

Furthermore, when the inverter is not feeding in power to the power distribution grid, it switches off automatically and disconnects all poles from the power distribution grid. In this status, the inverter does not make any noise.

6 Question: What influence does a line voltage smaller than the nominal value of the power distribution grid (e.g. 230 V) have on the feed-in operation of the inverters?

6.1 Answer:

If the line voltage currently present on the inverter does not reach the official nominal value of the power distribution grid of e.g. 230 V/400 V, this may influence the plant yield, depending on the size of the deviation.

The reason for this is that the maximum feed-in current of each inverter is restricted to protect the inverter. For every line voltage, current limiting automatically results in corresponding maximum feed-in capacity of the inverter. As a result of this control, it may not be possible to feed the maximum possible energy that the PV array makes available at the time into the power distribution grid.

Our inverters have been dimensioned such that normal fluctuations in the line voltage cannot cause any restrictions in power. The limiting value of the line voltage, below which the inverter cannot feed in its maximum output power, comes from the maximum output current on the datasheet.

However, it is difficult to estimate the precise extent of the yield loss caused by insufficient line voltage. For a precise calculation you would need to know the behavior over time of the line voltage and the solar irradiation at those times, which are not available in almost all cases.

If the line voltage is continually too low, we recommend contacting the responsible

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distribution grid operator. In contacting the distribution grid operator, you can clarify whether the supply voltage for the feed-in point can be increased.

7 Question: would it be useful to have additional cooling of the inverter?

7.1 Answer:

Additional cooling is not necessary. As a rule, no additional cooling is required for our inverters since they come equipped with an efficient temperature management system. It only makes sense if the inverter is installed in an environment with a very high ambient temperature, meaning the inverter cannot release the heat generated during operation to the environment quickly enough (non-compliance with the installation manual!). External measures for cooling the inverter are generally tailored to the respective plant, meaning we are unfortunately unable to make any statements on the effectiveness of these measures or their impact on the plant yield. It is essential that any additional cooling measures do not result in interventions or modifications to the inverter as, if this were the case, the warranty and guarantee covering the device would be voided.

8 Question: How much space is needed for my PV system installation?

8.1 Answer:

Our grid connected systems start from around 1kW peak power, this occupies about 6-8 square meters on your roof.

9 Question: How much do the PV solar panel weight?

9.1 Answer:

Normally about 12kg per m^2.

10 Question: What's difference between three-phase and single phase?

10.1 Answer:

Normally, three phase system with the following characteristics:
Electric symmetry of the power generation units, i.e.:

- the r.m.s. values of the three phase to neutral or line voltages, respectively, are equal,
- all voltages have the same frequency f or angular frequency $\varpi = 2\pi f$,
- the phase displacement between the individual voltages is 120°;
- symmetrically designed equipment, i.e. equal positive-sequence and negative-sequence impedances;
- symmetric loading

11 Question: What's active power, reactive power and apparent power for PV inverter?

11.1 Answer:

In a simple alternating current (AC) circuit consisting of a source and a linear load, both

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the current and voltage are sinusoidal. If the load is purely resistive, the two quantities reverse their polarity at the same time. At every instant the product of voltage and current is positive; indicating that the direction of energy flow does not reverse. In this case, only real power is transferred.

If the loads are purely *reactive*, then the voltage and current are 90 degrees out of phase. For half of each cycle, the product of voltage and current is positive, but on the other half of the cycle, the product is negative, indicating that on average, exactly as much energy flows toward the load as flows back. There is no net energy flow over one cycle. In this case, only reactive energy flows—there is no net transfer of energy to the load.

Practical loads have resistance, inductance, and capacitance, so both real and reactive power will flow to real loads. Power engineers measure apparent power as the magnitude of the vector sum of real and reactive power. Apparent power is the product of the root-mean-square of voltage and current.

Engineers care about apparent power, because even though the current associated with reactive power does no work at the load, it heats the wires, wasting energy. Conductors, transformers and generators must be sized to carry the total current, not just the current that does useful work.

Another consequence is that adding the apparent power for two loads will not accurately give the total apparent power unless they have the same displacement between current and voltage (the same power factor).

Conventionally, capacitors are considered to generate reactive power and inductors to consume it. If a capacitor and an inductor are placed in parallel, then the currents flowing through the inductor and the capacitor tend to cancel rather than add. This is the fundamental mechanism for controlling the power factor in electric power transmission; capacitors (or inductors) are inserted in a circuit to partially cancel reactive power 'consumed' by the load.

Engineers use the following terms to describe energy flow in a system (and assign each of them a different unit to differentiate between them):

Real power (*P*) or **active power**: [W]

Reactive power (*Q*): [VAr]

Complex power (*S*): [VA]

Apparent Power (|*S*|), that is, the magnitude of complex power *S*: volt-ampere [VA]

Phase of Voltage Relative to Current (φ), the angle of difference (in degrees) between voltage and current; Current lagging Voltage (Quadrant I Vector), Current leading voltage (Quadrant IV Vector)

In the diagram, *P* is the real power, *Q* is the reactive power (in this case positive), *S* is the complex power and the length of *S* is the apparent power.

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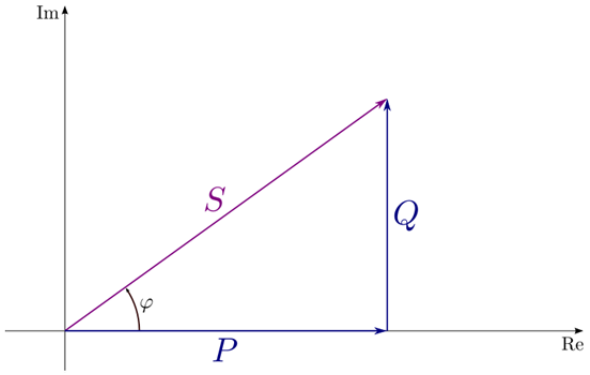

12 Question: For Germany and Italy standards (VDE 4105 and CEI 0-21), the reactive power control is needed. What do the positive or negative reactive power?

12.1 Answer:

Positive reactive power: the generator absorbs reactive power by providing a current later than the voltage;

Negative reactive power: the generator delivers reactive power by providing a current in advance with respect to the voltage.

13 Question: What's harmonic?

13.1 Answer:

A harmonic of a wave is a component frequency of the signal that is an integer multiple of the fundamental frequency, i.e. if the fundamental frequency is f, the harmonics have frequencies 2f, 3f, 4f, . . . etc. The harmonics have the property that they are all periodic at the fundamental frequency; therefore the sum of harmonics is also periodic at that frequency. Harmonic frequencies are equally spaced by the width of the fundamental frequency and can be found by repeatedly adding that frequency. For example, if the fundamental frequency (first harmonic) is 50 Hz, the frequencies of the next harmonics are: 100 Hz (2nd harmonic), 150 Hz (3rd harmonic), 200 Hz (4th harmonic) etc.

14 Question: What does THD means for PV grid-tied inverters? How about THDi for Samil PV inverters?

14.1 Answer:

The THD is the short name of total harmonic distortion which is defined as:

$$\mathrm{THD_X} = \frac{\sqrt{\sum_{n=2}^{x} X_n^2}}{X_1}$$

Where

X1 is the r.m.s. fundamental voltage or current

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Xn is the r.m.s. harmonic voltage or current of order n
The THDi of all Samil SR/SL/SP inverters is less than 3%.

15 Question: What's islanding? Does Samil Products have islanding protection?

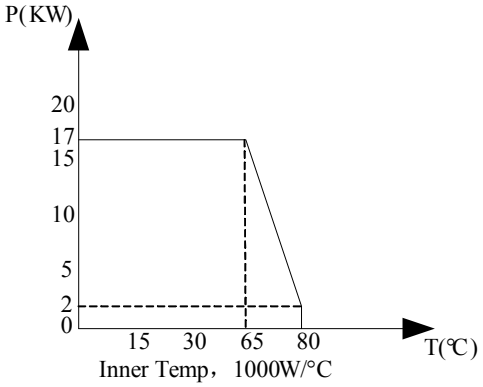
15.1 Answer:

Iintentional Island: an island that is intentionally created, usually to restore or maintain power to a section of the utility grid affected by a fault. The generation and loads may be any combination of customer owned and utility-owned, but there is an implicit or explicit agreement between the controlling utility and the operators of customer-owned generation for this situation.
Unintentional Island: an islanding condition in which the generation within the island that is supposed to cease energizing the utility grid instead continues to energize the utility grid.
All Samil PV grid-connected inverters meet the islanding standards (eg. IEC 62116) in different countries that declared officially on Samil Website.

16 Question: In terms of over-temperature protection, In which degree does Samil PV inverter start derating?

16.1 Answer:

The inverter starts to derate from 45° C and shuts down at 65° C. The environment Temp Derating Curve（Inner Temp 65° C Corresponding to 45° C Outside）is shown as below.



17 Question: What does IP code standard for? Is Samil inverter suitable for outdoor use?

17.1 Answer:

The IP Code, Ingress Protection Rating, sometimes also interpreted as International Protection Rating, classifies and rates the degree of protection provided against the intrusion of solid objects (including body parts like hands and fingers), dust, accidental contact, and water in mechanical casings and with electrical enclosures. It

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is published by the International Electrotechnical Commission (IEC).

Solid particle protection

The first digit indicates the level of protection that the enclosure provides against access to hazardous parts (e.g., electrical conductors, moving parts) and the ingress of solid foreign objects.

Level	Object size protected against	Effective against
0	—	No protection against contact and ingress of objects
1	>50 mm	Any large surface of the body, such as the back of a hand, but no protection against deliberate contact with a body part
2	>12.5 mm	Fingers or similar objects
3	>2.5 mm	Tools, thick wires, etc.
4	>1 mm	Most wires, screws, etc.
5	Dust protected	Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment; complete protection against contact
6	Dust tight	No ingress of dust; complete protection against contact

Liquid ingress protection

The second digit indicates the level of protection that the enclosure provides against harmful ingress of water.

Level	Protected against	Testing for	Details
0	Not protected	—	—
1	Dripping water	Dripping water (vertically falling drops) shall have no harmful effect.	Test duration: 10 minutes Water equivalent to 1 mm rainfall per minute
2	Dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted at an angle up to 15° from its normal position.	Test duration: 10 minutes Water equivalent to 3 mm rainfall per minute
3	Spraying	Water falling as a spray at any angle up to	Test duration:

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	water	60° from the vertical shall have no harmful effect.	5 minutes Water volume: 0.7 litres per minute Pressure: 80–100 kPa
4	Splashing of water	Water splashing against the enclosure from any direction shall have no harmful effect.	Test duration: 5 minutes Water volume: 10 litres per minute Pressure: 80–100 kPa
5	Water jets	Water projected by a nozzle (6.3 mm) against enclosure from any direction shall have no harmful effects.	Test duration: at least 3 minutes Water volume: 12.5 litres per minute Pressure: 30 kPa at distance of 3 m
6	Powerful water jets	Water projected in powerful jets (12.5 mm nozzle) against the enclosure from any direction shall have no harmful effects.	Test duration: at least 3 minutes Water volume: 100 litres per minute Pressure: 100 kPa at distance of 3 m
7	Immersion up to 1 m	Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (up to 1 m of submersion).	Test duration: 30 minutes Immersion at depth of at least 1 m measured at bottom of device, and at least 15 cm measured at top of device
8	Immersion beyond 1 m	The equipment is suitable for continuous immersion in water under conditions which shall be specified by the manufacturer. Normally, this will mean that the equipment is hermetically sealed. However, with certain types of equipment, it can mean that water can enter but only in such a manner that it produces no harmful effects.	Test duration: continuous immersion in water Depth specified by manufacturer

SolarRiver, SolarLake and SolarPond series products are suitable for outdoor

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installation due to IP 65 above.

18 What's RCD? Why RCD is needed for PV installation with transformer less inverter?

18.1 Answer:

A residual-current device (RCD), or residual-current circuit breaker (RCCB), is an electrical wiring device that disconnects a circuit whenever it detects that the electric current is not balanced between the energized conductor and the return neutral conductor. Such an imbalance may indicate current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit. A lethal shock can result from these conditions. RCCBs are designed to disconnect quickly enough to prevent injury caused by such shocks. They are not intended to provide protection against overcurrent (overload) or short-circuit conditions.
The transformer less inverter will output DC current component (exceed the limits regulated by some standards) into grid when earth fault happens. So a RCD is needed for the safety of person.

19 Question: RCD in the property will be tripped when the inverter comes on. This happens with 30ma and100ma RCDs. What's the exact problem and how to solve it?

19.1 Answer:

20 Question: MCBO with often 16A will be tripped when the inverter comes on or when the solar radiation is high.

20.1 Answer:

The RCBO is a combination of an MCB and RCD. The RCBO enables both overcurrent protection and earth fault current protection in a single unit..

21 Question: No display on the inverter or completely dead unit. How can I do?

21.1 Answer:

Basically, it would be very hard for us to identify out the issue via the phone unless somebody can measure the dc input voltage on-site. The damaged dc isolator may be the reason that the inverter does not work (there are two isolators at here).
From our experience, completely dead unit may be from the broken on control board, damaged IGBT on the boost circuit (if there is short circuit on the DC connector's side), auxiliary power problem on the main board. All of these problems happen indicate that the inverter needs to be recalled.

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22 Question: Inverter restarting continuously, does the count down, starts normal operation, but restarts count down immediately. When this happens, the error message is often something to do with grid voltage or frequency.

22.1 Answer:

It might be caused by the U08 on control board damage or IGBT on the convert circuit damage. At this case, it is better to ask for providing the replacement inverter by Samil Service.

23 Question: Inverter turns off when the solar radiation is at its peak. What makes this problem and how can do?

23.1 Answer:

There are few reasons that may cause the problem. One is that PV inverter may shut down if the temperature is too high (normally 60 degrees). Please check if it is installed correctly according to the manual guide. The other reason is incorrect system configuration with low kW/kWp ratio. When the kW/kWp ratio is too low (below 70%), when the solar irradiation is strong, the inverter will shut down with High DC.

24 Question: How does Samil PV Grid-tied inverter work on MPP tracking in order to maximize solar energy? Can you explain more details on the algorithm?

24.1 Answer:

P&O MPPT Algorithm with variable steps is employed for maximizing solar energy from PV array. The operating principle is descripted as below:

Adjusting a small disturbance value when the PV system is in normal working status, constantly on the operating-point voltage of the PV system.When the PV array voltage changes meanwhile, the inverter will detect output power trend, then determine the voltage changes trend. If the PV array's voltage and output power is both increased, it indicates that the current operating point is located in the left side of the maximum power point; the next step is to increase the voltage. Otherwise, the next step is to decrease the voltage.

The final result of the disturbance voltage method is that the operating point of the PV system catchs up with the maximum power point.

Using variable step size disturbance method in control algorithm, that means, when the operating point is relatively far away from the maximum power point, PV system will catch up with the maximum power point quickly via long step size. Otherwise, PV system will catch up with the maximum power point quickly via short step size

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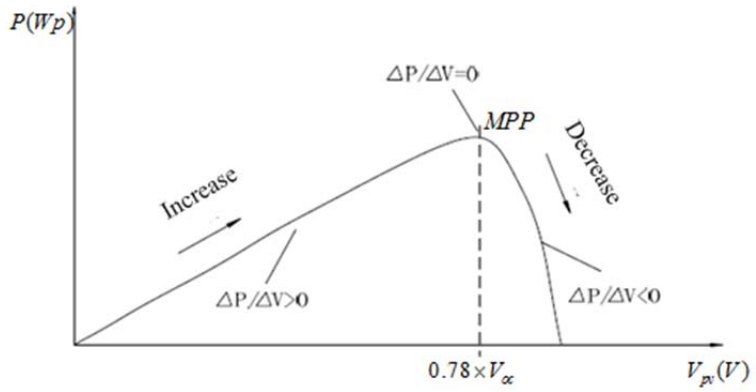

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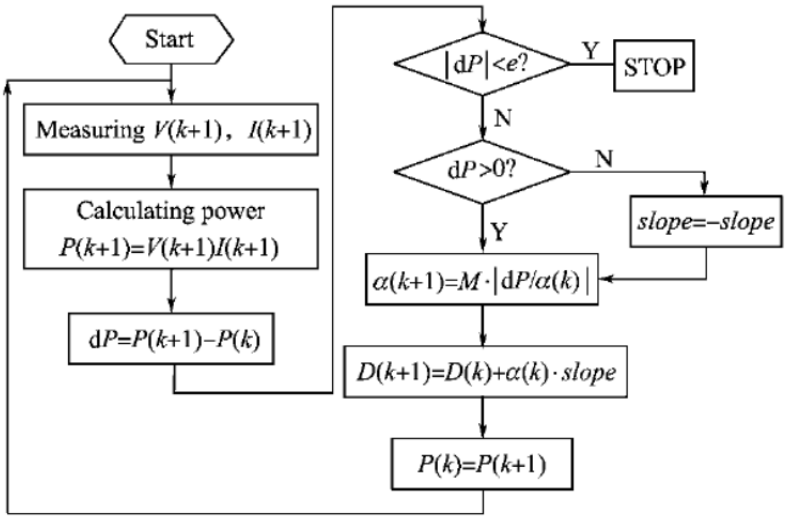

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