SSE OWNER'S MANNUAL

SHAKTISTELLER ENERGY SOLUTIONS

Solar Electric Power System

Owner's Manual

VERSION 2

Table of Contents

General Safety Instructions

⚠ WARNING

- Read this entire manual and associated product manuals before using your system.
- **SAVE THESE INSTRUCTIONS**. This manual contains important guidelines that should be followed when maintaining your system.
- There are no user serviceable parts in your system. Only qualified personnel should service your Shaktisteller Energy solar electric power system.
- Use solar modules for their intended use only. Follow all manufacturer instructions. Do not disassemble the module, or remove any part installed by the manufacturer, as this will void any manufacturer warranties and certified listings.
- Do not drop, allow objects to fall on, stand or step on solar modules.
- Do not concentrate sunlight on modules with mirrors, reflectors or lenses, or in any other manner. Doing so voids any warranty and the UL listing for the module.
- Do not touch the solar modules or the mounting structure once installed. When these surfaces are exposed to sunlight they can become extremely hot.
- Do not walk, lean, sit or rest heavy objects on solar panels.
- Solar modules have a protective glass front. Broken solar module glass is an electrical safety hazard (electric shock and fire). These modules cannot be repaired and must be replaced immediately. If you have a broken module turn your system off.
- Do not store anything in front of the inverter or junction boxes (AC or DC).
- Do not store anything above or below the inverter. A minimum of 12" of clearance must be maintained to allow heat to naturally flow from the inverter.
- Call for service immediately if the inverter indicates a Ground Fault Error. Refer to the troubleshooting section found in this manual to determine if the inverter has a ground fault.

Documents

It is recommended that you keep the following documents with this manual for easy reference. Please note that these documents may not apply to your system as installation requirements vary:

- Electrical permit and documentation
- Utility interconnection agreement and net metering agreement
- Electrical schematic
- Product manuals, warranties and specification sheets

Congratulations

Your solar electric power system from Shaktisteller Energy enables your home to generate a portion of its own electrical power from sunlight. Your Shaktisteller Energy solar electric system has been engineered to provide many years of automatic operation without producing noise or air emissions and without requiring fuel or extensive mechanical maintenance.

The benefits of solar electric power are now yours

- ### Reduced Pollution and Environmental Protection

Solar energy uses the sun to generate clean renewable power. Power produced by a solar electric system displaces the need for conventional power generation. It is estimated that every kilowatt of installed solar generation prevents 6300 kg's of CO_2 (associated with global warming) and 13 kg's of NO_X (one source of smog) during its operating life.

- ### Reduced Utility Bills

Every kilowatt-hour (kWh) generated by the system means less energy needed from the electric utility, and that means lower electric bills from your utility.

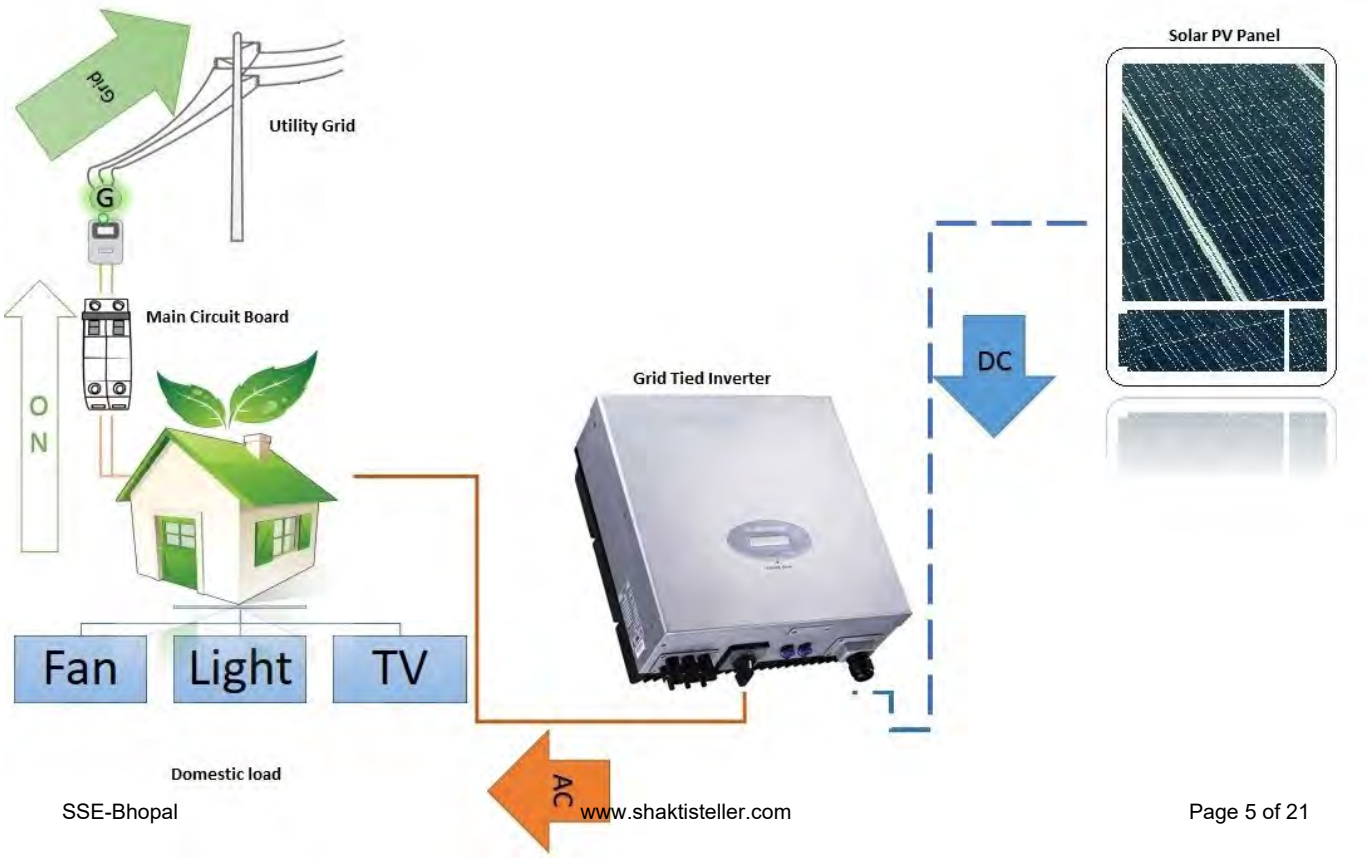
Principles of Operation

Solar Modules

Solar modules are typically roof mounted. During daylight hours, the solar modules instantly convert sunlight energy into direct current (DC) electrical energy. Modules are connected in series (positive to negative), making “panels” with enough DC voltage to operate the inverter. The DC current (amps) output of a solar module is directly proportional to sunlight intensity. Output varies with sun angle, shadows and shading - all of which can greatly impact electricity output.

Power Flow

Wiring carries the DC power from the solar panels to a DC-AC “inverter” that automatically converts the solar- generated DC power into common household alternating current (AC). The AC output from the inverter may pass through an optional external lockable visible disconnect switch and then connect to the breaker installed in the house utility power panel. If the system includes more solar power than one inverter can handle, several inverters will be wired in parallel into the utility power panel. If your local utility accepts excess generated power back onto their grid, your electric utility meter will spin backward when they are accepting power, thereby generating a credit toward electricity purchased from the utility.



Power Usage

During the day, the AC power produced by the inverter can be consumed immediately for power needs within the residence. The solar power is displacing power that would have been provided by the utility. If more power is needed than the solar modules can produce, the extra power needed is drawn from the utility.

At night or during periods of low sunlight, the solar modules do not produce power, and the residence operates completely on utility power.

During each day, if the residence is not consuming all of the electricity produced by the solar power system, then the excess power is sent out through the utility meter to the utility company. This generates a credit against what will be consumed by the residence at night. The residential monthly electric utility bill will be reduced by the power generated by the solar electric system during that month, either through displacing power that would have been consumed or through sending excess power to the utility. State of Madhya Pradesh have implemented net metering laws that require electric utilities to purchase your solar system's excess power at APPC rate the as defined by recent policy if excess energy is still in credit after month on month accounting at the end of the financial year. MP State Utility (MPEB) requires an Interconnection Agreement and Metering Agreement for residential solar power systems before interconnection is allowed.

Automatic Shut-off During Outages ("Anti-Islanding")

To prevent injury to utility personnel working on power lines, power from the inverter to the home's electric panel is shut off immediately when there is a utility outage. No power is allowed to flow out of the inverter into the utility grid from the system.

This means that the house will have no electric power, either from the solar panels or from the utility, during a utility outage.

The inverter will automatically re-start when utility power is restored. There is a one-minute delay before the inverter returns to normal operation, during which it synchronizes with the utility power.

Power
is a **rate**

Electric power is the rate, per unit time, at which electrical energy is transferred by an electric circuit.Electric power, like mechanical power, is the rate of doing work, measured in watts, and represented by the letter P. The term wattage is used colloquially to mean "electric power in watts."

Electric power is transformed to other forms of energy when electric charges move through an electric potential (voltage) difference, which occurs in electrical components in electric circuits.

Energy
is an **amount**

Power x Time = Energy

(watts) x (hours) = (watt-hours or kilowatt-hours, kWh)

Energy is the actual work that is done by electricity. It is the heat, motion, or sound that results from electrical activity. Energy is measured in watt-hours or kilowatt-hours (kWh). This is what a customer pays for on their utility bill. Utilities charge for how much power is consumed over a certain period of time not the amount of energy being consumed at any one particular moment. The amount of energy consumed, or generated, is the product of the rate of power times the amount of time it flows.

For example

A solar electric power system producing 1,000 watts and operating at this rate for five hours would generate a total amount of energy of: **1,000 watts X 5 hours = 5,000 watt-hours or 5 kWh.**

An incandescent lamp consuming 150 watts and operating for three hours would consume a total amount of energy of: **150 watts X 3 hours = 450 watt-hours or 0.45 kWh.**

System "Peak" Power

The difference between a solar arrays "DC rating" and the actual power output indicated by the inverter is caused by variations in real world conditions as opposed to standard test conditions (STC). The "DC rating" refers to the DC power (direct current) measured by manufacturers when classifying modules during manufacturing. The standard measurement uses ideal noon-day sunlight and solar modules operating at room temperature (25ºC). Standard measurements do not include the real-world effects of heat, dirt and dust, DC-to-AC inverter conversion efficiency, wiring, off-south orientation, non-optimal roof pitch angle, and weather conditions. This DC rating value is used by manufacturers to measure and ensure quality control prior to shipping.

These real operating conditions typically result in peak AC output power that is about 60-70% of the artificial room temperature "DC rating" of the solar array alone.

For example, a system with 48, 100-watt solar modules could be expected to have a peak output of approximately 2,900 to 3,400 watts of power under typical operating conditions with the sun directly over the modules.

The actual typical peak AC (alternating current) power generated by your system under real outdoor operating conditions will be less than this rating due to several factors:

- the solar modules are operating hot on your roof (typically above 50ºC)
- the solar energy shining on the modules may be less than ideal due to the angle of the sun and sky conditions (dust, haze, fog, smog)
- power is lost when the inverter changes the solar DC power to common household AC power.

Understanding Variations in Power Output

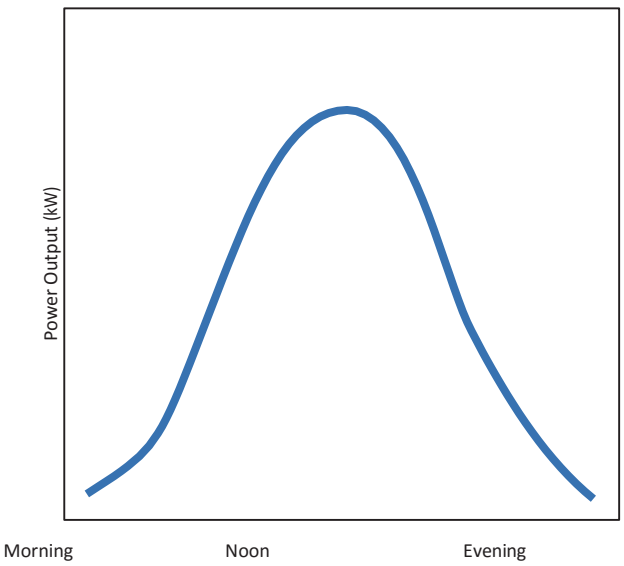
The power output [measured in watts or kilowatts (kW)] from your system at any moment will vary throughout each day, and the patterns and peak values will vary with the seasons. It is important to understand these normal variations in system performance.

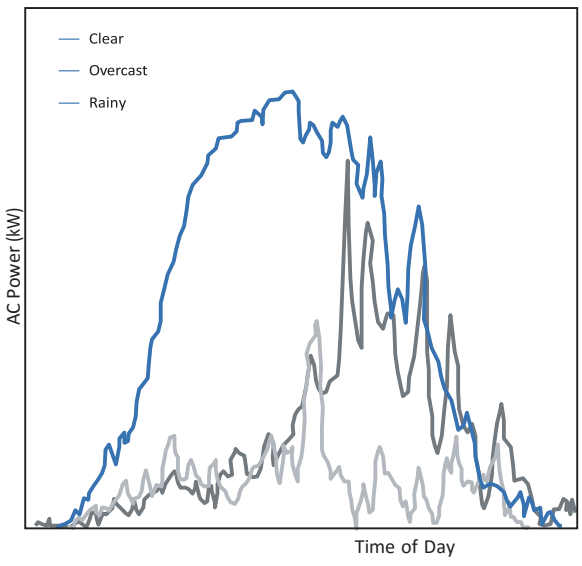
Daily Output Power Profiles

The momentary output of your system depends on the angle of the sun and the clearness of the sky as well as the temperature and the cleanliness of the solar module glass. An idealized "typical" profile of system output during a day is shown.

In the early morning, even though the day is "bright" to the eye, the angle of the sun to the solar modules is very low resulting in a reduced power output. As the sun rises in the sky, it moves more directly in front of the modules and the output rises to a peak value near noon. As the sun begins its decent, the angle of the sun to the panels gets lower and reduces the power output of the system.

Some actual daily profiles are shown here to illustrate the effects of sky conditions on output. Notice how the real profiles vary moment to moment compared to the smooth idealized profile shown. This is a more true representation of how your system output will vary during a day.





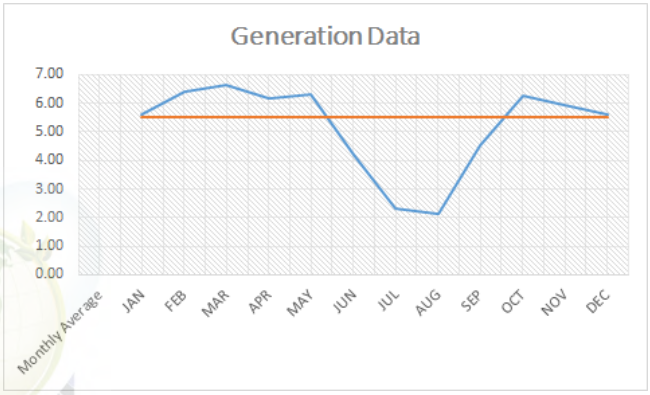
South facing Orientation

The momentary output of your system depends on the angle of the sun and the clearness of the sky as well as the temperature and the cleanliness of the solar module glass.

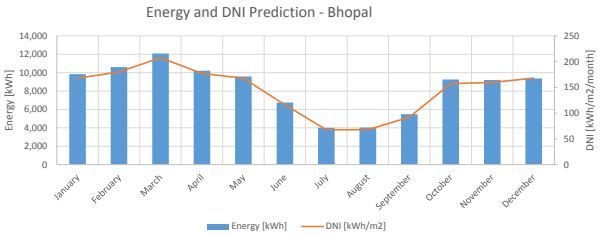
In the early morning, even though the day is “bright” to the eye, the angle of the sun to the solar modules is very low resulting in a reduced power output. As the sun rises in the sky, it moves more directly in front of the modules and the output rises to a peak value near noon. As the sun begins its decent, the angle of the sun to the panels gets lower and reduces the power output of the system.

Seasonal Variation

During winter months the sun shines for fewer hours of the day and has a lower angle in the sky. This results in a generally lower power output profile than in summer, when there are more hours of sunshine and the angle of the sun is higher during the day.



Seasonal variations and local conditions can have a large effect on the output of your solar electric system. The observations reveal that the maximum variation with respect to annual average value is in the monsoon season and least in the summer season, whereas it is slightly lower and has an opposite trend in the winter season compared to summer. The presented results showed a very dominant effect of the monsoon season on the measured spectral parameters, which is a special season in Indian subcontinent perspective as compared to rest of the world. (PR = Performance Ratio)



Monthly

⚠ WARNING **Monthly inspections should be performed from the ground.**

Solar Array

- Check that the solar array is not being shaded between 10 am and 5 pm by vegetation or building structures. Trim vegetation if necessary.
- Visually inspect the solar array from the ground for damage. Solar modules have a protective glass front that can break from excessive loading (greater than 5.4 kN / m^2), from hail (greater than 1" traveling at 80 kMPH), or from other causes such as vandalism. When the glass breaks the module will typically look different than the other solar modules. If broken glass is discovered, call for service immediately and turn your system off.
- Optional: Check solar array glass surface for debris, dirt, or severe soiling from bird droppings. It is not necessary to clean the module glass, as seasonal rains should wash away most normal soiling, but you may choose to do so to clean module surfaces. First verify there are no broken solar modules in your array. Then remain on the ground and spray the glass with water.

⚠ WARNING

DO NOT clean during the middle of the day when the glass is hot. The thermal shock of cold water on hot, tempered glass could shatter the glass. Clean only at dawn or dusk when the module glass is cool.

⚠ WARNING

Solar modules have a protective glass front. Broken solar module glass is an electrical safety hazard (electric shock and fire). These modules cannot be repaired and must be replaced immediately. If you have a broken module turn your system off.

⚠ WARNING

DO NOT clean the solar modules if your inverter reads a “Ground Fault Error”. Call for service immediately if the inverter indicates a Ground Fault Error. Refer to the inverter troubleshooting section for additional details.

Annual

⚠ WARNING

Annual Service should be performed by qualified service personnel only!

Solar Array

- Check all solar array wiring to confirm no loose connections or insulation wear.
- Check all module mounting to confirm all bolting is secure.

Power Electronics

- Check all wiring to confirm no loose connections or insulation wear

Maintenance Date	Inverter	Solar Panels	BOS	Technician

Identify Typical System Parts

House Circuit Breaker Panel

Solar Array → DC Disconnect → Inverter → AC Disconnect → House Loads → Utility Meter

Shutdown Procedure

If for any reason you feel that your solar system is not operating safely, the system should be shut down. To shut your system down, follow the steps detailed below.

1. Disconnect DC power

inverters: switch DC disconnect switch(es) to Off position.

The DC disconnect switch is typically located next to the inverter and should be labeled “DC DISTRIBUTION BOX”.

2. Disconnect AC power

Set the utility AC disconnect switch to Off position

The AC disconnect switch is located next to the inverter in a transparent box labeled as AC DISRIBUTION BOX.

Startup Procedure

Only qualified personnel should perform the startup procedures. Please contact your installer for assistance in turning your system on.

1. Disconnect AC power

Set the utility AC disconnect switch to On position.

2. The AC disconnect switch is located next to the inverter in a transparent box labeled as AC DISRIBUTION BOX.

3. Disconnect DC power

inverters: switch DC disconnect switch(es) to Off position.

The DC disconnect switch is typically located next to the inverter and should be labeled “DC DISTRIBUTION BOX”.

Troubleshooting

LED (Light Emitting Diodes) are located on the face of the inverter.

Problem		What to do
Utility Failed, Power Outage, Blackout	No problem	Do nothing; the inverter will automatically restart in 1 minutes after the utility
Inverter, Steady Green LED on	No problem	The inverter is working correctly.
Inverter Flashing Green LED once per second	The inverter detected a utility fault or the inverter is waking up.	This occurs whenever the inverter detects a power interruption from the utility and every morning, it means the inverter is processing its starting conditions and will
Inverter No indicator lights	It is night	At night the inverter enters a sleep mode to conserve power.
	It is a bright sunny day	The DC disconnect and possibly the AC disconnects are turned off. Turning these on will allow the inverter to restart. Refer to start up procedure for power up
Inverter Yellow/Orange/Red LED is steady on.	Read the LCD inverter display, It will cycle through several displays. One display will read an error message.	

Warnings (W) are displayed on the LCD screen in front of the inverter above the LED light. W codes are as follows.

Error message	Description	Suggestion
No AC Connection	No utility grid connected or utility grid power failure	1. Check AC Wiring 2. Contact Shaktisteller
AC Voltage Outrange /AC Grid Over Voltage Fault	Utility grid voltage is out of permissible range	1. Check Grid voltage 2. Contact Shaktisteller in case the error exists despite the grid voltage within tolerable range
AC Frequency Outrange/ AC Grid Frequency Fault	Utility grid frequency is out of permissible range	1. Check Grid frequency 2. Contact Shaktisteller in case the error exists despite the grid frequency within tolerable range
Over temperature	Temperature outrange	1. Check the inverter operation state 2. If error persists contact Shaktisteller
PV Isolation low / Isolation Fault	Insulation problem	1. Check if panel enclosure ground properly 2.Check if inverter ground properly. 3. Check if DC breaker wet. 4. If error message persists contact Shaktisteller.
Output High DCI	Output current DC offset too high	1. Restart Inverter 2. If error message persists contact Shaktisteller
Residual I High	Leakage Current too high	1. Restart Inverter 2. If error message persists contact Shaktisteller
PV Voltage High	The DC Input voltage is exceeding the maximum tolerable value	Disconnect the DC switch immediately
Auto Test Failed	Auto test did not pass	Restart Inverter

Errors (E) codes identify a possible equipment failure, fault or incorrect inverter setting or configuration. Typical error codes:

Description	Suggestion
Communication fault Slave processor can't receive data from Master processor.	1. Restart Inverter 2. If error message persists contact Shaktisteller
Consistent fault. Data received by Master and Slave processor are different. The reason can be utility grid voltage or frequency change frequently.	1. Restart Inverter 2. If error message persists contact Shaktisteller
EEPROM fault	Contact Shaktisteller
	Contact Shaktisteller
Relay fault	Contact Shaktisteller
Init model fault	Contact Shaktisteller
GFCI Device Damage	Contact Shaktisteller
HCT fault	Contact Shaktisteller
Communication fault. Master processor can't receive data from Slave processor.	1. Restart Inverter 2. If error message persists contact Shaktisteller
Bus voltage fault	Contact Shaktisteller

For errors that are not listed above or when the yello/orange/red LED is on, your installer should be contacted immediately.

Before Calling for Service

1. Write down the error message that is displayed.
2. Have this manual with you so the information on the cover can be supplied.

Product Safety and Laboratories Certifications

The inverters used in solar electric power systems are certified by CE, VDE 0126-1-1, IEC 62109, G83, AS4777, AS/NZS 3100. Declaration covers inverters that convert DC electric power from photovoltaic arrays to AC electric power intended for use in parallel with an electric utility to supply common loads (utility interactive).

The solar modules used in our systems qualify IS/IEC 14286/61215 or IS/IEC 16077/61646 and IS/IEC 61730(PART 1, 2), IS/IEC 61701 and also IEC 61804 PID. The photovoltaic modules are intended for installation on buildings, or to be ground mounted (that is, not attached to buildings), in accordance with the MNRE, MPUVN, "*Madhya Pradesh Policy For Decentralized Renewable Energy Systems, 2016"*, and Building Codes. The photovoltaic modules must be installed over a roof of appropriate fire resistance. Do not install the solar module integral with a roof or wall of a habitable structure. Modules are not rated as roofing material.

Ministry of New & Renewable Energy (MNRE)

The Ministry of new and renewable energy covers the installation of solar power systems and should be adhered to when systems are designed and installed. Net metering scheme for the state of M.P. was declared in January 2017. The "Madhya Pradesh Policy For Decentralized Renewable Energy Systems, 2016"applies to solar photovoltaic electrical energy systems including the array circuit(s), power conditioning unit(s), and controller(s) for such systems.

Details of the renewable energy system

A. Details of the Solar PV module

1.	Model No.	
2.	Name and address of manufacturer	
3.	Capacity of each Module (Wp)	
4.	No. of Modules	
5.	Total Capacity (kWp)	
6.	Date of Installation	

B. Details of the Inverter

1.	Name and address of the inverter manufacturer	
2.	Brand Name of the inverter	
3.	Model No.	
4.	AC capacity of individual inverter (kW)	
5.	No. of inverters installed	
6.	Total AC capacity of inverter (kW)	
7.	Serial Nos.	
8.	Date of Installation	

C. Details of the Cables: DC

1.	Make / Name of manufacturer	
2.	Size & Type	

D. Details of the AC wiring

1.	Make / Name of manufacturer	
2.	Size & Type	

E. Details of the DC distribution box

1.	Make / Name of manufacturer	
2.	Sl. No.	
3.	DC Surge Protection Device	
4.	MCB /Isolator quantity & capacity	
5.	Size & Type	

F. Details of the AC distribution box

1.	Make / Name of manufacturer	
2.	Sl. No.	
3.	AC Surge Protection Device	
4.	MCB /MCCB quantity &capacity	
5.	Size & Type	

G. Details of Battery Bank (if applicable)

1.	Make / Name of manufacturer	
2.	Type of battery	
3.	Sr. Nos.	
4.	Capacity of each Cell (V / AH)	
5.	Number of Cells in series	
6.	Number of Cells in parallel	
7.	Total capacity in AH	
8.	Total battery bank voltage	

H. Details of the Earthing

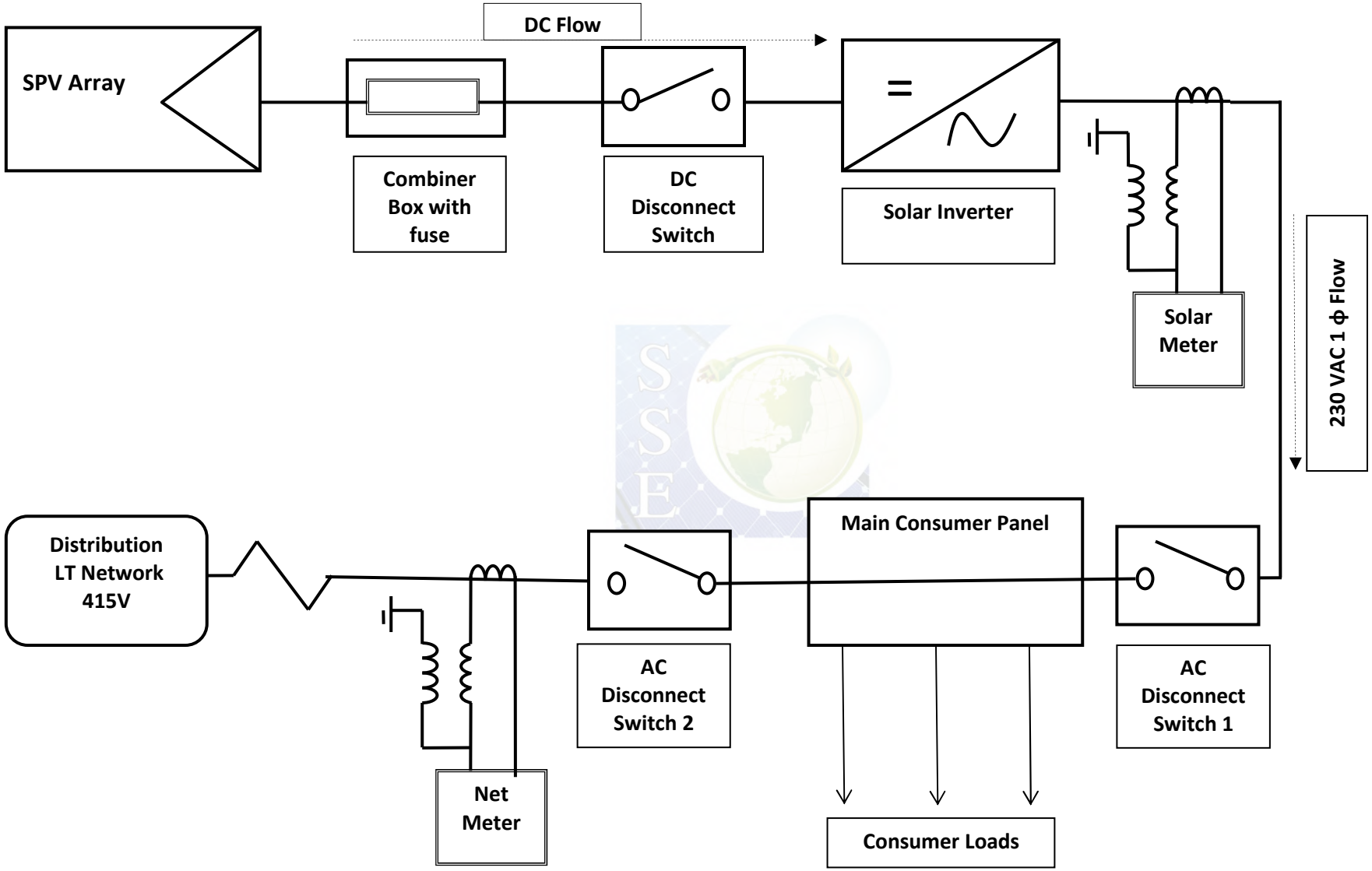
1	Earth resistance (shallbe less than 2 ohms)	
2	Size of the Earth wire / flat*	
3	Two separate Earthing points Modules & DC Surge arrester Inverter, AC Surge protection device & Lightening Arrester	 Yes / No Yes / No
4	Size & Type	

I. Details of the Net meter

1.	Make	
2.	Serial No.	
3.	Capacity	

4.	Type / Model	
5.	Single ph./Three ph.	
6.	CT Ratio	
7.	Date of Test by MT, Discom	

SLD FOR GRID TIED ROOFTOP SPV SYSTEM OF CAPACITY 3 KW 230 V SINGLE PHASE LT CONNECTION



Shaktisteller Energy Solutions Pvt. Ltd.
284, Bharat Nagar
J K Road
Bhopal
India

T +91 755 4925962
M +91 9425019265

For Complaint Registration visit www.shaktisteller.com
For more information on Solar contact us at shaktisteller@yahoo.com