



# Off-Grid Power Supply Systems



*From the pioneer of AC coupled systems*

Clean power anywhere in the world.



Volker Wachenfeld  
Executive Vice President Off-Grid Solutions

## Self-sufficient with Solar Power

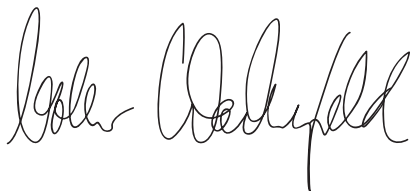
Produce your own power, defy grid outages or simply be independent from the power distribution grid and conventional energy supply. With SMA off-grid systems technology you can set up a PV-based off-grid power supply in just a few steps. This is a clean, cost-effective solution guaranteeing a stable power distribution grid at all times. Whether farm, hotel, supermarket, restaurant, or any kind of remote dwelling, stand-alone systems are the ideal solution in any location where the connection to a public power distribution grid is too cost-intensive, technically not feasible or simply not desired. We offer complete solutions for all system sizes from 2 kW to 100 kW, for single-phase 120/240 V, split-phase or three-phase grids. It has never been easier to be independent of the grid and thus energy self-sufficient. And the good news is that our systems are so flexible that they even allow for configuration as a utility back-up system if access to the public grid is installed in future.

Our modular off-grid system solutions even supply whole islands with renewable energy. A good example of this is a Scottish island where the inhabitants are fully supplied with energy generated from renewable sources. Since 2008, they have been producing environmentally friendly electricity totally independently of the public power distribution grid. If the energy demand of the inhabitants increases, the off-grid system can be expanded in stages, as required.

At our company headquarters in Germany, we, of course, rely on renewable energy forms, in particular on solar power. Since 2010, a solar-powered off-grid system has been supplying the SMA Solar Academy with electricity. This is our personal beacon project demonstrating the practical application of SMA off-grid systems. Here, visitors experience the system's technology first hand and can see for themselves that a self-sufficient, regenerative energy supply does not come at the cost of comfort. On the contrary, the PV modules integrated in the building create a cozy climate in more ways than one.

We owe much valuable expertise on the storage of solar power within power distribution grids to our years of experience with self-sufficient AC grids. Accordingly, our Sunny Island inverters are also designed for back-up applications. These systems are capable of assuring the electricity supply even when the conventional power grids fail.

SMA stands for a worldwide, cost-effective and stable electricity supply based on renewable energy sources. This vision, which we have been working on since the founding of our company, will continue to drive our actions forward in the future.



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Executive Vice President  
Off-Grid Solutions



# Off-Grid Inverters by SMA

## System manager for all types of energy generators

The Sunny Island battery inverter provides a secure power supply for off-grid systems. It forms a standard AC voltage grid into which all electricity consumers and generators can be flawlessly integrated. With AC coupling and the Sunny Island as a system manager, SMA provides an innovative solution for supplying energy to remote locations or for creating an emergency power supply for areas with unstable grids—for all system sizes from two kW to 100 kW.

### Operating principles

The Sunny Island constantly holds the voltage and frequency of the AC grid within the permissible limits, It establishing a stable stand-alone power grid.

Both loads and power sources are connected directly to this grid. If there is an energy surplus, the Sunny Island charges the batteries. If there is a shortage, it supplies the grid with energy from the batteries. Thanks to its highly developed battery management system, it can recognize the state-of-charge at any given moment and, as system manager, it can also make ongoing decisions. If there is a great demand for electricity, the Sunny Island can start a diesel generator or it can disconnect loads as needed. If the batteries are fully charged and there is little demand, it can reduce the PV plant's electricity production. It also determines the optimal strategy for charging the batteries, increasing their life span.

### Flexible grid layout

Whether bringing power to a single-family home, a business or a whole village, SMA stand-alone grids are extremely flexible. They can be installed quickly, easily expanded and can even be retroactively connected to the power distribution grid.

On the AC side it is possible to connect solar power plants and wind turbine systems, diesel generators or other electricity generators, as well as all AC loads. This eliminates the need for costly DC cabling. Charge controllers are used for the DC connection of the PV plant and battery.

For small-scale, 120/240V split-phase stand-alone grids, we offer an all-in-one solution, namely, the SMA Smartformer. With this option, systems up to eight kilowatts capacity can easily be implemented. The pre-wired transformer, together with just one Sunny Island and one Sunny Boy, supports all loads with 120 and 240 Volts, a generator or grid, and the PV plant.

### Grid-interactive operation

In grid operation, the Sunny Island can also perform back-up functions. It automatically switches to off-grid power supply within

approximately 20 milliseconds of a power outage. This operation reliably disconnects the PV plant from the supply grid and ensures that it feeds its power exclusively to the stand-alone grid. Both new and existing PV systems can be retrofitted with a Sunny Island to act as a battery back-up—without any adverse effect on PV efficiency. Depending on battery capacity, not only can the available back-up power be adjusted as required, but it even becomes possible to set up an entirely self-sufficient stand-alone grid. This allows the solar energy to still be fully exploited, even during power outages, thus prolonging the amount of time back-up power is available.

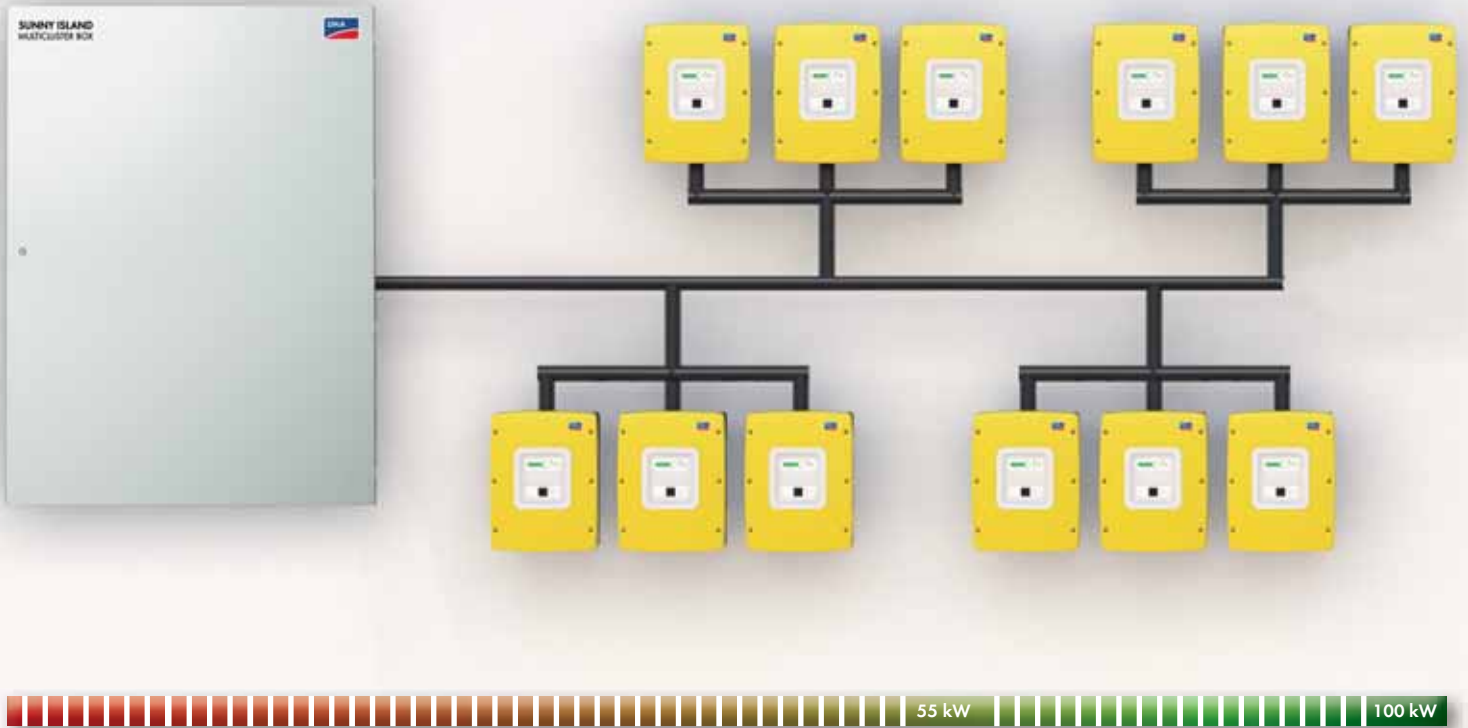
### Expandable up to 100 kW

Stand-alone grids with the Sunny Island 4548-US, 5048-US or 6048-US can be easily expanded by connecting several devices in parallel, in single-phase, 120/240V split-phase or three-phase. To create systems of more than 18 kW, three Sunny Island inverters and one battery are combined to form a cluster. To achieve the desired total power of up to 100 kW, several of these clusters are connected in parallel. The advantage: even if a cluster fails, only one sub-system is affected, making the off-grid power supply extremely secure.



**Components:** 1. PV array, 2. SUNNY BOY, 3. SUNNY ISLAND, 4. Batteries, 5. Diesel generator, 6. Wind turbine system





# SMA Multicluster Technology

## The path to your own power distribution grid

AC Off-grid systems open up new possibilities for providing a stable and powerful energy supply that is entirely independent of the power distribution grid. This kind of stand-alone power grid provides the customary supply quality usually associated with large power distribution grids. And, due to its modular structure, it is also very simple to install and can be easily expanded. Through the integration of renewable energy sources, which avoid fuel costs and are simultaneously becoming ever more efficient, such systems are today more cost-effective than conventional systems running on diesel generators.

### Why Alternating Current?

AC coupling is the foundation for modular off-grid power supply with capacities of up to 100 kW. In contrast to DC coupling, all energy sources and loads are connected via an AC grid. This offers a number of advantages.

On the load side, commercially available and affordable AC power devices can be used. On the generator side, any kind of renewable or conventional energy sources can be incorporated. Alternating Current grids can be expanded without specialized expertise using standard components that are readily available. These components are far less expensive than components for Direct Current grids because, although they normally have to carry higher voltages, the amperages involved are much lower. AC coupling enables far more design flexibility, since much larger distances between the generators, batteries and consumers can be implemented without problems. Furthermore, it is possible to connect generators and loads in Alternating Current grids at practically any point in the network, providing optimum conditions for subsequent expansion.

## Sunny Island - the grid and battery manager

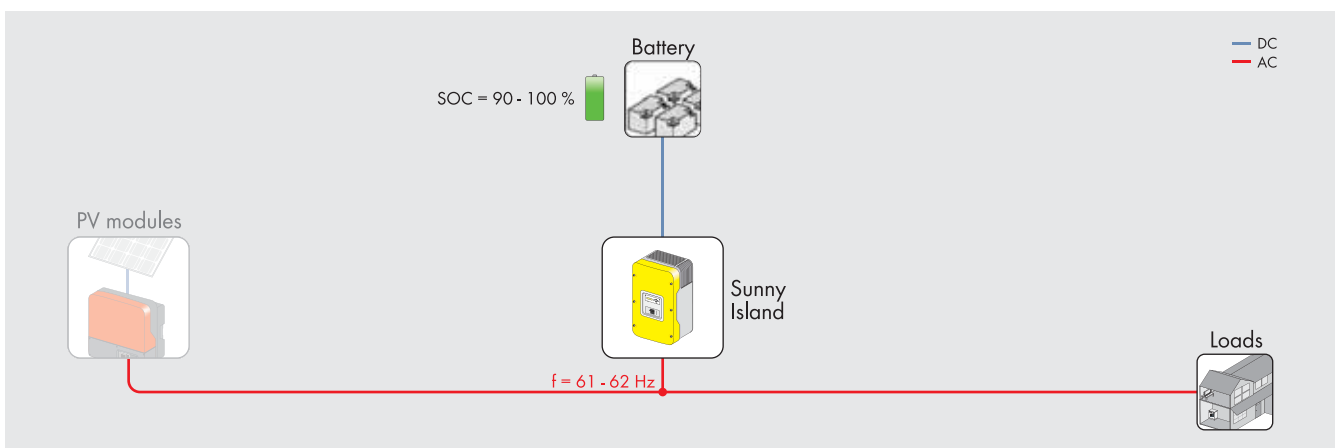
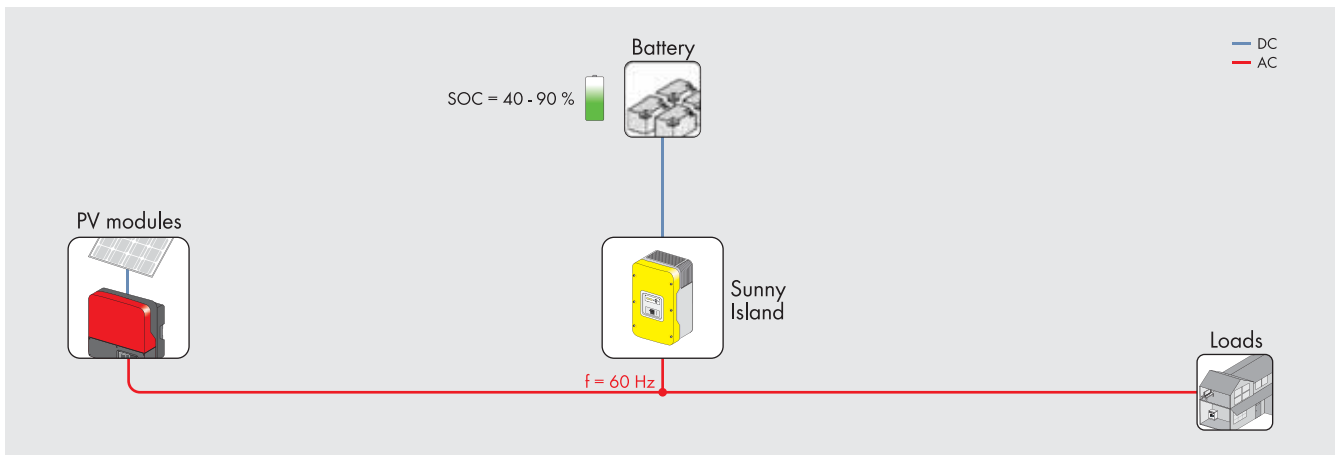
The central component of the stand-alone power grid is the Sunny Island battery inverter. In its role as grid former and manager, it maintains the stability of the AC grid and ensures that voltage and frequency remain within permissible limits. The Sunny Island stores surplus energy in the battery and as soon as additional energy is required, it supplies the grid with battery power. Thus, it is a bi-directional battery inverter, often referred to as a combined inverter/battery charger. Such devices are particularly cost-effective, since the power semiconductor devices enable both functions.

The Sunny Island is equipped not only with grid management, but also with a highly developed battery management function, including monitoring. As system manager, it collects data on the precise state of charge at all times and can also make long-term

decisions. At times when the batteries are empty and there is little generation capacity, it can activate a back-up energy source (e.g., a diesel generator) or switch off certain consumption loads. Furthermore, it extends battery life by implementing the optimum charging strategy. Apart from all this, the compact device provides further special functions specifically geared to the requirements of stand-alone power grids.

### Automatic reactive power compensation

With a possible phase shift of  $-90$  degrees to  $+90$  degrees (displacement power factor  $\cos(\phi)$  from zero to one (lagging/leading)), the Sunny Island can, if necessary, make its entire nominal power available in the form of reactive power; thereby, it compensates for phase shifts in the stand-alone grid caused by lagging or leading loads (e.g., engines, transformers, cable lines).



At a state of charge under 90 percent, power surpluses can be absorbed by the battery at any time. When the battery is fully charged and power surpluses are produced, the Sunny Island increases the AC frequency. This triggers a gradual reduction of power output from the generators.



### Power generation management by remote control

When the batteries are full and electricity demand is low, the Sunny Island reduces the electricity produced by all renewable energy generators, whether PV plants, hydropower or wind turbine systems sole provision that all the inverters must be SMA devices and their stand-alone grid mode must be activated. If this is the case, the devices will no longer disconnect from the grid with rising frequency, but will continuously reduce their power output. As grid manager, the Sunny Island specifies the frequency in the stand-alone grid and can limit the power of all the generators and maintain the energy balance of the grid.

### Extreme overload capacity

When certain loads are switched on, high start-up currents are frequently encountered that can be well in excess of the normal operating current. In addition, some loads may require a lot of energy just for a short while, creating short peaks on the load profile. For off-grid system sizing, it is extremely important to use battery inverters with a high overload capacity so that such load peaks can be handled without a problem. Sunny Island inverters have an extremely high overload capacity and, depending on the model, can provide two or three times their nominal power.

AC power at 25 °C	SI 4548-US	SI 5048-US	SI 6048-US
for 30 min.	5.3 kW	6.5 kW	7 kW
for 1 min.	8.4 kW	8.4 kW	8.4 kW
for 30 sec.	11 kW	11 kW	11 kW

### Three phases - no problem

For the transmission of large capacities in AC grids, a three-phase configuration has proven effective. This is true both for large power distribution grids and for stand-alone grids. Due to the overlap of the individual phase-shifted capacities, three-phase loads have practically continuous power at their disposal. As a rule, the generators in diesel power units or wind turbine systems also supply three-phase power.

It is also possible to set up single-phase systems up to a battery inverter power of 18 kW by connecting three Sunny Island 6048-US inverters in parallel to one phase. For larger capacities, however, three-phase stand-alone grids are usually preferred. This is



accomplished by having three Sunny Island inverters linked into a three-phase cluster. One device acts as master and sets the frequency, while the other two act as slaves and comply with this frequency, operating at an exact phase shift of 120 or 240 degrees from each other. A special communication link between the devices synchronizes the clusters accordingly. The entire cluster can be configured using only the master inverter.

A three-phase stand-alone grid works just as well as a single-phase version. An asymmetric grid load caused by a single-phase load is also automatically compensated for by having the inverter responsible for the phase with the greater load draw correspondingly more power from the battery.

Theoretically, even completely unbalanced operation is possible, for example, when solar power is fed to phase one of the stand-alone grid and there is consumption on phase three. Since in this case the energy must be put through two additional Sunny Island inverters, it is in practice still better to keep the distribution of loads and generators as balanced as possible in the interests of maximum efficiency.

**Multicluster technology - less expense for large systems**

The special advantage of SMA's off-grid system technology lies in its modular design. PV plants of any performance class are built using comparatively small and manageable components, which makes transport and installation easy, even at remote locations.

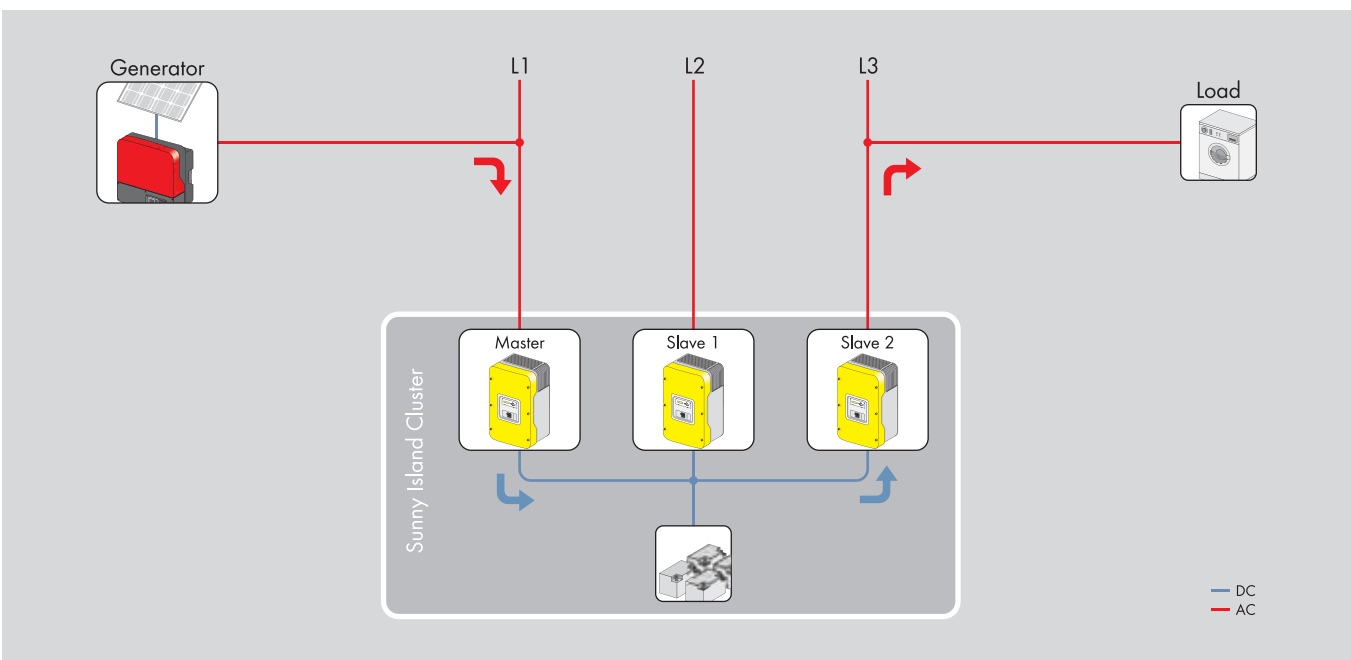
By dividing the inverter capacity into clusters (i.e. groups of three devices each), the system becomes extremely flexible with respect to performance. This design is almost infinitely scalable thanks to the parallel connection of multiple clusters, and a subsequent expansion of the off-grid system is also easy to implement.

Because the basic design is identical and the devices used are always the same, trained service personnel can configure, operate and maintain plants of any size.

**Power made to measure: the Multicluster Box**

In addition to the Sunny Island battery inverter, the core element of this modular system is the Multicluster Box, which is responsible for the simple connection of all components into one battery-supported AC grid with a variety of power generators.

The Multicluster Box comes fully wired and contains all of the necessary switching elements and monitoring devices. As a pre-configured AC distribution board, it enables the easy connection of all AC components in the stand-alone power grid, including generator, renewable-energy generation plants (e.g. photovoltaic, wind or hydro-electric power), loads and two to four clusters, each made up of three Sunny Island inverters. The layout is clear. There are connections for each Sunny Island inverter and main connections for a generator, the renewable-energy generation plant and the loads. These latter two usually require sub-distributions, which have to be planned separately.



*Asymmetric load on the three-phase grid is no problem*

### **Multi-level security: Generator and load-shedding contactors**

A power contactor is integrated into the distribution board for both load and generator connections. The generator contactor connects grid-forming generators such as those used in more powerful diesel generating plants or CHPs. In contrast to generators in grid-parallel operation, they cannot synchronize with an existing grid, and therefore, the generator specifies the grid parameters in this case. The cluster group of Sunny Island inverters adjusts accordingly, i.e., as soon as voltage and frequency before and after the generator contactor are equalized, the connection is established. If the Sunny Island cluster fails or is switched off, the generator contactor closes automatically, so that the generator is directly linked to the connected loads.

In the case of a generator failure, on the other hand, the system disconnects instantaneously and maintains the supply with battery current and the available renewable energy generators. Even when one component fails, safe operation is assured.

If a long-term generator failure occurs and the renewable energy sources are not sufficient to fully power all the loads, the energy stored in the battery will be used first. Once the lower discharge threshold is reached, the contactor on the load side opens and disconnects the line, reliably preventing deep discharge of the batteries and disconnection of the cluster group. The system remains active and uses all available sun, wind or hydro-power to recharge the battery. The loads are automatically reconnected once the battery's state of charge is high enough. Even in the case of a severe fault, the maximum possible supply reliability and battery protection are guaranteed. Load management, for instance, to avoid unnecessary load peaks, is carried out via the multi-function relay in the Sunny Island inverter. In each device of the main cluster there are two relays available and one of 17 functions can be assigned to each of these through the device menu. When the battery charge is low, it is possible to start the generator or to switch individual loads by means of a separately installed contactor.

### **Flat hierarchy: inverters in cluster groups**

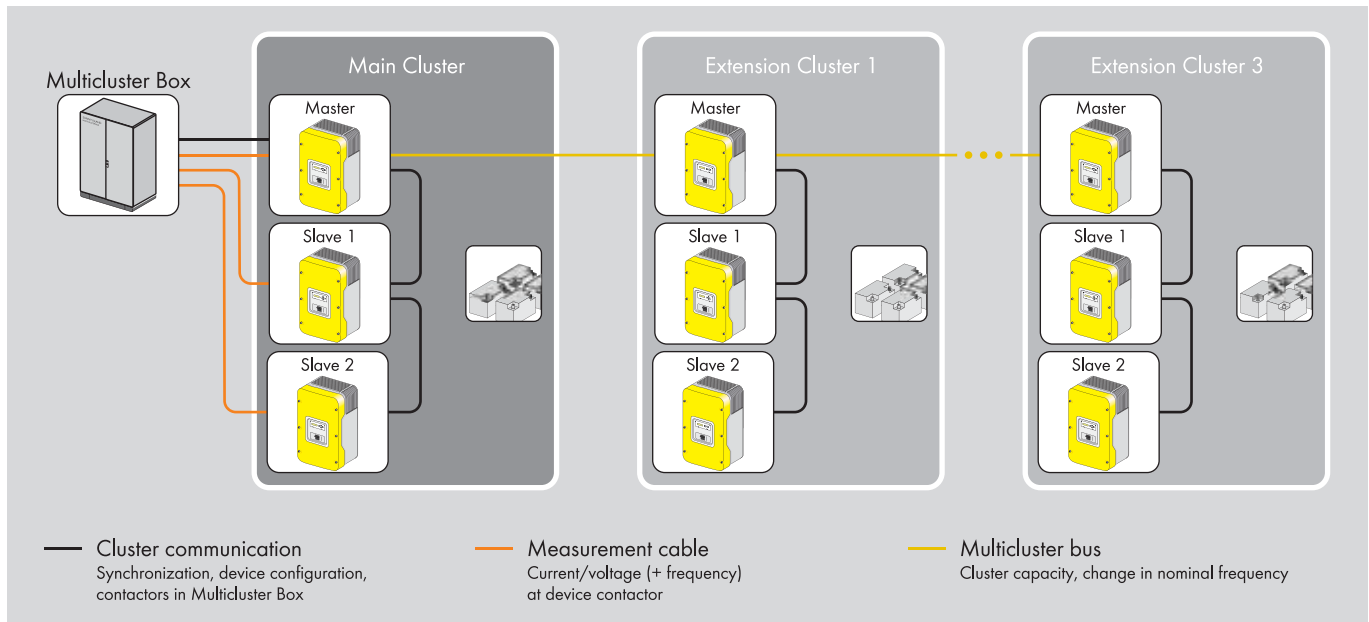
In a stand-alone grid with up to 12 Sunny Island inverters, a clearly organized structure is essential to ensure effective control of the grid. Each of the maximum four clusters consists of three inverters—one master and two slaves. Each of the three-phase clusters is assigned a separate sub-battery that it controls and monitors. One cluster acting as main cluster controls the entire system and communicates with the Multicluster Box.

The main cluster is supported by up to three extension clusters, each of which in turn consists of one extension master and two extension slaves. Thus, we distinguish four hierarchy levels (number of devices in brackets): main master, main slave, extension master, and extension slave.

### **Measurement and control: Communication lines**

In addition to the contactors, the Multicluster Box also contains two interfaces for communication with the main cluster. These are responsible for transmitting current, voltage and frequency at the generator connection to the three inverters of the main cluster, in order to synchronize the clusters with the generator.

To enable tripping of the contactors, the Multicluster Box is also connected to the internal communication bus of the main cluster. In addition, all master inverters in the system are linked to a multicluster bus and exchange information on the current power of the cluster, the state of battery charge and the nominal frequency.



The structure of the modular multicuster system with the required communication connections

### Flexible in day-to-day operation

The modular design of off-grid systems makes them highly flexible, not only in terms of planning, but also for system expansion or maintenance. This makes it easy to expand and upgrade any small system in stages. Additional clusters can be connected to the Multicuster Box at any time, enabling the renewable generation capacity to be expanded according to demand. The only limiting factors are the number of Sunny Island connections possible on each Multicuster Box and the ampacity of their switching devices (see the technical data of the Multicuster Box).

The availability of the total system is also enhanced by the modular structure, based on compact, standard devices. With the exception of the main cluster, maintenance or replacement of individual Sunny Island inverters can take place during system operation, the only difference being that the total output of the system is correspondingly lower during this time. The same is also true of the individual battery segments assigned to the various Sunny Island clusters. The intelligent battery management of the cluster group ensures that all battery segments have regained the same charge within a very short time.

### Easy maintenance by local service technicians

The only regular service work necessary on Sunny Island inverters is the cleaning of the ventilation fans. The individual battery units must be serviced once a year. Due to the protective low voltage used on the DC side, this work can also be performed without any specialized knowledge and during normal operation. In case of a Sunny Island inverter error, every service technician trained by SMA is able to carry out a device replacement.

And, in the even more unlikely case of an error in the Multicuster Box, remedial action involves little effort. It is normally sufficient for a service technician to replace the component on-site.



### **The Island Solution – modern electricity supply on Eigg Island**

Eigg Island is a prime example of a high-performance, off-grid power supply system. The island situated in the Scottish Hebrides, with an area of approximately 11.6 square miles, has never been connected to a power distribution grid. The almost 10 miles separating it from the mainland make such a connection prohibitively expensive. So until 2008, the only electricity available to the approximately 90 island residents was supplied by diesel generators that came with clear disadvantages—electricity generated by diesel engines is both costly and loud. The system had to be switched off at night due to the noise pollution. And for the duration of any maintenance work, the power supply came to a complete standstill.

#### **A power distribution grid of their own**

Since 2008, the islanders have been reaping the benefits of a modern three-phase power distribution grid, 95 percent of which is supplied from renewable energy sources: hydroelectric, wind power and photovoltaics. There is still a diesel generator, but it is purely to provide back-up power when other sources cannot produce. The hybrid system brings the residents considerable benefits. Their energy costs have fallen by more than 60 percent and, at the same time, grid-quality electricity is now available 24 hours a day. The central element of the stand-alone power grid is a group of four Sunny Island clusters, which are connected to various generators and loads via a Multicluster Box 12. Three

water turbines with a total of 110 kW, four small wind turbines with 24 kW and a PV plant with 32 kW peak power are responsible for the supply of green electricity. This means the Sunny Island inverters, with 60 kW nominal power, face a power generation capacity from renewables of around 166 kW. This power ratio is typical for off-grid systems, since the maximum capacities of the different generators are only rarely available at the same time. Two diesel generators, each with 64 kW nominal power, serve as back-up systems in case the renewable energy output falls too low. However, only one of the generators is ever in operation at any one time, so that the system can switch over to the other generator during maintenance work or troubleshooting. The battery bank stores 212 kWh—sufficient to supply the island exclusively with battery current for approximately eight hours. The local power distribution grid operates partially at a medium-voltage level of 11 kV. This helps to avoid transmission losses resulting from the distance of a few miles between loads and power generation plants. Distributed power generation further relieves the power grid, as a certain amount of the energy produced is consumed in the immediate vicinity.

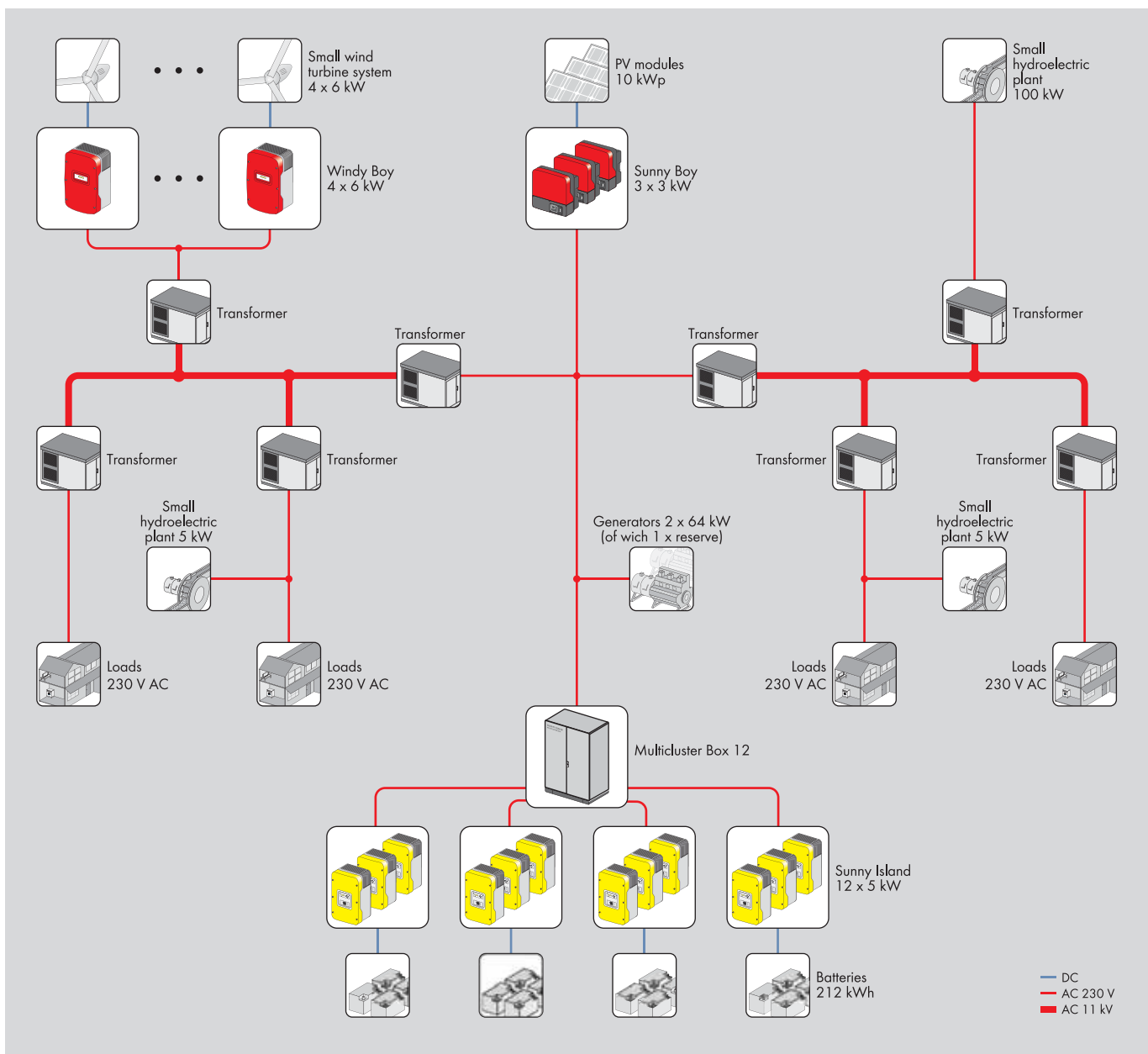
#### **Operating principles**

In normal operation, the main master of the Sunny Island inverters controls the entire grid and ensures that the energy balance is equalized at all times. When the generated power from renewable sources exceeds the current demand (15 kW to 60 kW), the energy surplus is stored in the battery. When the battery is fully

charged, the main master slightly increases the power frequency. One hand, this activates remote-controlled electric room heating in public buildings. On the other, the renewable energy generators carry out a frequency-controlled reduction of their capacity. If the power generation capacity from renewables is not sufficient at any given time, the Sunny Island inverters will support the generators with a total capacity of 60 kW by feeding battery power into the grid. The main master will only start the diesel generator when the state of battery charge falls below 60 percent. In this case, the power frequency is preset by the diesel generator and the Sunny Island clusters synchronize to its grid parameters. At the same time, they are continuously stabilizing the energy balance. When large loads are activated or deactivated, the load on the generator does not change immediately. The inverters are able to compensate for the load fluctuation by instantaneous changing their charge or discharge current. The enormous overload capac-

ity of the devices makes an important contribution to this action. For three seconds, they supply 144 kW of battery power to the grid.

In its role as grid manager, the main cluster analyzes the alternatives of operating the diesel generator at nominal power with the highest possible efficiency, or charging the battery with the appropriate charging current (the current state of charge also plays a role in this equation). As a result, the generator runs less frequently on inefficient partial load and is burdened less with unnecessary, short start/stop cycles. Moreover, such generators, which only have a low power output in relation to the consumption loads, can also be operated safely, as the Sunny Island inverters compensate for sudden load changes. With SMA off-grid systems technology, the island found a perfect solution for its independent energy supply.







**Efficient**

- Max. efficiency > 96%
- CEC efficiency of 94.5%
- Charge level calculation

**Simple**

- Easy commissioning with the "Quick Configuration Guide"
- Complete off-grid management
- Excellent for grid-tied battery back up

**Flexible**

- For Sunny Island systems from 4.5 to 72 kW
- Single and three-phase operation, connectable in parallel and modularly expandable
- AC and DC coupling

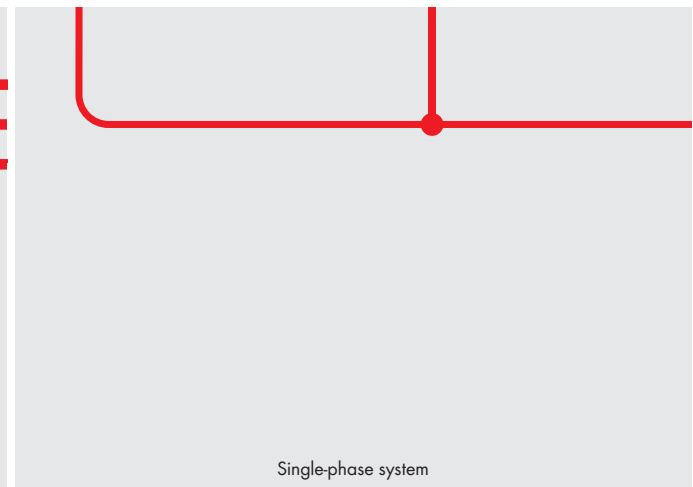
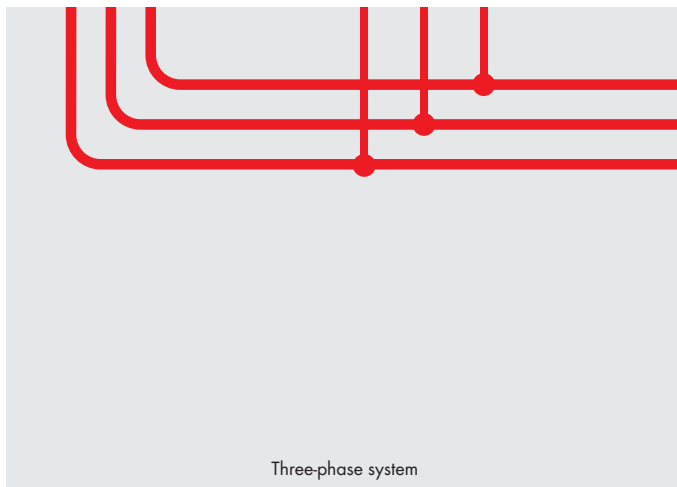
**Durable**

- Extreme overload capacity
- OptiCool™ active temperature management system
- 5-year standard warranty, extendable to 20 years

## SUNNY ISLAND 4548-US / 6048-US

The efficient off-grid manager—now with 20 percent more power

The new SMA Sunny Island 4548-US and 6048-US inverters are based on the proven off-grid technology in the Sunny Island 5048-US but now feature 20 percent more power output. A maximum efficiency of 96 percent ensures peak production, which results in reduced diesel usage in rural communities. More flexible sizing allows for simplified system planning. And, with multicuster technology, up to 12 Sunny Islands can be integrated into off-grid power systems up 110 kW in size.



Technical Data	Sunny Island 4548-US	Sunny Island 6048-US
<b>AC output (loads)</b>		
Nominal AC voltage / adjustable	120 V / 105 V - 132 V	120 V / 105 V - 132 V
Nominal AC frequency / adjustable	60 Hz / 55 Hz ... 65 Hz	60 Hz / 55 Hz ... 65 Hz
Continuous AC power (at 25 °C / at 40 °C) for 3 h	5000 W / 4000 W	6000 W / 5000 W
Continuous AC power (at 25 °C)	4500 W	5750 W
AC power at 25 °C for 30 min / 1 min / 3 s	5300 W / 8400 W / 11000 W	7000 W / 8400 W / 11000 W
Nominal AC current / max. AC current (peak)	37.5 A / 180 A for approx. 60 ms	48 A / 180 A for approx. 60 ms
THD output voltage / power factor at rated power	3 % / -1 ... +1	3 % / -1 ... +1
<b>AC input (generator or grid)</b>		
AC input voltage / range	120 V / 80 V - 150 V	120 V / 80 V - 150 V
AC input frequency / range	60 Hz / 54 Hz ... 66 Hz	60 Hz / 54 Hz ... 66 Hz
Max. input current / adjustable	56 A / 0 A ... 56 A	56 A / 0 A ... 56 A
Max. input power	6.7 kW	6.7 kW
<b>Battery DC input</b>		
Battery voltage / range	48 V / 41 V - 63 V	48 V / 41 V - 63 V
Max. battery charging current / continuous charging current at 25 °C	100 A / 85 A	130 A / 110 A
Battery type / battery capacity	Lead, NiCd / 100 Ah ... 10000 Ah	Lead, NiCd / 100 Ah ... 10000 Ah
Charge control	IUoU process	IUoU process
<b>Efficiency / self-consumption</b>		
Max. efficiency / CEC efficiency	96 % / 94.5 %	96 % / 94 %
Self-consumption with no load / standby	25 W / 4 W	25 W / 4 W
<b>Protection</b>		
DC reverse polarity protection / DC fuse	● / ●	● / ●
AC short circuit / AC overload	● / ●	● / ●
Overtemperature / battery deep discharge	● / ●	● / ●
<b>General data</b>		
Dimensions (W / H / D)	467 / 612 / 235 mm (18.4 / 24.1 / 9.3 inch)	467 / 612 / 235 mm (18.4 / 24.1 / 9.3 inch)
Weight	63 kg / 139 lb	63 kg / 139 lb
Operating temperature range	-25 °C ... +60 °C / -13 °F ... +122 °F	-25 °C ... +60 °C / -13 °F ... +122 °F
Degree of protection (according to IEC 60529)	Interior assembly (NEMA 1)	Interior assembly (NEMA 1)
<b>Features / function</b>		
Operation & display / multifunctional relay	Internal / 2	Internal / 2
3-phase systems / parallel connection	● / ●	● / ●
Integrated bypass / multicuster operation	- / ●	- / ●
State of charge calculation / full charge / equalization charge	● / ● / ●	● / ● / ●
Integrated soft start / generator support	● / ●	● / ●
Battery temperature sensor / communication lines	● / ●	● / ●
Warranty (5 / 10 / 15 / 20 / 25 years)	● / ○ / ○ / ○ / -	● / ○ / ○ / ○ / -
Certificates and approvals	www.SMA-Solar.com	www.SMA-Solar.com
<b>Accessories</b>		
Battery cable / battery fuse	○ / ○	○ / ○
Interface (RS485 / multicuster PB)	○ / ○	○ / ○
Extended generator start "GenMan"	○	○
Load-shedding contactors / external battery current measurement	○ / ○	○ / ○
● Standard features ○ Optional - Not available		
Type designation	SI4548-US-10	SI6048-US-10



**Flexible**

- Integrated AC distribution for Sunny Island, generator and PV systems
- Accommodates various generator, PV and load sizes
- For systems up to 110 kW

**Simple**

- Load shedding, Sunny Island and generator contactors and circuit breakers
- Circuit breaker for PV system

**Enhanced Safety**

- Reverse current monitoring
- Simple emergency operation of the generator

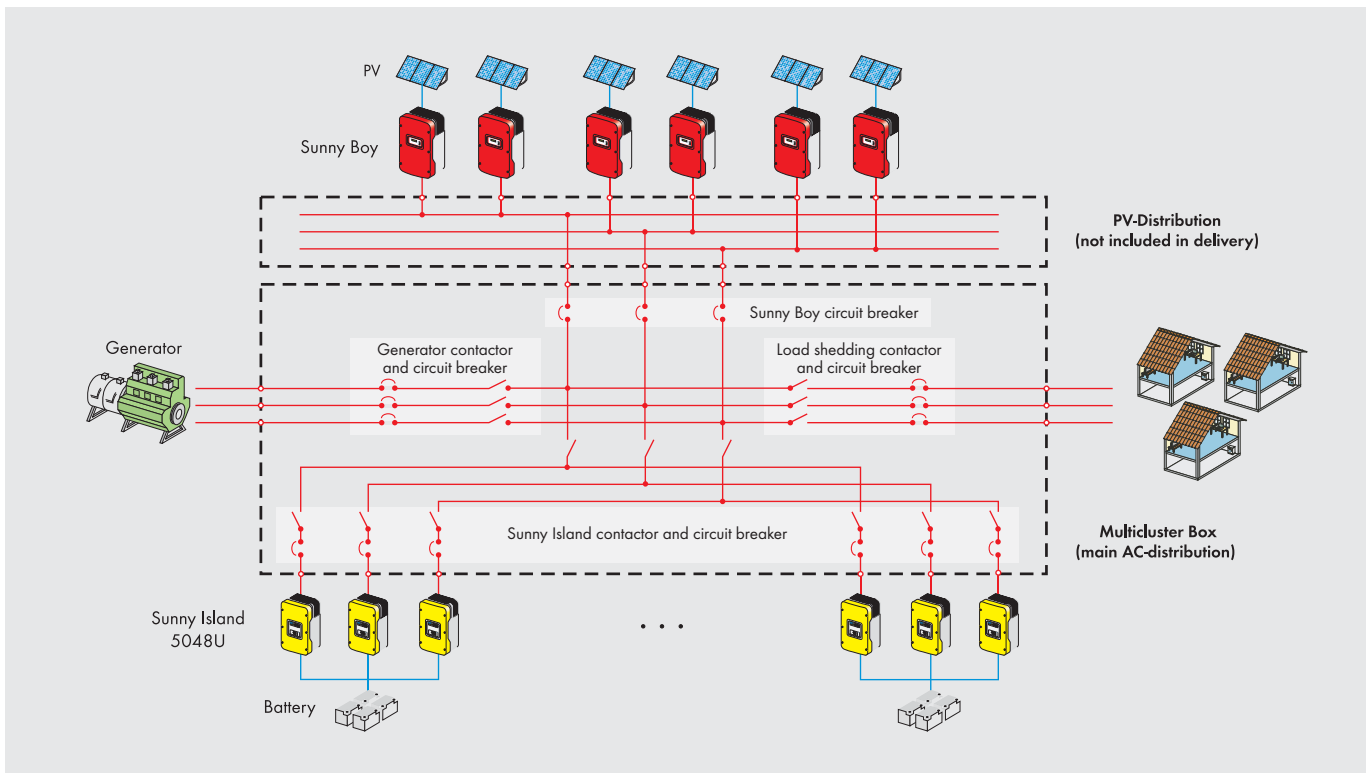
**Sturdy**

- Robust NEMA 3 enclosure rating protects against weather and windblown dust

## Multicluster Box for Sunny Island 4548-US, 5048-US, and 6048-US

Simple design of large off-grid systems

The Multicluster Box for the Sunny Island 4548-US, 5048-US, and 6048-US is the ideal solution for the easy installation of off-grid systems up to 110 kW. Two to four three-phase clusters, each with three Sunny Islands, can be connected in parallel. The Multicluster Box is pre-wired for operation and equipped with a main connection for PV or wind energy systems. The communication cables necessary for installation are also included.



Technical Data	
<b>General</b>	
Number of phases	
Nominal voltage	
Voltage range	
Nominal frequency / range	
Dimensions (W / H / D)	
Mounting type	
Weight	
<b>Connections for Sunny Island</b>	
Number	
Continuous AC output at 77 °F (25 °C)	
AC output for 30 min. / 1 min.	
Nominal AC current at 77 °F (25 °C)	
<b>Connections for PV system</b>	
Number	
Nominal AC power / AC current	
<b>Load Connection</b>	
Number	
Nominal power / current	
<b>Generator connection</b>	
Number	
Nominal power / current	
<b>Ambient conditions</b>	
Ambient temperature	
Enclosure rating	
Certifications and permits	
<b>Accessories</b>	
Communication cable	
Multicuster Piggy-Back	
<p>● Standard features   ○ Optional features   – Not available</p>	
Type designation	
Last revision: September 2011	

Multicuster-Box 12U	
3-phase	
3 x 120 V / 208 V	
105 - 132 V /	
181 - 229 V	
60 Hz / 55 Hz ... 65 Hz	
48 / 65 / 14 in (122 / 165 / 36 cm)	
standing on base	
approx. 485 lbs (220 kg)	
12	
up to 72 kW	
80 kW / 100 kW	
3 x 167 A	
1 x 3-phase	
110 kW / 3 x 300 A	
1 x 3-phase	
110 kW / 3 x 300 A	
1 x 3-phase	
110 kW / 3 x 300 A	
-25 °C to +60 °C (-13 °F to +122 °F)	
NEMA 3	
UL 508	
4 x 5 m FTP Cat 5e55 kW	
○	
MC-BOX-12.3U	



**Simple**

- Pre-wired AC distribution board
- Fast installation and commissioning

**Complete**

- Bypass switch for direct grid operation
- Load shedding relay to prevent deep battery discharge
- Miniature circuit breakers for PV and load

**Efficient**

- Maximum efficiency of 99%

**Safe**

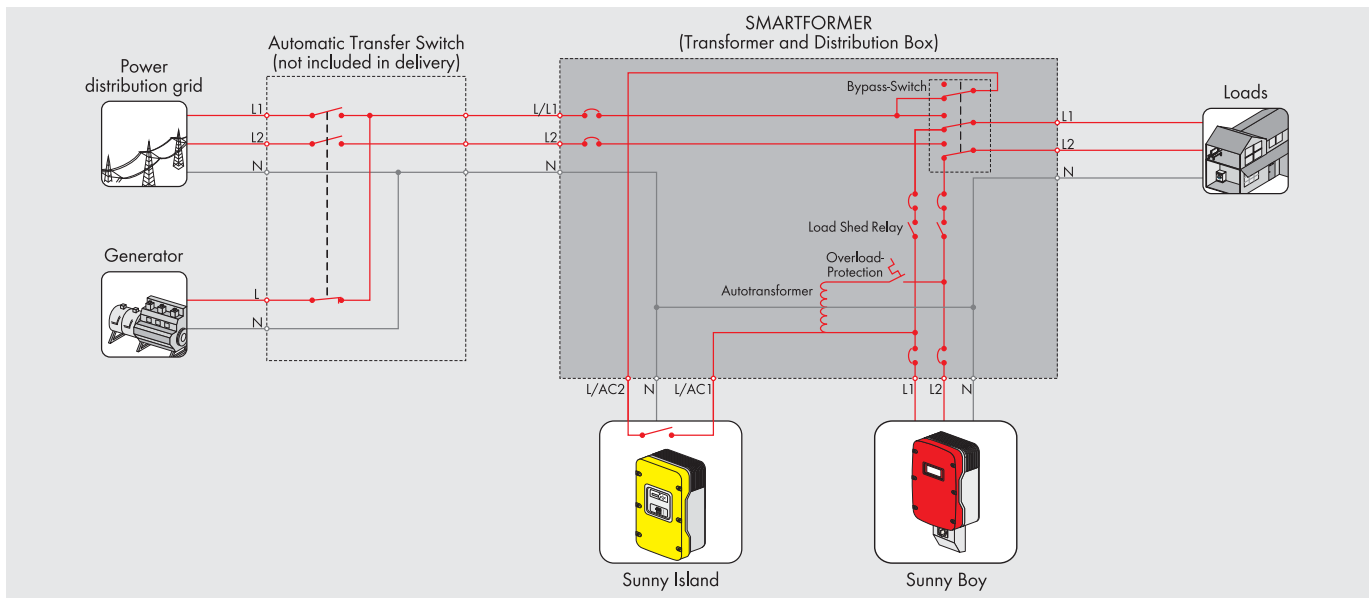
- UL certified
- Optimized overload protection
- 5-year standard warranty, extendable to 20 years

## SMARTFORMER FOR SUNNY ISLAND

Split-phase stand-alone grids—now easier than ever

The Smartformer is the complete solution for off-grid and battery back-up systems up to eight kilowatts. It acts simultaneously as AC distribution and a 120/240 V autoformer. The autoformer provides step-up and step-down options to supply loads with 120 V and 240 V using a Sunny Island and a Sunny Boy, with high efficiency over the entire power spectrum. Thanks to the pre-wired bypass function, the PV system can be easily bridged via a robust switch for maintenance. The optimized transformer overload protection and a load shedding relay provide extra protection to the system. The Smartformer makes the stand-alone power supply simple and reliable.





Technical Data	Smartformer
<b>General Data</b>	
Number of phases	Split-phase
Rated voltage	120/240 V <sub>ac</sub>
AC voltage range between L <sub>1</sub> and N	102 ... 132 V
AC voltage range between L <sub>1</sub> and L <sub>2</sub>	204... 264 V
Rated frequency	60 Hz
Dimensions (width x height x depth)	24.02 x 24.02 x 9.25 in (610 x 610 x 235 mm)
Weight	approx. 123.5 lbs (approx. 56 kg)
Idle power consumption	19 W (typical)
Nominal power autotransformer	4 kVA
Max. efficiency/CEC efficiency	99% / 98,6%
Hookup access	Knockouts top: 2x 3/4", 2x 1", 2x 1 1/4" bottom: 5x 3/4", 3x 1", 3x 1 1/4"
<b>Connections for Sunny Island</b>	
Maximum number and nominal voltage of Sunny Island	1 x 120 V (L1, N)
Rated power	5.8 kW
Current at rated values	48 A
Fuses	1x miniature circuit breaker K60A for AC2
<b>PV plant connection</b>	
Number of connections/nominal voltage	1 x 240 V (L1, L2, N)
Rated power	9.6 kW
AC current at rated values	40 A
Fuses	2 x miniature circuit breaker Z50A or Z25A, adaptable
<b>Load connection</b>	
Number of connections/nominal voltage	1 x 120/240 V (L1, L2, N)
Rated power	9.6 kW
AC power at 40 °C	9.1 kW
Current at rated values	2 x 40 A (with activated bypass: 2 x 48 A)
Fuse	2 x Z50A (with activated bypass: K60A)
<b>Generator connection</b>	
Number of connections/nominal voltage	1 x 120 / 240 V (L1, L2, N)
Rated grid input power	11.5 kW
AC input current	2 x 48 A
Fuse	2x miniature circuit breaker K60A
<b>Ambient conditions</b>	
Operating temperature range	-13 °F ... +140 °F (-25 °C ... +60 °C)
Air humidity	0 - 100 % (non-condensing)
Protection class	NEMA Type 1
certification and permits	UL 1741
<b>Features/function</b>	
Warranty: 5/10/15/20 years	● / ○ / ○ / ○
Integrated bypass for maintenance/load-shedding relay/transformer protection	● / ● / ●
● Standard features   ○ Optional features   – Not available	
Type designation	SI-TD-BOX-10

Last revision: September 2011



### Efficient

- Maximum efficiency of 98.3%
- Transformerless, with H5 topology

### High Yields

- Superior yield with OptiTrac MPP tracking
- OptiCool™ active temperature management

### Safe

- SMA Power Balancer for three-phase grid connection
- Integrated DC load disconnect and combiner box
- UL 1741/IEEE-1547 compliant

## SUNNY BOY 8000TL-US / 9000TL-US / 10000TL-US

Transformerless design, maximum yields

The Sunny Boy TL-US series is UL-listed for North America and features SMA's innovative H5 topology, resulting in superior efficiencies of up to 98 percent and unmatched solar yields. The transformerless design reduces weight, increases the speed of payback and provides optimum value for any decentralized, commercial PV system. The Sunny Boy TL-US series for North America is the ideal choice for mid-size and large plants from 24 kWp up to the megawatt range.

For more product information and technical data, please visit [www.SMA-America.com](http://www.SMA-America.com).



**UL Certified**

- For countries that require UL certification (UL 1741/IEEE 1547)

**Efficient**

- 97% peak efficiency
- OptiCool™ active temperature management system

**Safe**

- Galvanic isolation

**Simple**

- Patented automatic grid voltage detection\*
- Integrated DC disconnect switch

## SUNNY BOY 5000-US / 6000-US / 7000-US / 8000-US

Versatile performer with UL certification

The Sunny Boy 5000-US, 6000-US, 7000-US and 8000-US inverters are UL certified and feature excellent efficiency. Graduated power classes provide flexibility in system design. Automatic grid voltage detection\* and an integrated DC disconnect switch simplify installation, ensuring safety as well as saving time. These models feature galvanic isolation and can be used with all types of modules—crystalline as well as thin-film.

\* US patent US7352549B1

\*\* also available with operating temperature range up to -40 °



### UL Certified

- For countries that require UL certification (UL 1741/IEEE 1547)

### Efficient

- 96.8% peak efficiency
- OptiCool™ active temperature management system

### Safe

- Galvanic isolation

### Simple

- Patented automatic grid voltage detection\*
- Integrated DC disconnect switch

## SUNNY BOY 3000-US / 3800-US / 4000-US

UL certified, reliable system managers

The Sunny Boy 3000-US, 3800-US and 4000-US inverters are specially designed for countries that require UL certification. Automatic grid voltage detection\* and an integrated DC disconnect switch simplifies installation, ensuring safety as well as saving time. These models feature galvanic isolation and can be used with all types of modules—crystalline as well as thin-film. The die-cast aluminum enclosure, with the OptiCool active temperature management system, guarantees the highest yields possible and a long service life, even under extreme conditions. The Sunny Boy 3800-US is designed for projects with a current limit of 16A.

\* US patent US7352549B1



Eigg Island (courtesy of Wind & Sun Ltd.)





### UL Certified

- For locations requiring UL certification (UL 1741/IEEE-1547)

### High Yields

- 97% peak efficiency
- CEC efficiency of up to 96%
- OptiCool™ active temperature management

### Easy to Use

- Automatic grid voltage detection\*
- Programmable polynomial curve enables free selection of turbines

### Reliable

- Rugged cast aluminum outdoor rated enclosure
- Compatible with Windy Boy Protection Box 600
- 10-year limited standard warranty

## WINDY BOY 5000-US / 6000-US / 7000-US / 8000-US

The customized solution for wind turbine systems

Windy Boy inverters combine the same proven technology present in all Sunny Boy inverters with special firmware that permits direct grid-tied operation with a broad range of wind turbines—without batteries. This greatly reduces the overall system cost because components such as the charge controller, batteries and associated switch gear can be eliminated. Increased total energy capture combined with a reduction of balance of system components greatly reduces the installation and operating costs of a grid-tied wind system. Contact your local wind turbine supplier for information on compatible wind turbine models and system design considerations.

\* US patent US7352549B1



#### UL Certified

- For the North American small wind market (UL 1741/IEEE-1547)

#### Efficient

- Peak efficiency of 96.5%
- OptiCool™ active temperature management

#### Easy to Use

- Programmable polynomial curve enables free selection of turbines

#### Reliable

- Galvanic isolation due to integrated transformer

## WINDY BOY 3000-US

A reliable option with UL certification

User-friendly, safe and reliable, the Windy Boy 3000-US is specially certified for locations requiring UL certification. The automatic grid voltage detection\* allows for straightforward and secure installation. The aluminum die-cast enclosure and the OptiCool active cooling system ensure optimal yield as well as a long lifespan, even under adverse operating conditions.

\* US patent US7352549B1.



**Simple**

- Intuitive operation
- Results are presented in an easy-to-read format

**Customized**

- Flexible system configuration options
- Variable input of numerous load situations

**Complete**

- Cost analysis calculation
- Comprehensive component database

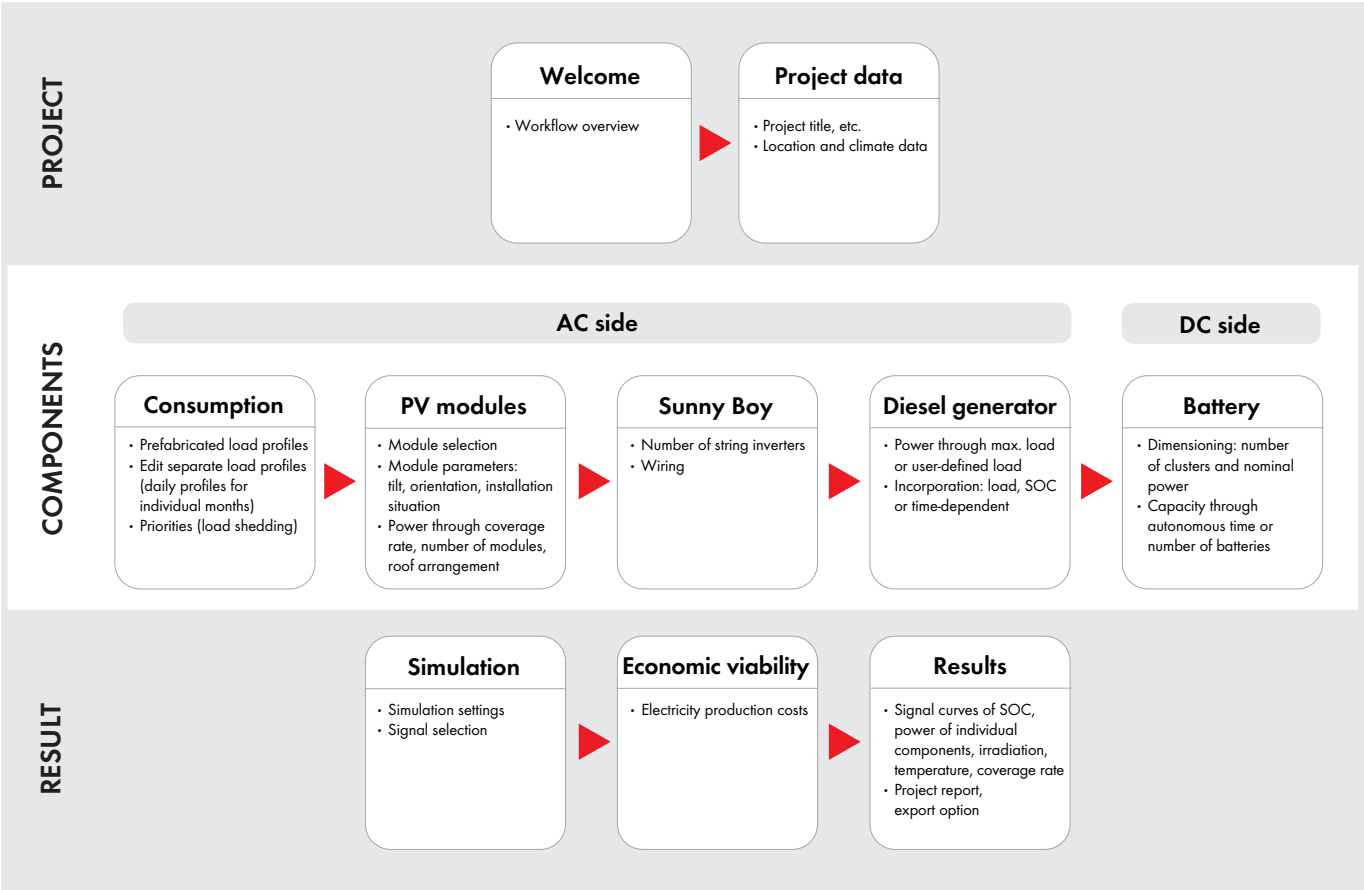
**Worldwide**

- Suitable for all systems, regardless of location
- Location-specific climate data

## SMA OFF-GRID CONFIGURATOR

Design and simulation program for off-grid systems

Designing and planning off-grid systems can be challenging and time-consuming. Whether it's for a small residential system or a large hybrid plant, the new SMA Off-Grid Configurator provides users with a customizable, professional solution for planning off-grid systems that saves time and money. Each design aspect is carefully analyzed, from sizing the PV array, battery and inverter, to a final cost analysis, providing the user with comprehensive planning assistance. The Off-Grid Configurator supports SMA off-grid systems worldwide, including both 230 V and 120 V systems.



Technical Data	SMA Off-Grid Configurator 1.0
<b>Languages</b>	
Available languages	German, English
<b>System requirements</b>	
Supported operating systems	Microsoft Windows XP, Microsoft Vista, Windows 7
Screen resolution	1024 x 768 high-color, 32-bit display
RAM	1 GB
Frequency	1 GHz
Program update	www.SMA-Solar.com
<b>Plant information</b>	
Loads	Individual loads and complete load profiles
Data management	Import and export of data sets
Line voltage	For 120 V and 230 V systems
Systems	1-phase, 2-phase (split phase), 3-phase
<b>Project data</b>	
Plant description	Selection of locations and climate data
Databases	PV module database, SMA inverter database, battery database
Plant layout	Incorporation of diesel generators and SMA Multicluster technology
<b>Interfaces</b>	
Export of results	Excel, Word, PDF
Type designation	SI-CONFIG-10
Last revision: May 2011	



**Customer-oriented**

- Professional commissioning and repair
- Telephone support at the SMA Service Line

**Optimum availability**

- Fast and simple device replacement
- Complete warranty for one year on every replacement device

**System-stabilizing**

- 5-year warranty on all Sunny Island products, PV and wind power inverters

**Flexible**

- Warranty extensions to 10, 15 or 20 years

## SMA Service for Off-grid System Solutions

Support even in remote regions

Stand-alone power plants are employed in off-grid regions. Since these places are often difficult to reach, devices are required which are long-lasting and easy to maintain and operate. Along with the most important components for a stand-alone grid, such as off-grid, PV or wind power inverters, SMA also offers professional service should problems arise, all from one source. Whether it's the SMA Service Line, support during commissioning or our replacement service, our services are individually tailored to the needs of solar power professionals – worldwide.

### Expert advice over the telephone via the SMA Service Line

Our SMA Service Line supports solar power professionals during the installation and commissioning of off-grid systems, advises on technical issues, and provides tips on PV plant monitoring. Specially trained expert teams are available for all inquiries about Sunny Island products as well as PV inverters and communication devices. On request, our professionals can also advise on how to optimize plant operation.

### On-site service support

We have a well-established service infrastructure with numerous access points, currently in 14 countries. From commissioning to device replacement, we are ready to support our customers around the world.

### Device replacement for the highest level of security

In the unlikely event of a failure, we will keep down times as short as possible by replacing your device. After a call is received, the replacement inverter is generally shipped on the same day. To replace the defective inverter, the customer will receive a comparable device with state-of-the-art technology, including all updates and alterations. If a device is exchanged within the warranty period, the remaining warranty period is transferred to the replacement device. In all cases, we provide a full one-year warranty on all replacement devices whether or not the original warranty is still valid.

### More security with long-term warranties

SMA products meet the highest quality standards and come with a standard five-year warranty. Furthermore, we offer an extended warranty option that covers your device for a total of 10, 15 or 20 years, with which operators can assure themselves of the right to free repair or a replacement device.

### Interested?

Both operators and solar power professionals are equally well served with the SMA service concept. Additional information on our services is available on the corresponding SMA website.



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