



Installation - Quick Reference Guide

Off-Grid Systems

Off-Grid Systems with SUNNY ISLAND 3.0M / 4.4M / 6.0H / 8.0H



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1 Information on this Document

1.1 Validity

This document is valid for off-grid systems with the following Sunny Island inverter device types:

- SI3.0M-11 (Sunny Island 3.0M) from firmware version 3.2
- SI4.4M-11 (Sunny Island 4.4M) from firmware version 3.2
- SI6.0H-11 (Sunny Island 6.0H) from firmware version 3.1
- SI8.0H-11 (Sunny Island 8.0H) from firmware version 3.1

1.2 Content and Structure of this Document

This document summarizes the specific information on off-grid systems with Sunny Island inverters. Circuitry overviews of selected off-grid systems provide the basis as to how an off-grid system can be designed. The structure of the document specifies the chronological sequence for configuration and commissioning. This document does not replace the documentation of the individual products. You will find details and help in the event of difficulties in the documentation of the respective product.

1.3 Target Group

The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:






- Training in how to deal with the dangers and risks associated with installing and using electrical devices and batteries
- Training in the installation and commissioning of electrical devices
- Knowledge of and adherence to the local standards and directives
- Knowledge of and compliance with this document and all safety precautions

1.4 Additional Information

Links to additional information can be found at www.SMA-Solar.com:

Document title	Document type
Sunny Island System Guide	Brochure
Off-Grid Systems	Planning guidelines
PV Inverters in Off-Grid Systems	Technical information
Sunny Island "Generator - Whitepaper"	Technical file
External Energy Sources	Technical information

1.5 Symbols for Information

Symbol	Explanation
 DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
 WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
 CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
 NOTICE	Indicates a situation which, if not avoided, can result in property damage
	Information that is important for a specific topic or goal, but is not safety-relevant
<input type="checkbox"/>	Indicates a requirement for meeting a specific goal
<input checked="" type="checkbox"/>	Desired result
x	A problem that might occur

1.6 Typographies

Typography	Use	Example
bold	<ul style="list-style-type: none"> • Display messages • Parameters • Terminals • Slots • Elements to be selected • Elements to be entered 	<ul style="list-style-type: none"> • Connect the grounding conductor to AC 2Gen/Grid. • Select the parameter 235.01 GnAutoEna and set to Off.
>	<ul style="list-style-type: none"> • Several elements that are to be selected 	<ul style="list-style-type: none"> • Select 600# Direct Access > Select Number.
[Button/Key]	<ul style="list-style-type: none"> • Button/key on the inverter to be selected or pressed 	<ul style="list-style-type: none"> • Press [ENTER].

1.7 Nomenclature

Complete designation	Designation in this document
Sunny Boy, Sunny Mini Central, Sunny Tripower	PV inverter
Battery charge controllers not supplied by SMA Solar Technology AG	Charge controllers from a third-party supplier
AC voltage source that can form a stand-alone grid (e.g., diesel generator)	Generator

The term parameter includes parameters with configurable values as well as parameters for displaying values.

2 Safety

2.1 Intended Use

Off-grid systems with Sunny Island inverters are self-sufficient utility grids that are being fed with energy from several AC sources in the stand-alone grid (e.g., PV inverter), from a generator, and/or with DC charge controllers (e.g., Sunny Island Charger). The Sunny Island forms the stand-alone grid as a voltage source. The Sunny Island regulates the balance between the energy fed-in and energy used and has a management system with battery and generator management and load control.

The Sunny Island can synchronize with a generator and connect directly, if necessary. When the stand-alone grid is connected to the generator, the voltage in the stand-alone grid is regulated by the generator.

Off-grid systems with Sunny Island inverters are single-phase or three-phase AC distribution grids. The local standards and provisions must be observed. Loads in off-grid systems are not protected against power failure. An off-grid system is not suitable for supplying life-sustaining medical devices.

Multiple Sunny Island inverters can be operated in an off-grid system. Three Sunny Island inverters are connected in parallel on the DC side and form a cluster. A cluster can consist of the following device types:

Device type	Potential device types within a cluster	Explanation
SI3.0M-11	SI3.0M-11	A cluster must consist of the same device types.
SI4.4M-11	SI4.4M-11	
SI6.0H-11	SI6.0H-11 or SI8.0H-11	A cluster can consist of different device types.
SI8.0H-11	SI6.0H-11 or SI8.0H-11	If the device types within the cluster are different, the master must be device type SI8.0H-11.

The circuitry of the Sunny Island inverters forming a cluster and the circuitry of several clusters in a system must be carried out in accordance with this documentation (see Section 3 "Information on Off-Grid Systems and System Description", page 11).

The output power of the AC sources in the stand-alone grid is controlled via the frequency and voltage of the stand-alone grid. The AC sources must be suitable for stand-alone mode with Sunny Island (see Technical Information "PV Inverters in Off-Grid Systems" at www.SMA-Solar.com). The maximum output power of the AC sources in a stand-alone grid must be observed (see the Sunny Island inverter installation manual).

The Sunny Island uses lead-acid batteries or lithium-ion batteries for energy storage in off-grid systems. Ensure that the battery room is sufficiently ventilated when using lead-acid batteries (see battery manufacturer's documentation). If a lithium-ion battery is connected, its battery management must be compatible with the Sunny Island. The lithium-ion battery must be able to supply enough current at maximum output power of the Sunny Island inverter (for technical data see the Sunny Island inverter installation manual). The individual products in the off-grid system must be used for their intended purpose (see documentation of each product). Any use of the system other than that described in the Intended Use section does not qualify as appropriate.

DC loads, up to four Sunny Island Charger charge controllers per cluster, or charge controllers from third-party suppliers can only be connected in off-grid systems with lead-acid batteries. The battery management must record the DC current during battery charging and electric discharge. If charge controllers from a third-party supplier or DC loads are installed in an off-grid system, an additional battery current sensor must be installed. The Sunny Island is not suitable for establishing a DC distribution grid.

The enclosed documentation is an integral part of the products. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

2.2 Safety Precautions

This section contains safety precautions that must be observed at all times when working on or with the system. To prevent personal injury or property damage and to ensure long-term operation of the system, read this section carefully and follow all safety precautions at all times.

⚠ WARNING

Danger to life due to incompatible lithium-ion battery

An incompatible lithium-ion battery can lead to a fire or an explosion. With incompatible lithium-ion batteries, it is not ensured that the battery management is intrinsically safe and will protect the battery.

- Ensure that the battery complies with the locally applicable standards and directives and is intrinsically safe.
- Ensure that the lithium-ion batteries are approved for use with the Sunny Island.

The list of lithium-ion batteries approved for the Sunny Island is updated constantly (see Technical Information "List of approved lithium-ion batteries" at www.SMA-Solar.com).

- If no lithium-ion batteries approved for Sunny Island can be used, you should use lead-acid batteries.

Danger to life due to explosive gases

Explosive gases may escape from the battery and cause an explosion. This can result in death or serious injury.

- Protect the battery environment from open flames, embers, or sparks.
- Install, operate, and maintain the battery in accordance with the manufacturer's specifications.
- Do not heat the battery above the temperature permitted or burn the battery.
- Ensure that the battery room is sufficiently ventilated.

Danger to life from electric shock due to circuit breakers that cannot be tripped

In the off-grid system, only the circuit breakers that can be tripped by the Sunny Island can be tripped. Circuit breakers with a higher operating current cannot be tripped. Under fault conditions, there may be a voltage that poses a danger to life present on accessible parts for several seconds. This can result in death or serious injury.

- Check if a circuit breaker has a higher trip characteristic than the following circuit breakers which can be tripped:
 - SI3.0M-11 and SI4.4M-11: circuit breaker with trip characteristic B6 (B6A)
 - SI6.0H-11 and SI8.0H-11: circuit breaker with trip characteristic B16 (B16A) or circuit breaker with trip characteristic C6 (C6A)

If a circuit breaker has a higher trip characteristic than the specified circuit breaker which can be tripped, you should also install a residual-current device of type A.

Danger to life from electric shock due to damaged devices

Operating a damaged device can lead to hazardous situations that can result in death or serious injuries due to electric shock.

- Only use the off-grid system when it is technically faultless and in an operationally safe state.
- Regularly check the off-grid system for visible damage.
- Ensure that all safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.

⚠ WARNING**Danger to life from electric shock due to live voltage**

High voltages are present in the off-grid system. When covers (e.g., an enclosure lid) are removed, live components can be touched, which can result in death or serious injury due to electric shock.

- When carrying out any work on the electrical installation, wear suitable personal protective equipment.
- Turn off or disconnect the following devices from voltage sources in the given order:
 - Loads
 - Generator
 - Sunny Island
 - In the distribution board, the circuit breakers of the Sunny Island inverter and of the generator
 - Load-break switch of the battery
- Ensure that the off-grid system cannot be reconnected.
- Open the enclosure lid on the Sunny Island inverter and ensure that no voltage is present in the device.
- Ground and short-circuit the AC conductors outside the Sunny Island inverter.
- Cover or isolate any adjacent live components.

Chemical burns and poisoning due to battery electrolyte

If handled inappropriately, battery electrolyte can cause irritation to the eyes, respiratory system, and skin and it can be toxic. This may result in blindness and serious chemical burns.

- Protect the battery enclosure against destruction.
- Do not open or deform the battery.
- Whenever working on the battery, wear suitable personal protective equipment such as rubber gloves, apron, rubber boots, and goggles.
- In the case of acid splashing into eyes or on skin, rinse thoroughly with clear water and consult a doctor.
- If acid fumes have been inhaled, consult a doctor.
- Install, operate, maintain, and dispose of the battery according to the manufacturer's specifications.

Risk of injury due to short-circuit currents

Short-circuit currents in the battery can cause heat build-up and electric arcs. Burns or eye injuries due to flashes may result.

- Remove watches, rings, and other metal objects.
- Use insulated tools.
- Do not place tools or metal parts on the battery.

Risk of crushing injuries due to movable generator parts

Moving parts in the generator can crush or sever body parts. A generator can be started automatically by the Sunny Island.

- Only operate the generator with the safety equipment.
- Install, maintain, and operate the generator according to the manufacturer's specifications.

⚠ CAUTION**Risk of burns due to short-circuit currents on the disconnected Sunny Island**

The capacitors at the DC connection input area store energy. After the battery is isolated from the Sunny Island, battery voltage is still temporarily present at the DC terminal. A short circuit at the DC terminal can lead to burns and may damage the Sunny Island.

- Wait 15 minutes before performing any work at the terminal or on the DC cables. This allows the capacitors to discharge.

NOTICE**Damage to the battery due to incorrect settings**

Incorrect settings can lead to premature aging of the battery. Settings of the parameters in the menu **220# Battery** influence the charging behavior of the Sunny Island inverter.

- Ensure that the values recommended by the battery manufacturer are set for the battery (for the battery technical data, see the documentation of the battery manufacturer).

Destruction of devices due to electrostatic discharge (ESD)

If enclosure parts are removed, the devices (e.g., Sunny Island or PV inverter) can be damaged or destroyed if electronic components or terminals are touched.

- Do not touch any electronic components in open devices.
- Ground yourself before touching any terminals.

3 Information on Off-Grid Systems and System Description

3.1 Off-Grid System Functions

Off-grid systems with Sunny Island inverters are self-sufficient utility grids that are being fed with energy from several AC sources in the stand-alone grid (e.g., PV inverter), from an external AC voltage source (e.g., diesel generator), and/or with DC charge controllers (e.g., Sunny Island Charger). The Sunny Island forms the stand-alone grid as a voltage source and provides active and reactive power. The Sunny Island regulates the balance between the energy fed-in and energy used and has a management system with battery and generator management and load control.

In order to be able to distribute the output power of the off-grid system to the loads, several Sunny Island inverters can be connected modularly in an off-grid system.

Battery Management

Battery management of the Sunny Island inverter is based on precise determination of the state of charge. By combining the three most common methods for recording the state of charge, the Sunny Island reaches a measuring accuracy of more than 95%. This way, overcharge and deep discharge of the battery are avoided.

A further feature of battery management is the extremely gentle charging control. It automatically selects the optimum charging strategy for the battery type and the situation in which it is used. This means that overcharging can be reliably prevented and that the battery can be fully charged regularly. The available charge energy is used optimally at all times (see Technical Information "Battery Management" at www.SMA-Solar.com).

Generator Management

The Sunny Island inverter generator management allows for uninterruptible connection of the stand-alone grid to the generator and uninterruptible isolation from the generator. The generator management controls the generator via a start and stop signal. A generator current control ensures that the generator always remains at the optimum operating point. The generator management allows the use of generators that have a low output power in proportion to the nominal load (see Technical Document "Sunny Island - Generator Whitepaper" at www.SMA-Solar.com).

Load Control

The load control enables control of the AC sources in stand-alone grids, control of a generator, and the specific disconnection of loads.

The AC sources in the stand-alone grid are limited in their power output by the stand-alone grid frequency. In case of excess energy, the load control increases the power frequency. This limits the output power of the PV inverters, for example.

If there is not enough energy available for all loads or the battery is to be preserved, load control can request energy from a generator by means of the generator management. The generator management starts the generator and the off-grid system is supplied with sufficient energy.

If there is no generator present in the off-grid system or the energy is not sufficient despite the generator being available, load control turns the loads off using load shedding. All loads are shed simultaneously with one-stage load shedding. A load shedding contactor sheds the noncritical loads during the first stage with two-stage load shedding. The remaining loads are shed during the second stage only when the state of charge declines further. This can further increase the availability of the off-grid system for critical loads.

3.2 Modular Design

3.2.1 Single System

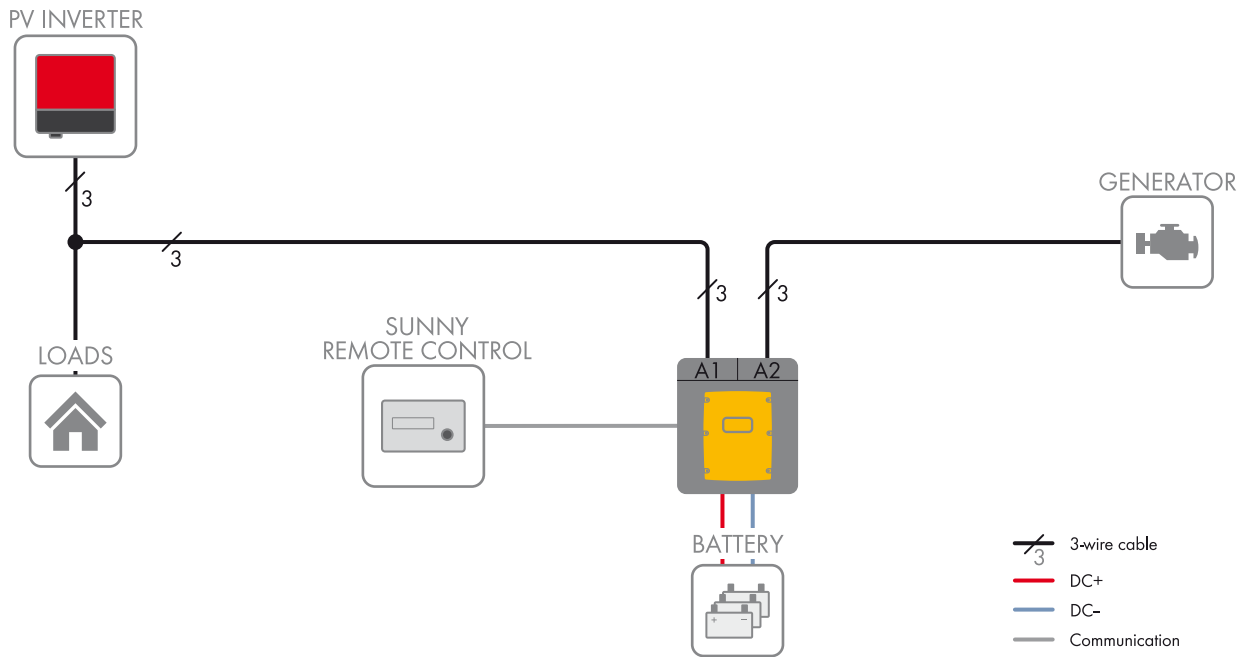


Figure 1: Block circuit diagram

In a single system, one Sunny Island forms a single-phase stand-alone grid.

3.2.2 Single-Cluster System (Single-Phase)

i Required device types for single-phase single-cluster systems

In single-phase single-cluster systems, the Sunny Island inverters must be device type SI6.0H-11 or SI8.0H-11.

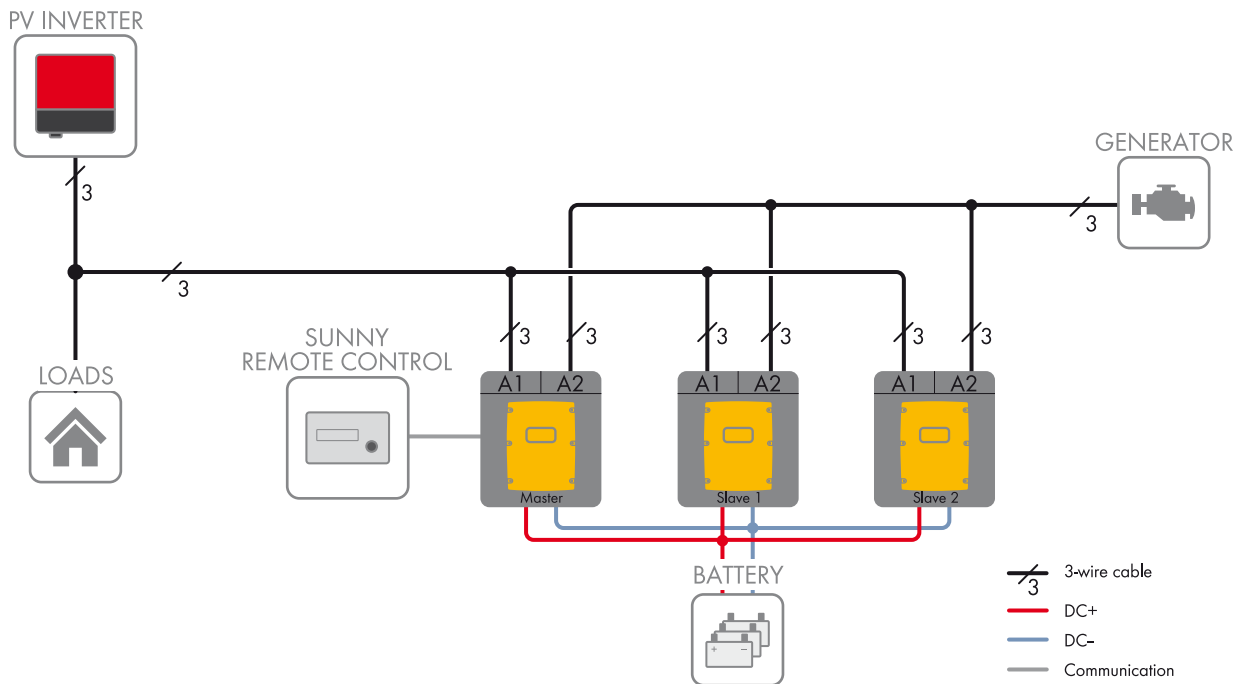


Figure 2: Block circuit diagram

In a single-phase single-cluster system, up to three Sunny Island inverters are connected to one battery forming a cluster. The Sunny Island inverters are connected on the AC side to the same line conductor. If the device types within the cluster are different, the master must be an SI8.0H-11.

3.2.3 Single-Cluster System (Three-Phase)

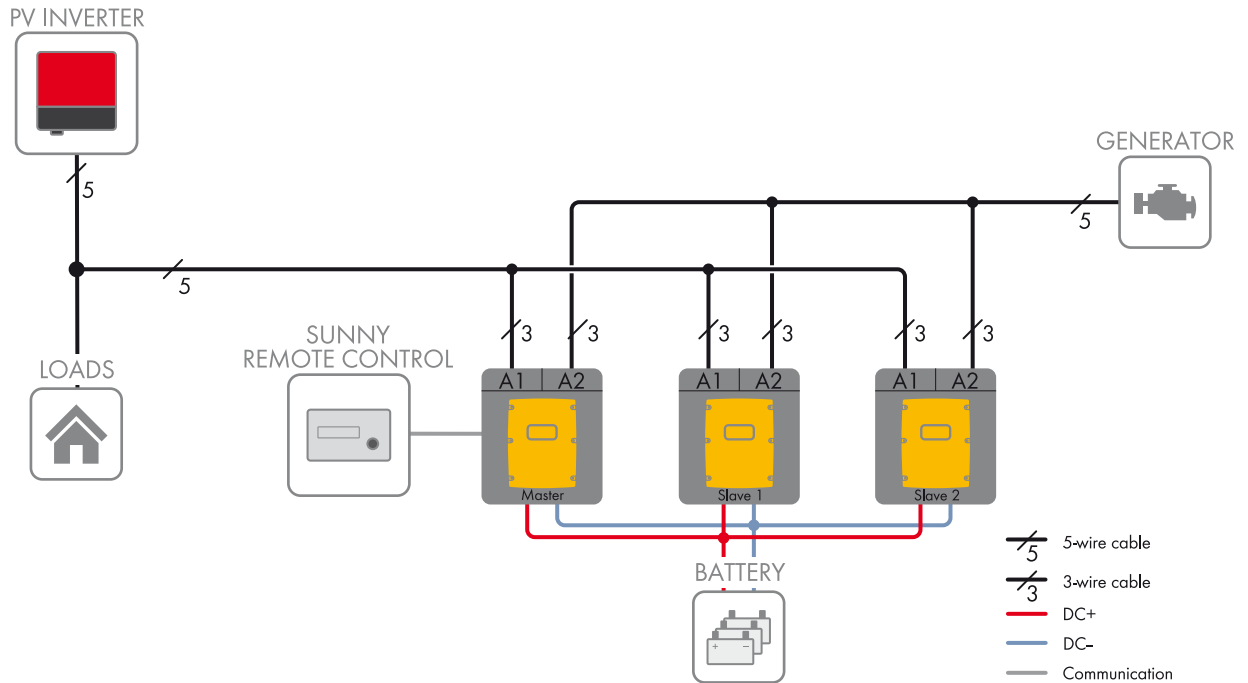


Figure 3: Block circuit diagram

In a three-phase single-cluster system, three Sunny Island inverters are connected to one battery forming a cluster. The Sunny Island inverters are connected on the AC side to three different line conductors. A cluster that consists of different device types is only supported by SI6.0H-11 and SI8.0H-11. If the device types within the cluster are different, the master must be an SI8.0H-11 (see Section 3.3 "Information on Off-Grid Systems", page 14).

3.2.4 Multicluster System

i Required device types for multicluster systems

In multicluster systems, the Sunny Island inverters must be device type SI6.0H-11 or SI8.0H-11.

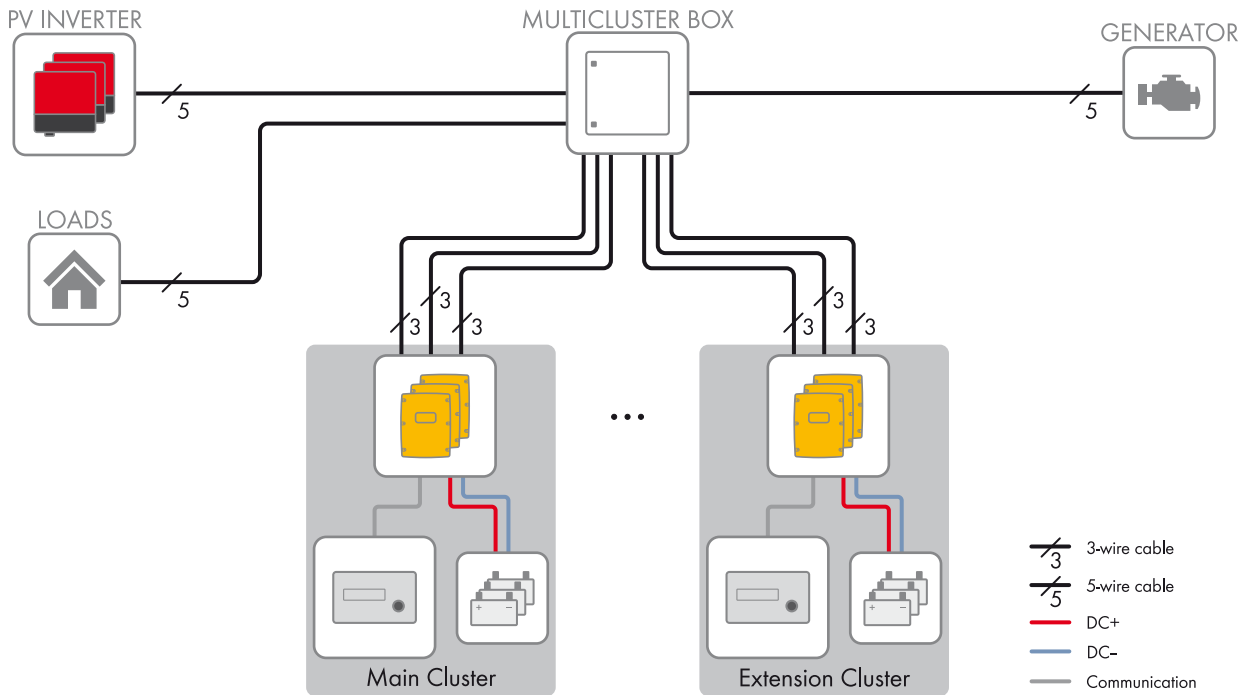


Figure 4: Block circuit diagram

Multicluster systems consist of several three-phase clusters. The individual clusters must be connected to a Multicluster Box. The Multicluster Box is the AC main distribution board in a multicluster system. If the device types within the cluster are different, the master must be an SI8.0H-11.

3.3 Information on Off-Grid Systems

i Information on batteries

Lithium-ion batteries in off-grid systems

In order to meet the requirements of off-grid systems, the Sunny Island has a high overload capacity. The prerequisite for this overload capacity is that the battery is able to supply sufficient current. With lithium-ion batteries, this capacity cannot be taken for granted.

- Check with the battery manufacturer whether the battery is suitable for off-grid systems with Sunny Island inverters. Pay special attention to the ampacity.

Recommendations for battery capacity

SMA Solar Technology AG recommends the following minimum battery capacities.

- Minimum battery capacity per Sunny Island inverter:
 - SI3.0M-11: 100 Ah
 - SI4.4M-11: 150 Ah
 - SI6.0H-11: 190 Ah
 - SI8.0H-11: 250 Ah
- Minimum battery capacity per 1,000 Wp power of the PV system: 100 Ah

The sum of the individual battery capacities is the total minimum battery capacity and applies to a ten-hour electric discharge (C10). The minimum battery capacity must be observed to ensure stable operation of the system.

i Information on clusters

Device types within a cluster

A cluster can consist of the following device types:

Device type	Potential device types within a cluster	Explanation
SI3.0M-11	SI3.0M-11	A cluster must consist of the same device types.
SI4.4M-11	SI4.4M-11	
SI6.0H-11	SI6.0H-11 or SI8.0H-11	A cluster can consist of different device types. If the device types within the cluster are different, the master must be device type SI8.0H-11.
SI8.0H-11	SI6.0H-11 or SI8.0H-11	

Clusters in single-phase single-cluster systems

In single-phase single-cluster systems, the Sunny Island inverters must be device type SI6.0H-11 and SI8.0H-11. If the device types within the cluster are different, the master must be an SI8.0H-11.

Clusters in multicluster systems

In multicluster systems, the Sunny Island inverters must be device type SI6.0H-11 and SI8.0H-11. The clusters can consist of different Sunny Island device types. If the device types within the cluster are different, the master must be an SI8.0H-11.

i Connecting the Sunny Island inverters in single-phase single-cluster systems

In a single-phase single cluster system, the following cable lengths and conductor cross-sections must be designed the same way:

- From the generator to each Sunny Island
- From each Sunny Island to the AC distribution board
- From the BatFuse to each Sunny Island

The same design is a requirement for stable and symmetrical operation of the off-grid system.

Maximum PV system power

In off-grid systems, the maximum PV system power depends on the total power of the Sunny Island inverters.

- Maximum output power of the PV system per SI3.0M-11: 4,600 W
- Maximum output power of the PV system per SI4.4M-11: 4,600 W
- Maximum output power of the PV system per SI6.0H-11: 9,200 W
- Maximum output power of the PV system per SI8.0H-11: 12,000 W

The maximum output power of the PV system must be observed to ensure stable operation of the off-grid system.

3.4 Optional Devices and Functions

Use of the following devices is optional in an off-grid system:

Device	Description
Load-shedding contactor	Contactors controlled by the Sunny Island for isolation of loads
Sunny WebBox	Remote monitoring and system configuration of the off-grid system
Sunny Island Charger 50	Charge controller for off-grid systems with lead-acid batteries A maximum of four Sunny Island Charger charge controllers can be connected to a cluster. In multicluster systems, four Sunny Island Charger charge controllers can be connected to each cluster. If lithium-ion batteries are used, no charge controllers can be connected.

Device	Description
Battery current sensor	Shunt for measuring the battery current A battery current sensor is required in off-grid systems with DC loads or with charge controllers from third-party suppliers (see Section 2.1 "Intended Use", page 7).

Sunny Island offers the following functions for off-grid systems via two multifunction relays (see the Sunny Island inverter installation manual):

Function	Description
Controlling generators	A multifunction relay activates if a generator request is received from the Sunny Island inverter's generator management. With the multifunction relay, you can control generators with electrical remote-start function or connect a signal generator for generators with no autostart function.
Control of load-shedding contactors	A multifunction relay is activated depending on the state of charge of the battery. Depending on the configuration, you can install a one-stage load shedding with one multifunction relay or a two-stage load shedding with two multifunction relays. You can also adjust the limiting values for the state of charge of the battery depending on the time of day.
Time control for external processes	External processes can be time-controlled with a multifunction relay.
Display of operating states and warning messages	You can connect message devices to the multifunction relays to allow operating states and warning messages from the Sunny Island inverter to be output. One of the following operating states and warning messages can be displayed for each multifunction relay: <ul style="list-style-type: none"> • The generator is running and is connected. • A Sunny Island displays an error message of level 2 or higher. Only the error messages within a cluster are evaluated here. • A Sunny Island displays a warning. Only the warnings within a cluster are evaluated here. • The Sunny Island is in operation in a single system. • The respective cluster is in operation in a cluster system. • The Sunny Island is in derating in a single system. • The respective cluster is in derating in a cluster system.
Control of a battery-room fan	The multifunction relay is activated when the charging current leads to the battery emitting gases. A connected battery room fan is switched on for at least one hour.
Control of an electrolyte pump	Depending on the nominal energy throughput, the multifunction relay is activated at least once a day.
Use of excess energy	During the constant voltage phase, a multifunction relay is activated and thus controls additional loads that can put any excess energy of AC sources in the stand-alone grid (e.g., of a PV system) to good use.

4 Single System

4.1 Circuitry Overview

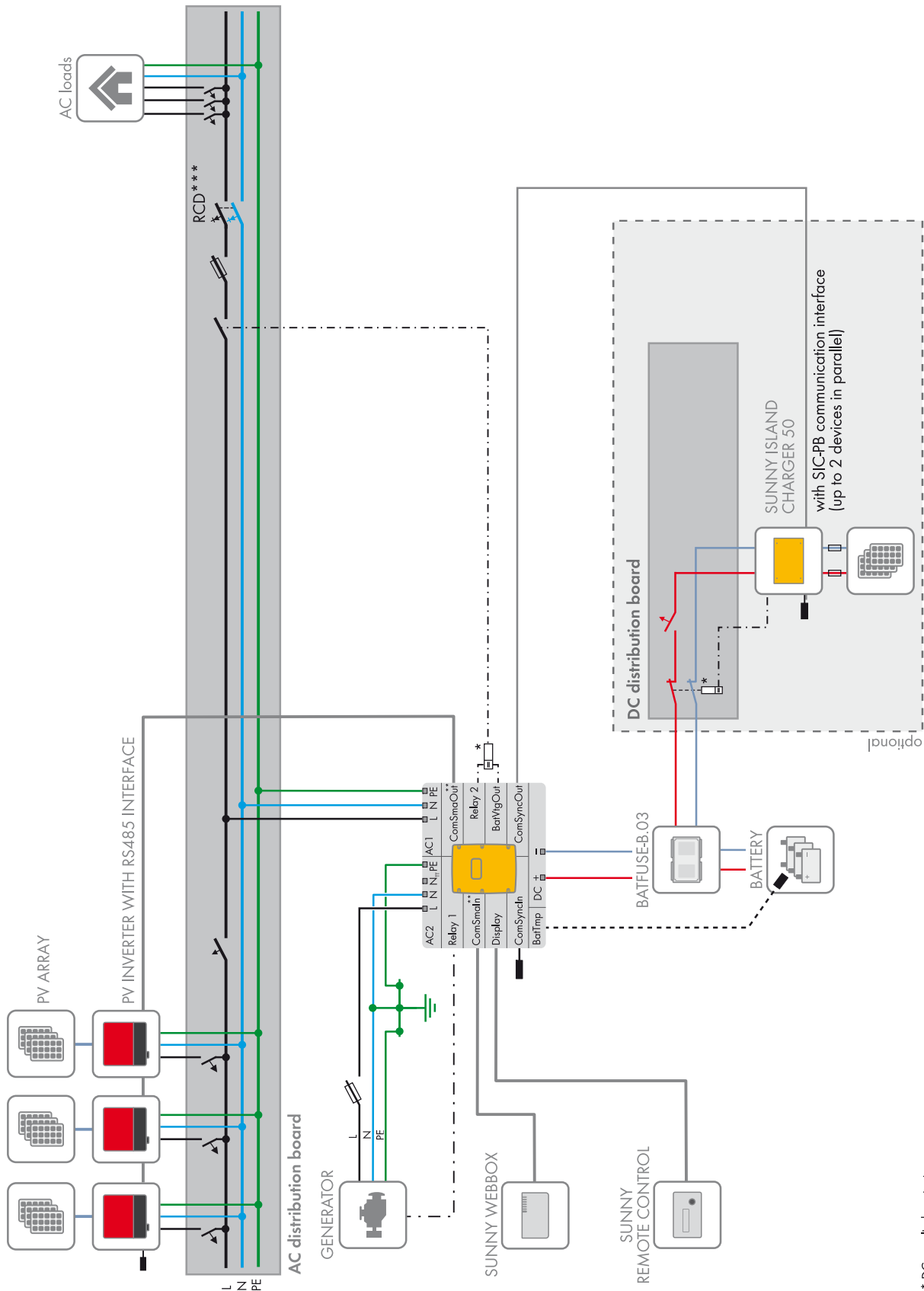


Figure 5: Single system

* DC-supplied contactor
 ** RS485 interface SLCOMSMA.BGx
 *** Whether a residual-current device (RCD) is required or not depends on the stand-alone grid configuration and the grid-forming voltage sources (see technical information "Grounding in Off-Grid Systems").

4.2 Connecting the Sunny Island

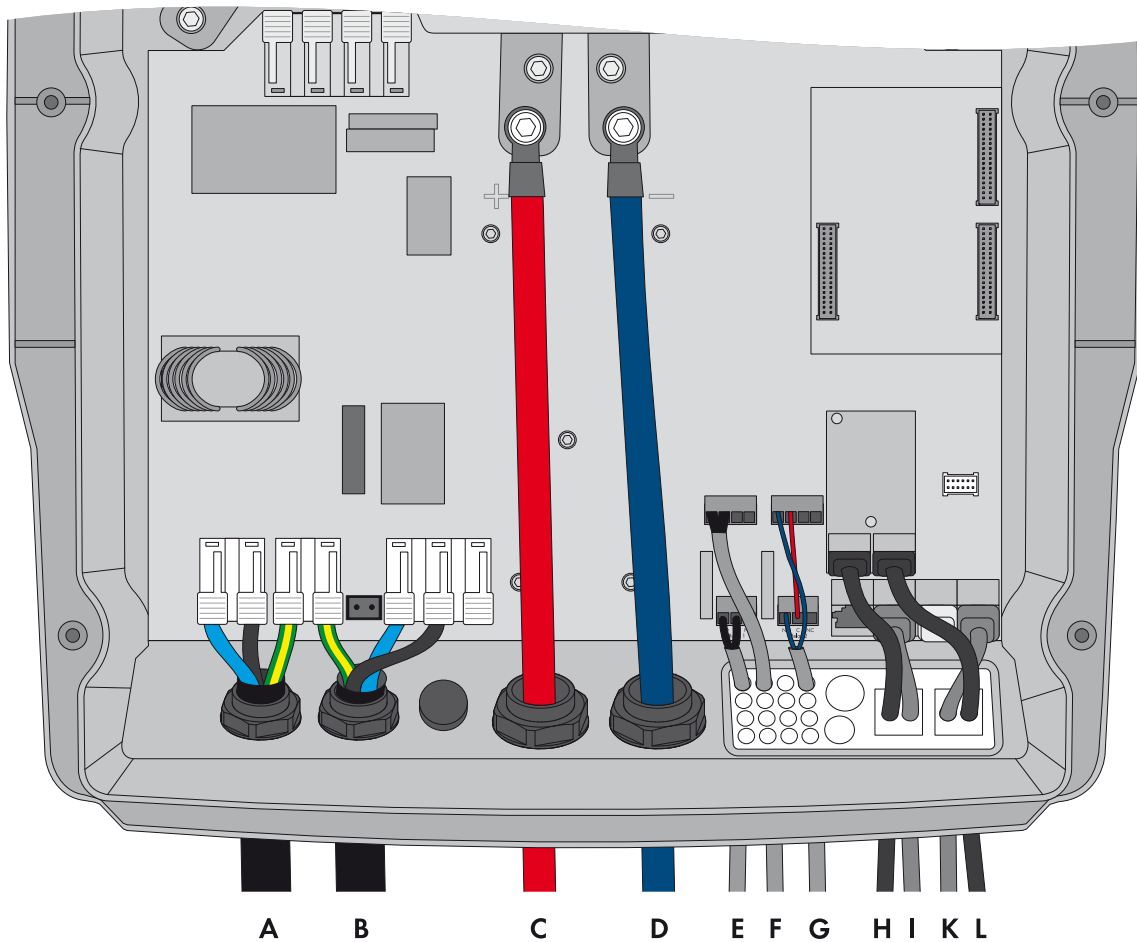


Figure 6: Connecting the Sunny Island inverter

Position	Designation	Description/information
A	AC power cable of the stand-alone grid	Sunny Island: connection to AC1 Loads/SunnyBoys terminals L, N, and PE Conductor cross-section: maximum 16 mm ²
B	AC power cable of the generator	Sunny Island: connection to AC2 Gen/Grid terminals L, N, and PE Conductor cross-section: maximum 16 mm ² The Sunny Island must be connected via a grounding conductor on the terminal AC1 or AC2 to the ground potential. The conductor cross-section of the grounding conductor must be 10 mm ² or larger. If the conductor cross-section is smaller, an additional grounding conductor on the enclosure with the conductor cross-section of the AC power cable must connect the Sunny Island with the ground potential.
C	DC+ cable	Battery terminal
D	DC - cable	Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm
E	Control cable, generator	Sunny Island: Relay1 NO and Relay1 C terminals Conductor cross-section: 0.2 mm ² to 2.5 mm ²

Position	Designation	Description/information
F	Measuring cable of the battery temperature sensor	Sunny Island: BatTmp terminal You only have to connect a battery temperature sensor if lead-acid batteries are used. Mount the battery temperature sensor in the middle of the battery terminal, in the upper third of the battery cell.
G	Control cable, load shedding	Sunny Island: Connect the control cable to the terminals Relay2 NO and BatVtgOut - . Inside the Sunny Island inverter, connect terminal Relay2 C and BatVtgOut+ . Conductor cross-section: 0.2 mm ² to 2.5 mm ²
H	RS485 communication bus	Sunny Island: at SI-COM SMA.BGx terminal ComSmaOut Connection to other nodes, e.g., PV inverter A terminator must terminate the RS485 communication bus on the last bus node.
I	Data cable to Sunny Remote Control display	Sunny Island: Display terminal
K	Data cable to Sunny Island Charger	Sunny Island: ComSync In terminal An additional data cable must be connected from the terminal ComSync Out to the battery only when lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.
L	RS485 communication bus	Sunny Island: at SI-COM SMA.BGx terminal ComSmaIn Sunny WebBox: terminal SMACOM
-	Data cable to lithium-ion battery	Only with lithium-ion batteries: additional data cable on terminal ComSync In

4.3 Connecting RS485 to the Sunny WebBox

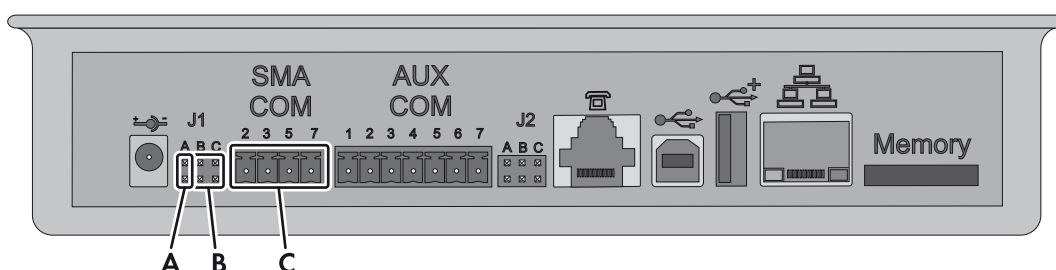


Figure 7: Connecting the RS485 communication bus to the Sunny WebBox

Position	Designation	Description/information
A	Jumper J1A	Terminator If the Sunny WebBox is installed at the end of the communication bus, a jumper must be inserted. If the Sunny WebBox is installed between two nodes, the jumper must be removed.
B	Jumper J1B and J1C	Signal bias voltage Make sure that both jumpers are inserted.

Position	Designation	Description/information
C	SMACOM	Terminal RS485 2: Signal Data+ (A), color coding of the insulated conductor: green with white stripes 5: Signal GND, color coding of the insulated conductor: orange with white stripes 7: Signal Data – (B), color coding of the insulated conductor: white with green stripes

4.4 Basic Configuration of the Sunny Island Inverter

NOTICE

Damage to the battery due to incorrect settings

The battery parameters influence the charging behavior of the Sunny Island inverter. The battery can be damaged by incorrect settings of the parameters for battery type, nominal voltage, and capacity.

- Ensure that the values recommended by the battery manufacturer are set for the battery during basic configuration (for the battery technical data, see the documentation of the battery manufacturer).
- In the basic configuration, configure the battery capacity for a ten-hour electric discharge (C10). The battery manufacturer specifies the battery capacity in relation to discharge time.

Requirements:

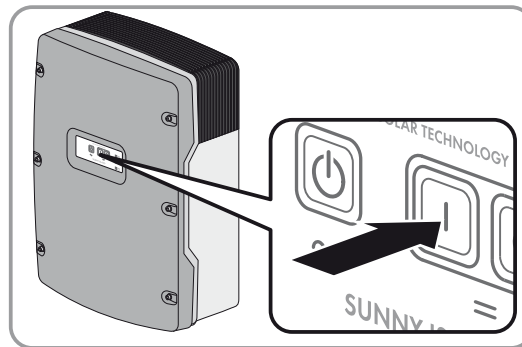
- The off-grid system must be installed according to the circuitry (see Section 4.1, page 17).
- All device enclosures must be closed except for the BatFuse. This protects all live components from being touched.
- All circuit breakers in the AC distribution board must be open. Thus, the Sunny Island is not connected to an AC source.

Procedure:

Check the wiring
(see the Sunny Island inverter installation manual).

Close all devices except the BatFuse.
This protects all live components from being touched.

Close the BatFuse load-break switch and press the "On" button on the Sunny Island.



↓

When the Sunny Remote Control shows **<Init System>**, press and hold the button on the Sunny Remote Control.

```

Boot          xxxxxxx-xx
              <Init System>#
xxxxxxxxxxxx  xx!xx!xx
    
```

An acoustic signal sounds three times and the Sunny Remote Control displays the Quick Configuration Guide.

```

Select option
001#01  [#####]
          StartMenu
          Start System#
    
```

↓

Turn the button on the Sunny Remote Control and select **New System**.

```

Select option
001#01  [#####]
          StartMenu
          New System#
    
```

Press the button. This confirms your selection of **New System**.

An entry confirmation prompt appears.

```

Select option
001#01  <accept Y/N>
          StartMenu
          New System#
    
```

↓

Set **Y** and press the button.

↓

Set the date.

```

Setup new device
003#04  <Set>#
          Dt
          02.01.2014 [d.m.y.]
    
```

↓

Set the time.

```

Setup new device
003#05  <Set>#
          Tm
          06:24:24 [hhmmss]
    
```

↓

Set **OffGrid**.

```

Setup new device
003#06  <Set>#
          AppSel
          OffGrid
    
```

Set the battery type:

```
Setup new device
003#07          <Set>#
                BatTyp
                URLA
```

VRLA: lead-acid battery with electrolyte absorbed in glass mat or immobilized in gel
FLA: lead-acid battery with liquid electrolyte

Lilon_Ext-BMS: lithium-ion battery

Set the nominal voltage of the battery.

```
Setup new device
003#08          <Set>#
                BatVtgLst
                48V
```

Set the battery capacity for ten-hour electric discharge (for determining the battery capacity, see the Sunny Island inverter installation manual).

```
Setup new device
003#10          <Set>#
                BatCapNom
                166 [Ah]
```

Set the battery capacity for ten-hour electric discharge (for determining the battery capacity, see the Sunny Island inverter installation manual).

```
Setup new device
003#10          <Set>#
                BatCapNom
                166 [Ah]
```

Set the grid voltage and power frequency of the stand-alone grid:

230V_50Hz: grid voltage 230 V, power frequency 50 Hz
220V_60Hz: grid voltage 220 V, power frequency 60 Hz

```
Setup new device
003#12          <Set>#
                AcVtgFrgTyp
                230V_50Hz
```

Set 1Phs:

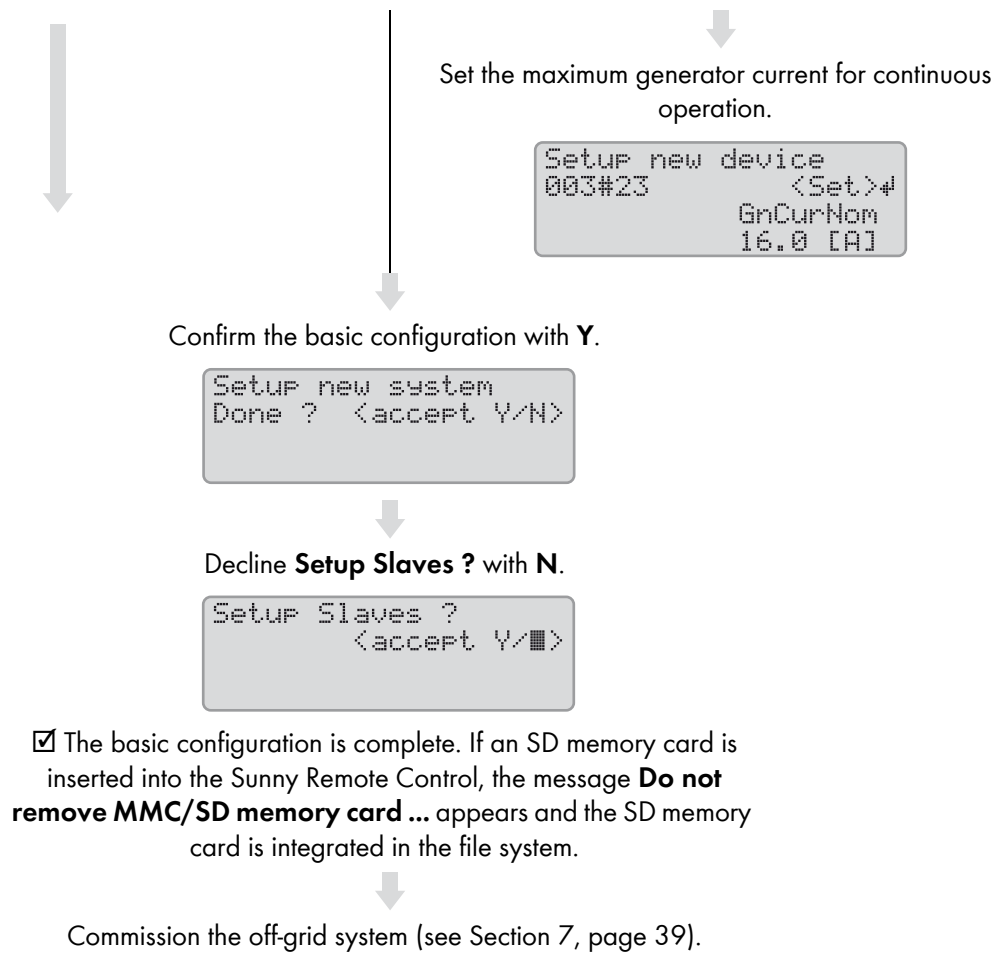
```
Setup new device
003#14          <Set>#
                ClstType
                1Phs
```

Set the type of energy sources:

```
Setup new device
003#21          <Set>#
                ExtSrc
                PvOnly
```

PvOnly: no generator is connected to terminal **AC2** of the Sunny Island inverter.

Gen: one generator is connected to terminal **AC2** of the Sunny Island inverter.

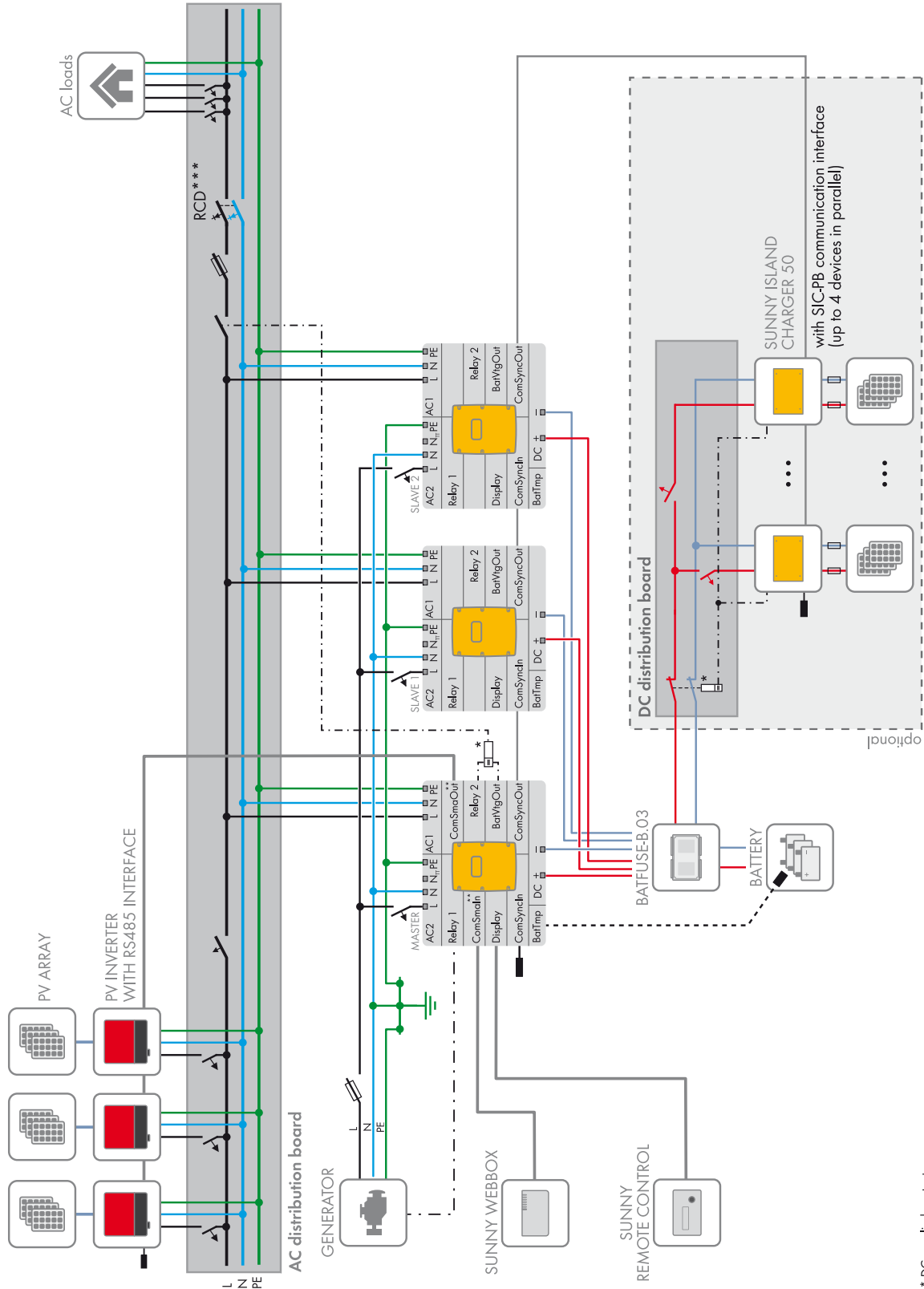


5 Single-Cluster System

5.1 Circuitry Overview Single-Phase Single-Cluster System

i Required device types for single-phase single-cluster systems

In single-phase single-cluster systems, the Sunny Island inverters must be device type SI6.0H-11 or SI8.0H-11.



* DC-supplied contactor
 ** RS485 interface SI-COM/SMA.BGx
 *** Whether a residual-current device (RCD) is required or not depends on the stand-alone grid configuration and the grid-forming voltage sources (see technical information "Grounding in Off-Grid Systems").

Figure 8: Circuitry overview single-phase single-cluster system, only possible with SI6.0H-11 or SI8.0H-11

5.2 Circuitry Overview Three-Phase Single-Cluster System

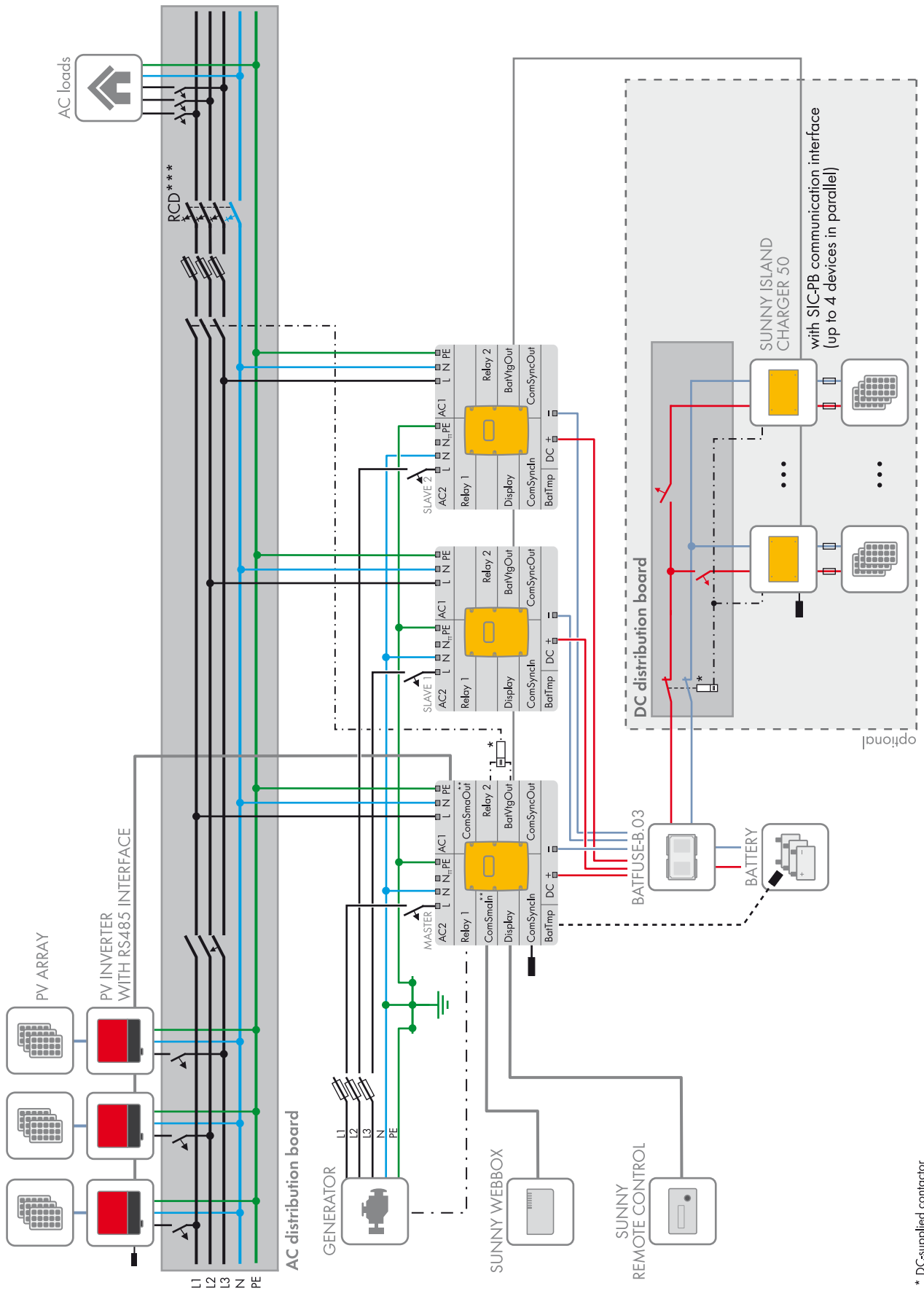


Figure 9: Circuitry overview three-phase single-cluster

* DC-supplied contactor
 ** RS485 interface SLCOMSMA.BGx
 *** Whether a residual-current device (RCD) is required or not depends on the standalone grid configuration and the grid-forming voltage sources (see technical information "Grounding in Off-Grid Systems").

5.3 Connecting the Sunny Island inverter

5.3.1 Connecting the Master

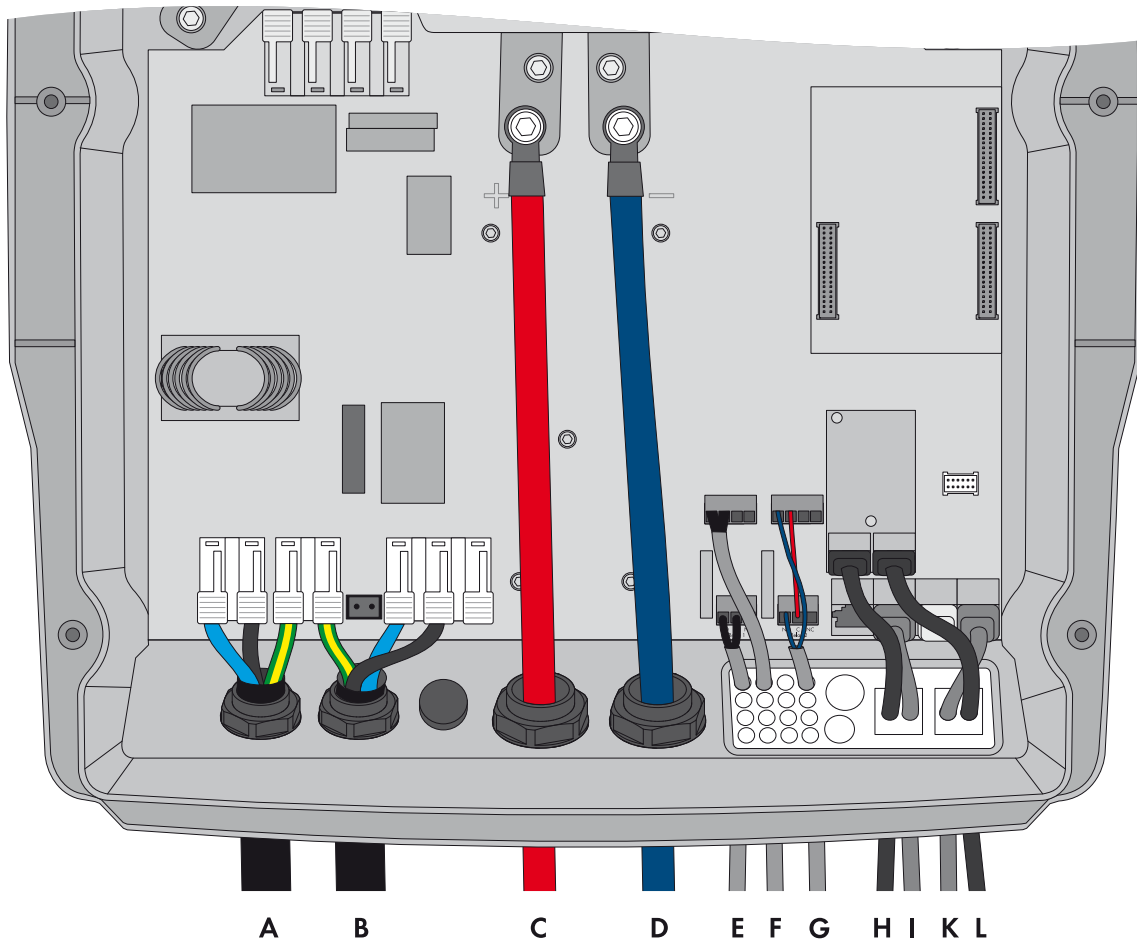


Figure 10: Connecting the master in the single-cluster system

Position	Designation	Description/information
A	AC power cable of the stand-alone grid	<p>Sunny Island: connection to AC1 Loads/SunnyBoys terminals L, N, and PE</p> <p>Stand-alone grid: connect master to line conductor L1.</p> <p>For a single-phase system, the cable length and the conductor cross-section must be identical on each Sunny Island.</p> <p>Conductor cross-section: maximum 16 mm²</p>

Position	Designation	Description/information
B	AC power cable of the generator	<p>Sunny Island: terminal AC2 Gen/Grid terminals L, N, and PE</p> <p>Generator: connect master to line conductor L1.</p> <p>Conductor cross-section: maximum 16 mm²</p> <p>For a single-phase system, the cable length and the conductor cross-section must be identical on each Sunny Island.</p> <p>The Sunny Island must be connected via a grounding conductor on the terminal AC1 or AC2 to the ground potential. The conductor cross-section of the grounding conductor must be 10 mm² or larger. If the conductor cross-section is smaller, an additional grounding conductor on the enclosure with the conductor cross-section of the AC power cable must connect the Sunny Island with the ground potential.</p>
C	DC+ cable	Battery terminal
D	DC – cable	<p>For a single-phase system, the cable length and the conductor cross-section must be identical on each Sunny Island.</p> <p>Conductor cross-section: 50 mm² to 95 mm²</p> <p>Cable diameter: 14 mm to 25 mm</p>
E	Control cable, generator	<p>Sunny Island: terminals Relay1 NO and Relay1 C</p> <p>Conductor cross-section: 0.2 mm² to 2.5 mm²</p>
F	Measuring cable of the battery temperature sensor	<p>Sunny Island: terminal BatTmp</p> <p>You only have to connect a battery temperature sensor if lead-acid batteries are used.</p> <p>Mount the battery temperature sensor in the middle of the battery terminal, in the upper third of the battery cell.</p>
G	Control cable, load shedding	<p>Sunny Island: Connect control cable to terminals Relay2 NO and BatVtgOut –.</p> <p>Inside the Sunny Island inverter, connect terminals Relay2 C and BatVtgOut+.</p> <p>Conductor cross-section: 0.2 mm² to 2.5 mm²</p>
H	RS485 communication bus	<p>Sunny Island: at SI-COMSMA.BGx terminal ComSmaOut</p> <p>Connection to other nodes, e.g., PV inverter</p> <p>A terminator must terminate the RS485 communication bus on the last bus node.</p>
I	Data cable to Sunny Remote Control display	Sunny Island: Display terminal
K	Data cable for the internal communication in the cluster	<p>Sunny Island: ComSync Out terminal</p> <p>Only with lithium-ion batteries: additional data cable on terminal ComSync In</p> <p>The communication bus must be equipped with a terminator on both ends.</p>
L	RS485 communication bus	<p>Sunny Island: at SI-COMSMA.BGx terminal ComSmaIn</p> <p>Sunny WebBox: terminal SMACOM</p>
–	Data cable to lithium-ion battery	Only with lithium-ion batteries: additional data cable on terminal ComSync In

5.3.2 Connecting the Slaves

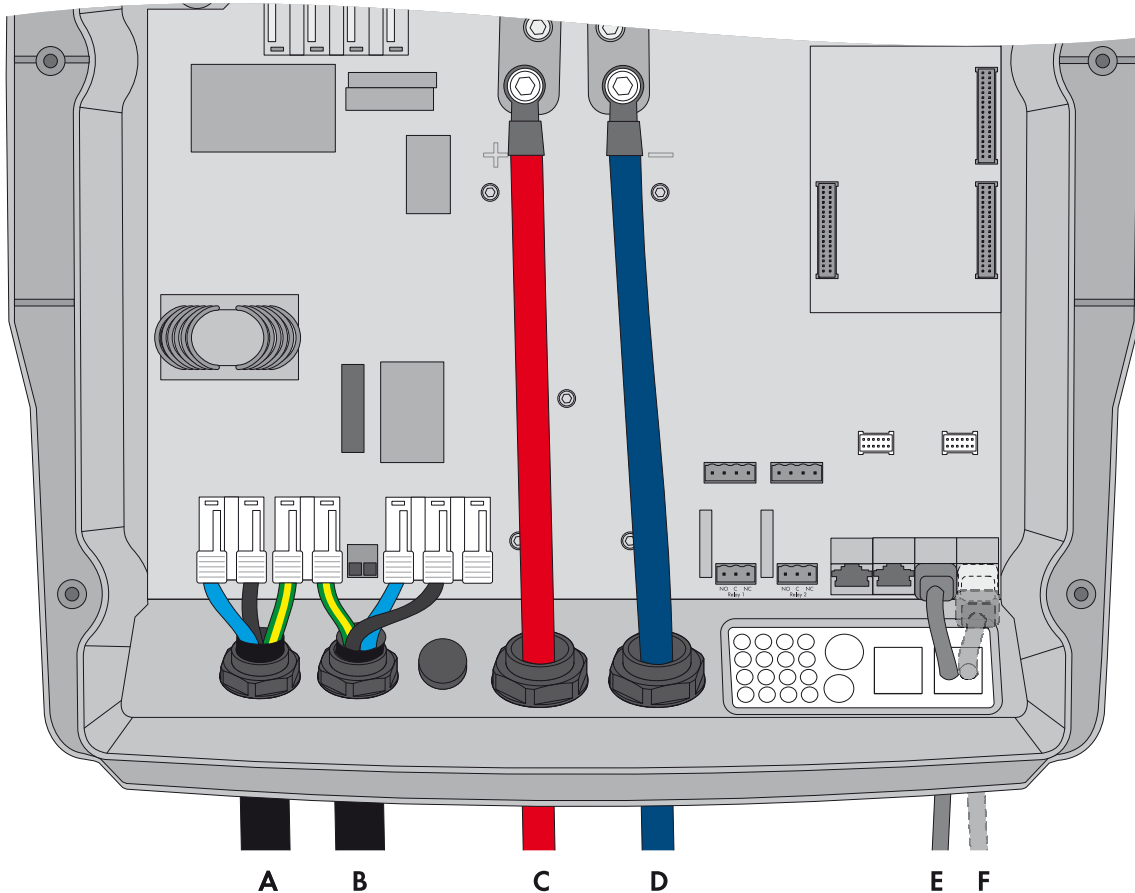


Figure 11: Connecting the slaves in a single-cluster system

Position	Designation	Description/information
A	AC power cable of the stand-alone grid	<p>Sunny Island: connection to AC1 Loads/SunnyBoys terminals L, N, and PE</p> <p>Stand-alone grid: Connect slave 1 to line conductor L2, and connect slave 2 to line conductor L3.</p> <p>For a single-phase system, the cable length and the conductor cross-section must be identical on each Sunny Island.</p> <p>Conductor cross-section: maximum 16 mm²</p>
B	AC power cable of the generator	<p>Sunny Island: connection of generator to AC2 Gen/Grid terminals L, N, and PE</p> <p>Generator: connect slave 1 to line conductor L2, connect slave 2 to line conductor L3.</p> <p>Conductor cross-section: maximum 16 mm²</p> <p>For a single-phase system, the cable length and the conductor cross-section must be identical on each Sunny Island.</p> <p>The Sunny Island must be connected via a grounding conductor on the terminal AC1 or AC2 to the ground potential. The conductor cross-section of the grounding conductor must be 10 mm² or larger. If the conductor cross-section is smaller, an additional grounding conductor on the enclosure with the conductor cross-section of the AC power cable must connect the Sunny Island with the ground potential.</p>

Position	Designation	Description/information
C	DC+ cable	Battery terminal
D	DC – cable	For a single-phase system, the cable length and the conductor cross-section must be identical on each Sunny Island. Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm
E	Data cable for the internal communication in the cluster	Sunny Island: terminal ComSync In
F		Sunny Island: terminal ComSync Out On slave 2 either connect the data cable of the Sunny Island Charger charge controller or insert the terminator into the terminal.

5.4 Connecting RS485 to the Sunny WebBox

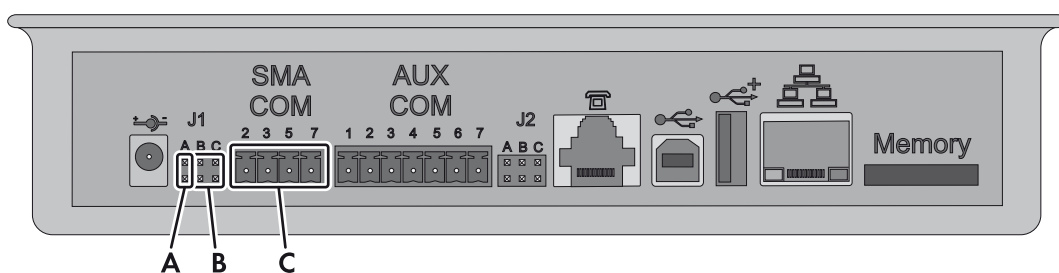


Figure 12: Connecting the RS485 communication bus to the Sunny WebBox

Position	Designation	Description/information
A	Jumper J1A	Terminator If the Sunny WebBox is installed at the end of the communication bus, a jumper must be inserted. If the Sunny WebBox is installed between two nodes, the jumper must be removed.
B	Jumper J1B and J1C	Signal bias voltage Make sure that both jumpers are inserted.
C	SMACOM	Terminal RS485 2 : Signal Data+ (A), color coding of the insulated conductor: green with white stripes 5 : Signal GND, color coding of the insulated conductor: orange with white stripes 7 : Signal Data – (B), color coding of the insulated conductor: white with green stripes

5.5 Basic Configuration

NOTICE

Damage to the battery due to incorrect settings

The battery parameters influence the charging behavior of the Sunny Island inverter. The battery can be damaged by incorrect settings of the parameters for battery type, nominal voltage, and capacity.

- Ensure that the values recommended by the battery manufacturer are set for the battery during basic configuration (for the battery technical data, see the documentation of the battery manufacturer).
- In the basic configuration, configure the battery capacity for a ten-hour electric discharge (C10). The battery manufacturer specifies the battery capacity in relation to discharge time.

Requirements:

- The off-grid system must be installed according to the circuitry (see Section 5.1, page 24 and Section 5.2, page 25).
- All device enclosures must be closed except for the BatFuse. This protects all live components from being touched.
- All circuit breakers in the AC distribution board must be open. Thus, the Sunny Island is not connected to an AC source.
- The Sunny Remote Control must be connected to the master. This determines which Sunny Island is the master during the basic configuration.

Procedure:

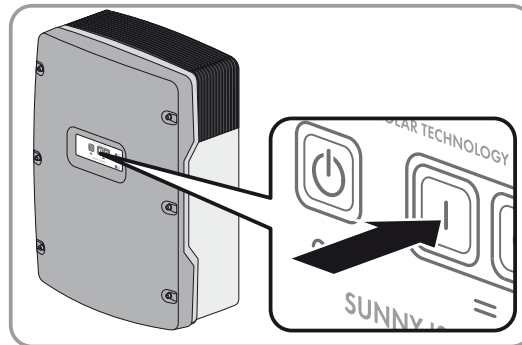
Check the wiring
(see the Sunny Island inverter installation manual).



Close all devices except the BatFuse.
This protects all live components from being touched.



Close the BatFuse and press and hold the "On" button on the master until you hear an acoustic signal.



When the Sunny Remote Control shows **<Init System>**,
press and hold the button on the Sunny Remote Control.

```

Boot          xxxxxx-xx
              <Init System>#
xx.xx.xxxx   xx#xx!xx
  
```

An acoustic signal sounds three times and the
Sunny Remote Control displays the Quick Configuration Guide.



```

Select option
001#01  [#####]
          StartMenu
          Start System#
    
```

Turn the button on the Sunny Remote Control and select **New System**.

```

Select option
001#01  [#####]
          StartMenu
          New System#
    
```

Press the button. This confirms your selection of **New System**.
 An entry confirmation prompt appears.

```

Select option
001#01  <accept Y/N>
          StartMenu
          New System#
    
```

Set **Y** and press the button. This confirms your selection.

Set the date.

```

Setup new device
003#04  <Set>#
          Dt
          02.01.2014 [d.m.y.]
    
```

Set the time.

```

Setup new device
003#05  <Set>#
          Tm
          06:24:24 [hhmmss]
    
```

Set **OffGrid**.

```

Setup new device
003#06  <Set>#
          ApplSel
          OffGrid
    
```

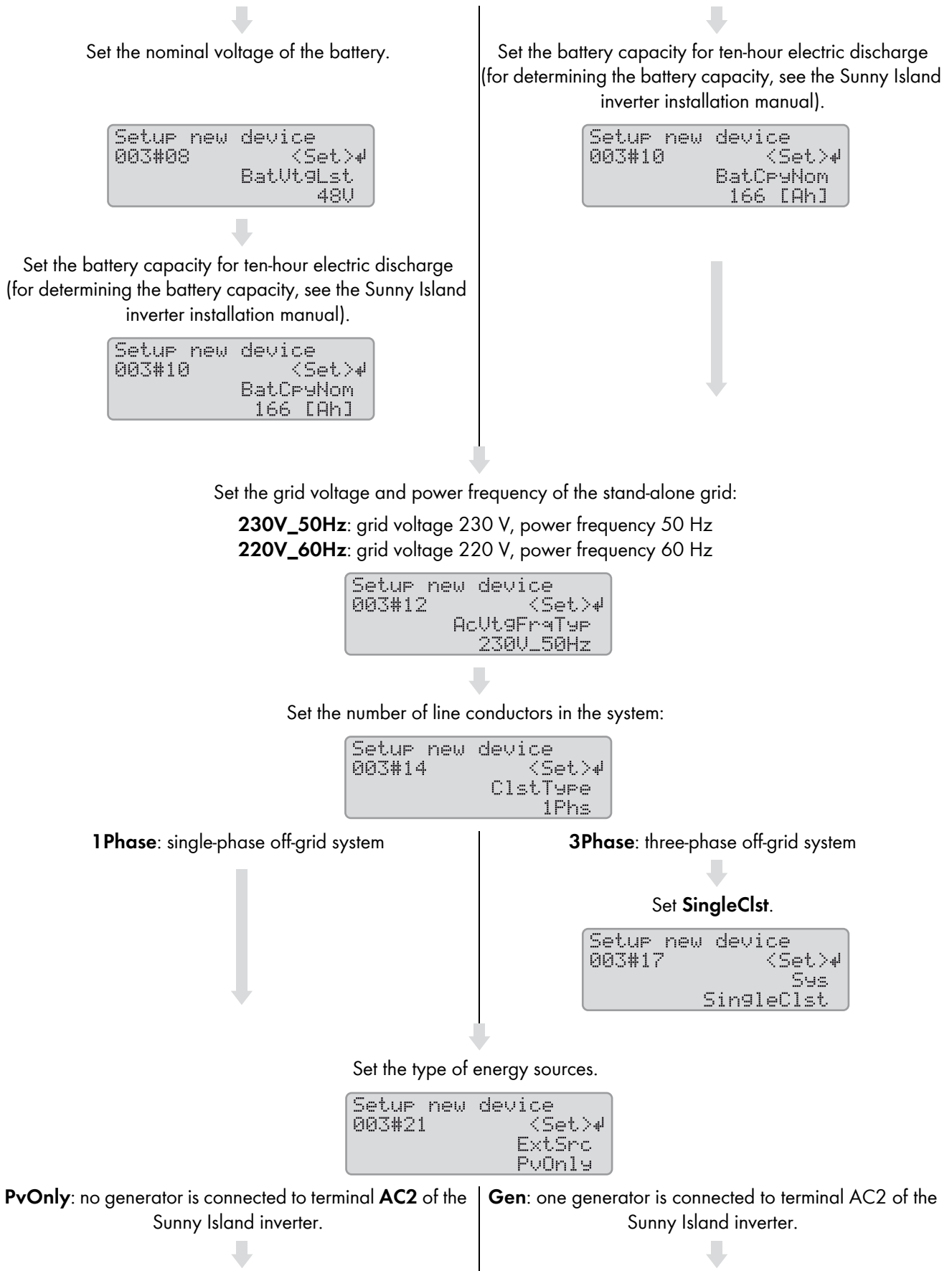
Set the battery type:

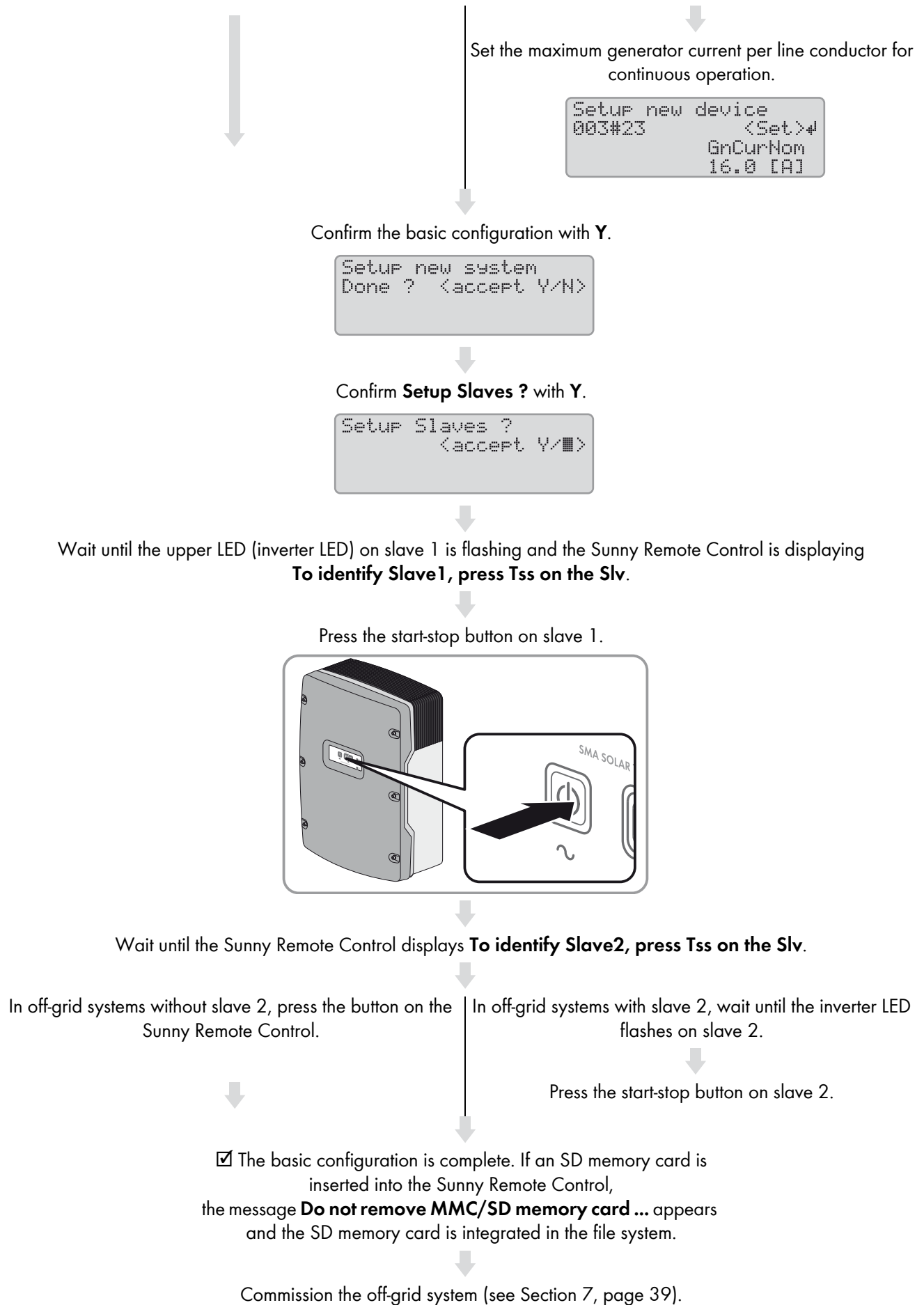
```

Setup new device
003#07  <Set>#
          BatTyp
          URLA
    
```

VRLA: lead-acid battery with electrolyte absorbed in glass mat or immobilized in gel
FLA: lead-acid battery with liquid electrolyte

Lilon_Ext-BMS: lithium-ion battery





6 Multicluster System

6.1 Circuitry Overview and Connection of the Sunny Island Inverters

i Required device types for multicluster systems

In multicluster systems, the Sunny Island inverters must be device type SI6.0H-11 or SI8.0H-11.

You can find a circuitry overview in the Multicluster Box documentation.

6.2 Basic Configuration

NOTICE

Damage to the battery due to incorrect settings

The battery parameters influence the charging behavior of the Sunny Island inverter. The battery can be damaged by incorrect settings of the parameters for battery type, nominal voltage, and capacity.

- Ensure that the values recommended by the battery manufacturer are set for the battery during basic configuration (for the battery technical data, see the documentation of the battery manufacturer).
- In the basic configuration, configure the battery capacity for a ten-hour electric discharge (C10). The battery manufacturer specifies the battery capacity in relation to discharge time.

Requirements:

- The off-grid system must be installed according to the circuitry (see Multicluster Box documentation).
- In the Multicluster Box, all Sunny Island circuit breakers must be open. As a result, the Sunny Island inverters are not connected to an AC source.
- The Sunny Remote Control must be connected to the master of each cluster. This determines which Sunny Island is the master during the basic configuration.

Procedure:

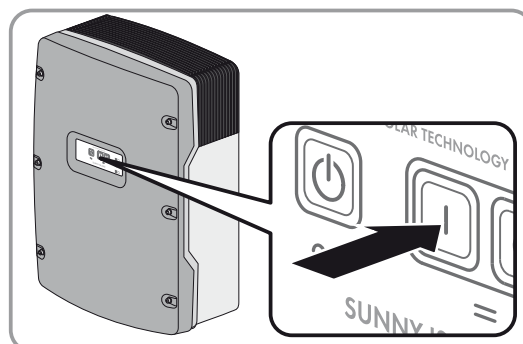
Check the wiring
(see the Sunny Island inverter installation manual).



Close all devices except the BatFuse.
This protects all live components from being touched.



Close the BatFuse and press and hold the "On" button on each master until you hear an acoustic signal.



↓

When the Sunny Remote Control shows **<Init System>**, press and hold the button on the Sunny Remote Control.

```

Boot          xxxxxxx-xx
              <Init System>#
xxxxxxxxxxxx  xx!xx!xx
    
```

☑ An acoustic signal sounds three times and the Sunny Remote Control displays the Quick Configuration Guide.

```

Select option
001#01 [#####]
        StartMenu
        Start System#
    
```

↓

Turn the button on the Sunny Remote Control and select **New System**.

```

Select option
001#01 [#####]
        StartMenu
        New System#
    
```

↓

Press the button. This confirms your selection of **New System**.

☑ An entry confirmation prompt appears.

```

Select option
001#01 <accept Y/N>
        StartMenu
        New System#
    
```

↓

Set **Y** and press the button.

↓

Set the date.

```

Setup new device
003#04 <Set>#
        Dt
        02.01.2014 [d.m.y.]
    
```

↓

Set the time.

```

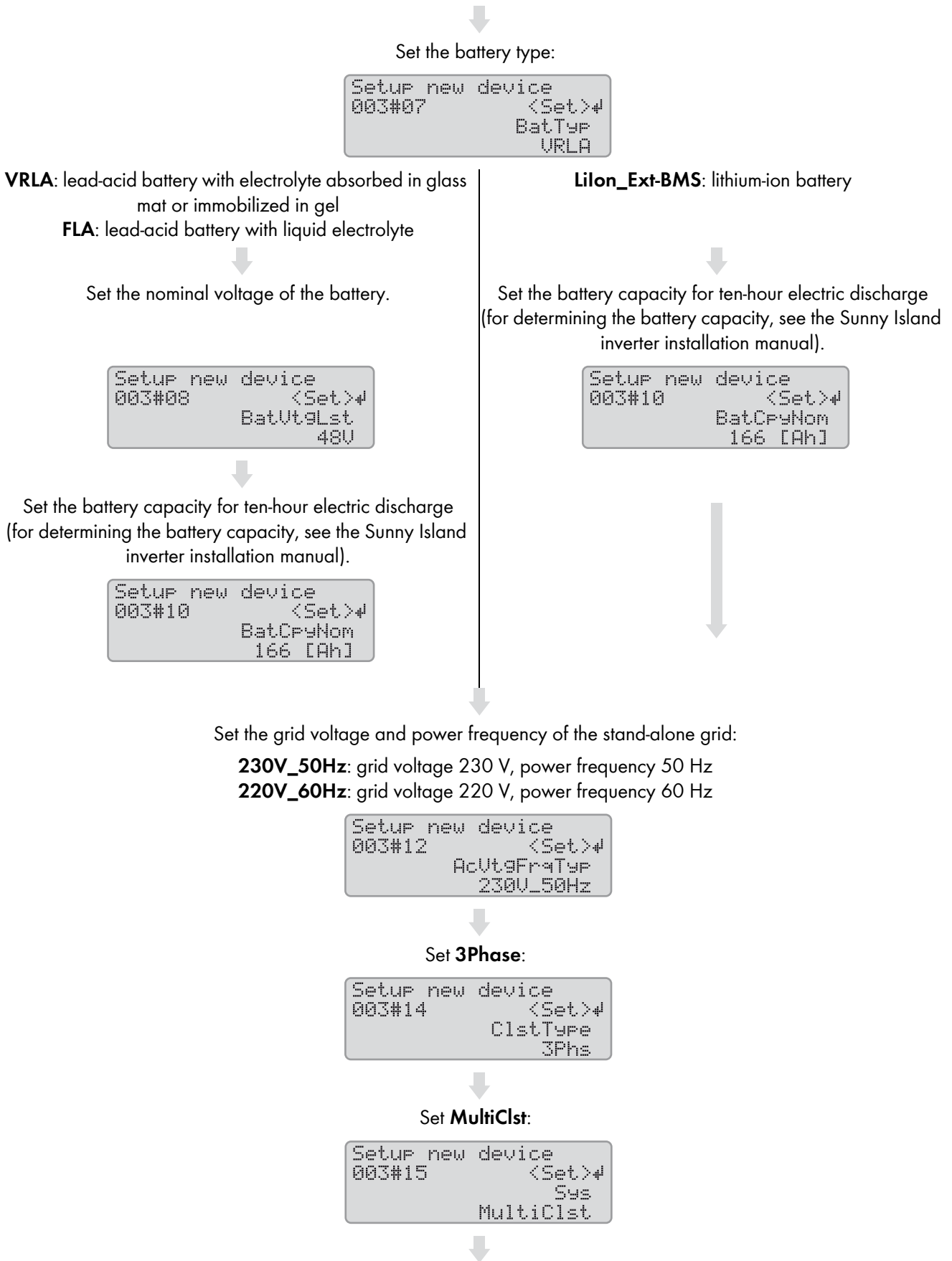
Setup new device
003#05 <Set>#
        Tm
        06:24:24 [hhmmss]
    
```

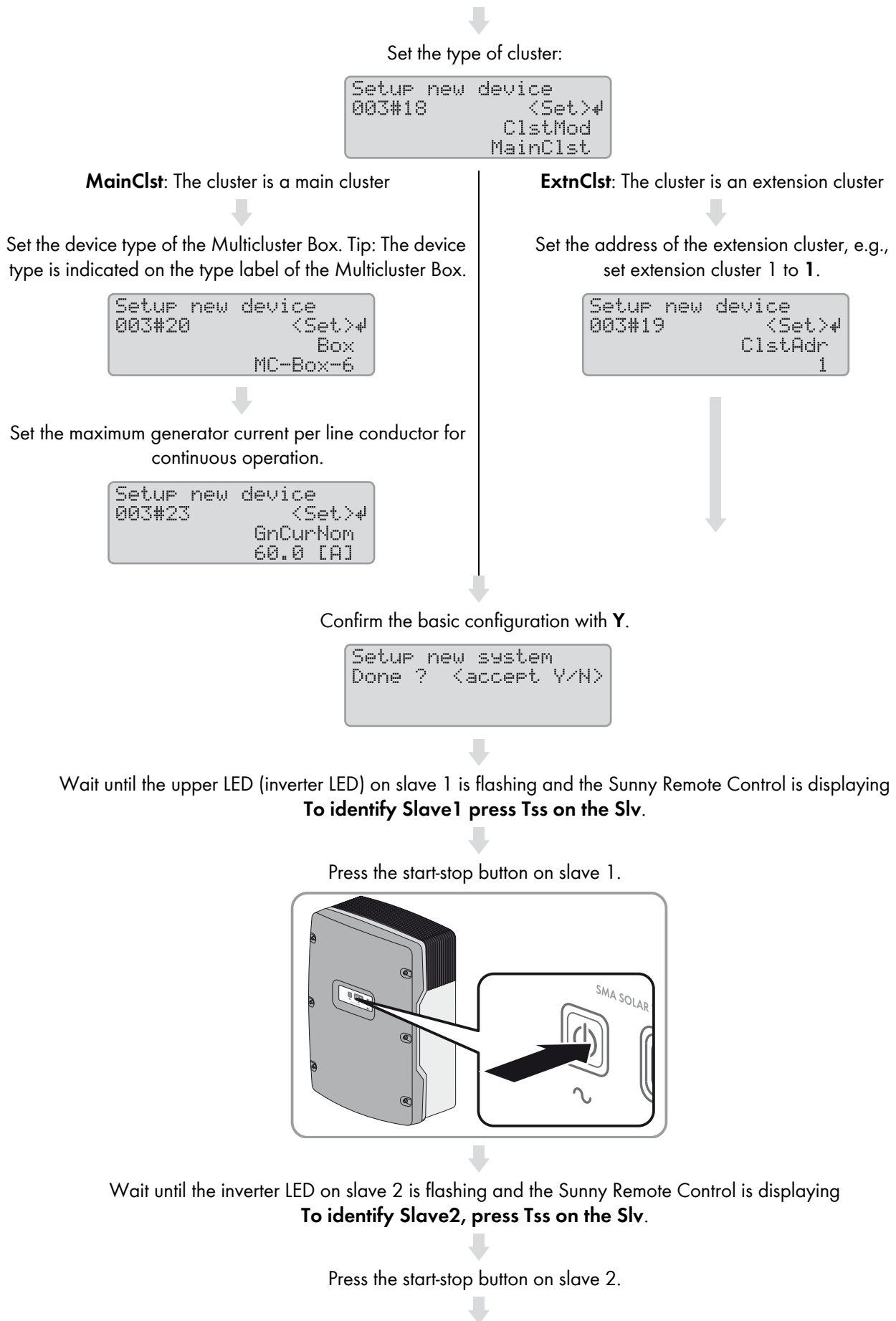
↓

Set **OffGrid**.

```

Setup new device
003#06 <Set>#
        App1Sel
        OffGrid
    
```







The basic configuration is complete.
If an SD memory card is inserted into the Sunny Remote Control,
the message **Do not remove MMC/SD card ...**
is displayed and the SD memory card is integrated in the file system.



Configure all other clusters.
For this purpose, perform the steps of the Quick Configuration Guide for each master separately.



Commission the off-grid system (see Section 7, page 39).

7 Commissioning

7.1 Switching to Installer Mode

The installer mode is protected with an installer password. The installer password changes constantly and must be re-calculated every time.

Switch to installer mode on the Sunny Remote Control in accordance with the following procedure.

NOTICE

Entering incorrect parameter values endangers operational safety

All parameters which could affect the operational safety of the system are protected by the installer password.

- Only a qualified person is permitted to set and adjust system parameters.
- Only give the installer password to qualified persons.

Procedure:

1. On the Sunny Remote Control, select the setting page **Password (1/1)** in user mode (see the Sunny Island inverter operating manual).
2. Calculate the checksum of the operating hours **Runtime**. This determines the installer password.

Example: Calculating the checksum

The operating hours **Runtime** is 1234 h. The checksum is the sum of all digits:

$$1 + 2 + 3 + 4 = 10$$

The checksum is 10.

3. Select the parameter **Set** and set the installer password calculated.
 - The Sunny Remote Control is in installer mode.

```
Installer
100# Meters      ↵
200# Settings
300# Diagnosis
```

7.2 Commissioning the Multifunction Relays

- Set the functions of the multifunction relays on the Sunny Remote Control (see the Sunny Island inverter installation manual). Tip: In the circuitry overviews, the multifunction relays are connected based on the default values of the Sunny Island inverter.

7.3 Starting the System

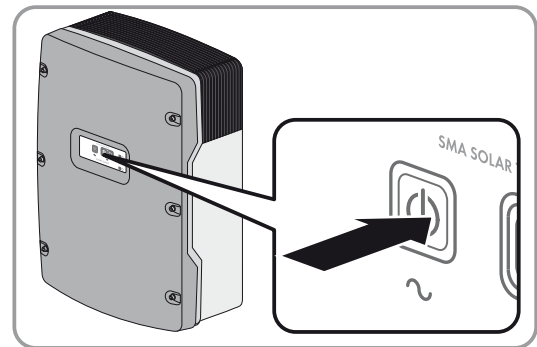
Requirement:

- All Sunny Island inverters must be switched on.
- The circuit breakers for the AC sources in the stand-alone grid must be switched off in the AC distribution board.
- The load-break switch of the generator must be open.
- The circuit breakers for the charge controllers must be switched off in the DC distribution board.

Procedure:

- Press the start-stop button on a Sunny Island and hold it until you hear an acoustic signal.

or



Press and hold the button on the Sunny Remote Control until you hear an acoustic signal.

- The system starts and the inverter LED on each Sunny Island inverter glows green.

7.4 Testing the Battery Current Sensor

If a charge controller from a third-party supplier, a DC load, or more than four Sunny Island Charger charge controllers are installed in the off-grid system, an additional battery current sensor must be installed (see the Sunny Island installation manual).

Requirements:

- The Sunny Island must be in operation (see Section 7.3 "Starting the System", page 40).

Procedure:

1. Switch on a load (e.g., a 1 kW radiant heater) and all associated protective devices in the AC distribution board.
2. Measure the battery current with a current clamp.
3. Switch to installer mode on the Sunny Remote Control (see Section 7.1, page 39).
4. Select the **120.06 TotBatCur** parameter and read off the value.

- The value is positive and is within the measuring tolerance range.

- Is the value not positive or is it outside the measuring tolerance range?

The value is negative because the poles of the measuring cable for the battery current sensor are reversed.

- Install the battery current sensor correctly (see the Sunny Island inverter installation manual).

The value is not within the measuring tolerance range since the incorrect battery current sensor type has been set.

- Set the correct battery current sensor type (see the Sunny Island inverter installation manual).

7.5 Testing the Generator

Requirement:

- The Sunny Island must be in operation (see Section 7.3 "Starting the System", page 40).

Procedure:

1. Switch on the protective devices for the generator in the AC distribution board.
2. Connect the circuit breakers of the AC loads.
3. Close the load-break switch of the generator.

The generator starts.

Does the generator not start?

The generator management does not request the generator.

- On the Sunny Remote Control, select the setting page **Generator > Mode** in user mode and set to **Start**. This starts the generator manually (see the Sunny Island inverter operating manual).

The control cable connected does not transmit the start signal.

- Eliminate faults in the wiring.

The generator is not ready for operation.

- Find out possible causes using the manual from the manufacturer and eliminate these.

4. Check whether the parameter **Generator > Power** displays the feed-in power on the Sunny Remote Control in user mode. This ensures that the Sunny Island has switched the stand-alone grid to the generator after completing the warm-up time **234.12 GnWarmTm**.

If no power is displayed after completion of the warm-up time, check the error messages:

- Select the **410# Error active** menu and rectify the cause of the displayed warning or error (see the Sunny Island inverter operating manual).

7.6 Testing the Load Shedding

Requirements:

- This system is not a multicluster system. Load shedding is part of the Multicluster Box in multicluster systems.
- The Sunny Island must be in operation (see Section 7.3 "Starting the System", page 40).

Procedure:

1. Switch to installer mode on the Sunny Remote Control (see Section 7.1, page 39).
2. Select the parameter of the multifunction relay for the load-shedding contactor, e.g., **241.02 Rly2Op** for the **Relay2** multifunction relay of the master.
3. Note the parameter value.
4. Set the parameter to **Off**.

The load-shedding contactor sheds the loads.

Does the load-shedding contactor not shed the loads?

The multifunction relay for triggering the load-shedding contactor was incorrectly configured.

- Check the configuration and eliminate the fault.

There is a fault in the wiring of the load-shedding contactor.

- Ensure that the multifunction relay is correctly wired.

5. Set the parameter to the setting that has been noted down.

7.7 Commissioning the Sunny WebBox

- Commission the Sunny WebBox (see the Sunny WebBox quick reference guide).

7.8 Commissioning the PV System

For operation in an off-grid system, the PV system must be configured for stand-alone mode.

Procedure:

1. Commission the PV system (see PV inverter documentation).
2. If the SMA PV inverters are not configured for stand-alone mode ex works, configure the country standard or country data set of the PV inverters for stand-alone mode (see the PV inverter documentation).

7.9 Completing Commissioning

1. On the Sunny Remote Control, adjust the configuration to the system (see the Sunny Island inverter installation manual). This way, you can increase the service life of the battery, for example.
2. When full charge of the battery is complete, switch on all circuit breakers and load-break switches. Tip: The state of charge of the battery is displayed on the Sunny Remote Control in standard mode.

Load shedding in the first two operating hours

The state of charge (SOC) recorded by battery management and the available battery capacity (SOH) will deviate strongly from the actual values of SOC and SOH for a newly connected battery. During operation, the values recorded by battery management will gradually approach the real values. In the first two operating hours with the new battery, these deviations can lead to corresponding entries in the **400# Failure/Event** menu.

8 Contact

If you have technical problems with our products, contact the SMA Service Line. We need the following information in order to provide you with the necessary assistance:

- Type of system installed (e.g., three-phase single-cluster system)
- Number and type of the Sunny Island inverters
- Serial number of the Sunny Island inverters
- Firmware version of the Sunny Island inverters
- Displayed error message
- Type of battery connected
- Nominal battery capacity
- Nominal battery voltage
- Type of the communication products connected
- Type and size of additional energy sources
- If a generator is connected:
 - Type
 - Power
 - Maximum current

Australia	SMA Australia Pty Ltd. Sydney	Toll free for Australia:	1800 SMA AUS (1800 762 287)
		International:	+61 2 9491 4200
Belgien/ Belgique/ België	SMA Benelux BVBA/SPRL Mechelen	+32 15 286 730	
Brasil	Vide España (Espanha)		
Česko	SMA Central & Eastern Europe s.r.o. Praha	+420 235 010 417	
Chile	Ver España		
Danmark	Se Deutschland (Tyskland)		
Deutschland	SMA Solar Technology AG Niestetal	Medium Power Solutions	
		Wechselrichter:	+49 561 9522-1499
		Kommunikation:	+49 561 9522-2499
		SMA Online Service Center:	www.SMA.de/Service
		Hybrid Energy Solutions	
		Sunny Island:	+49 561 9522-399
		PV-Diesel Hybridssysteme:	+49 561 9522-3199
		Power Plant Solutions	
		Sunny Central:	+49 561 9522-299
España	SMA Ibérica Tecnología Solar, S.L.U. Barcelona	Llamada gratuita en España:	900 14 22 22
		Internacional:	+34 902 14 24 24

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		Onduleurs :	+33 472 09 04 40
		Communication :	+33 472 09 04 41
		Hybrid Energy Solutions	
		Sunny Island :	+33 472 09 04 42
		Power Plant Solutions	
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Italia	SMA Italia S.r.l. Milano	+39 02 8934-7299	
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Luxemburg/ Luxembourg	Siehe Belgien/ Voir Belgien (Belgique)		
Magyarország	lásd Česko (Csehország)		
Nederland	zie Belgien (België)		
Österreich	Siehe Deutschland		
Perú	Ver España		
Polska	Patrz Česko (Czechy)		
Portugal	SMA Solar Technology Portugal, Unipessoal Lda Lisboa	Gratuito em Portugal:	800 20 89 87
		Internacional:	+351 2 12 37 78 60
România	Vezi Česko (Cehia)		
Schweiz	Siehe Deutschland		
Slovensko	pozri Česko (Česká republika)		
South Africa	SMA Solar Technology South Africa Pty Ltd. Centurion (Pretoria)	08600 SUNNY (08600 78669)	
		International:	+27 (12) 643 1785
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Ελλάδα	SMA Hellas AE Αθήνα	801 222 9 222	
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대한민국	SMA Technology Korea Co., Ltd. 서울	+82-2-520-2666	

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