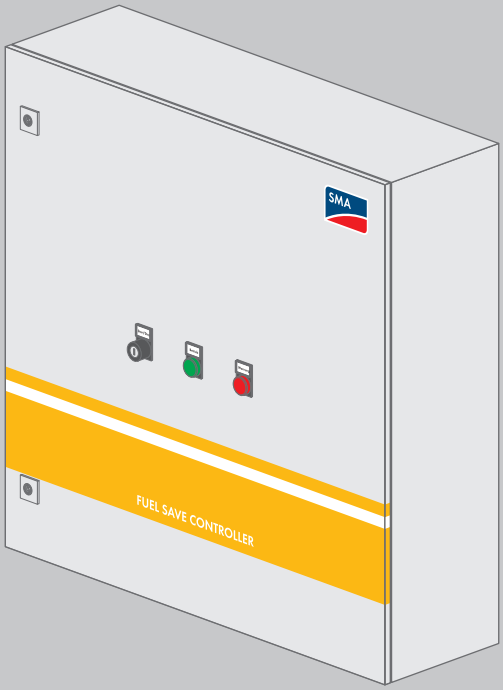
Technical Information

Gensets in PV Diesel Hybrid Systems with SMA Fuel Save Controller 2.0M



Legal Provisions

The information contained in these documents is property of SMA Solar Technology AG. Any publication, whether in whole or in part, requires prior written approval by SMA Solar Technology AG. Internal reproduction used solely for the purpose of product evaluation or other proper use is allowed and does not require prior approval.

Trademarks

All trademarks are recognized, even if not explicitly identified as such. Missing designations do not mean that a product or brand is not a registered trademark.

The BLUETOOTH® word mark and logos are registered trademarks of Bluetooth SIG, Inc. and any use of such marks by SMA America LLC and SMA Solar Technology Canada Inc. is under license.

Modbus® is a registered trademark of Schneider Electric and is licensed by the Modbus Organization, Inc.

QR Code is a registered trademark of DENSO WAVE INCORPORATED.

Phillips® and Pozidriv® are registered trademarks of Phillips Screw Company.

Torx® is a registered trademark of Acument Global Technologies, Inc.

SMA Solar Technology AG

Sonnenallee 1

34266 Niestetal

Germany

Tel. +49 561 9522-0

Fax +49 561 9522-100

www.SMA.de

E-mail: info@SMA.de

© 2004 to 2015 SMA Solar Technology AG. All rights reserved.

1 Information on this Document

1.1 Validity

This document is valid for the device type “FSC-20-M” (SMA Fuel Save Controller 2.0M) from software version 2.01.

1.2 Content and Structure of this Document

This document is a summary of the information that is to be observed when using the SMA Fuel Save Controller with gensets and genset controllers.

This document does not replace the documentation included with the SMA Fuel Save Controller (see SMA Fuel Save Controller installation manual and user manual).

1.3 Nomenclature

Complete designation	Designation in this document
SMA Fuel Save Controller 2.0M	Fuel Save Controller
Sunny Tripower	Inverter
Electric generator with combustion engine	Genset
System for the regulation and control of electric generators with combustion engine	Genset controller

2 Requirements for the Optimum Operation of the Gensets

Together with SMA inverters, the SMA Fuel Save Controller is a system solution for the installation of photovoltaic diesel hybrid systems through the integration of PV power plants into local utility grids based on gensets. The SMA Fuel Save Controller monitors and controls the SMA PV inverters and allows stable operation of the photovoltaic diesel hybrid system. To ensure this, the SMA Fuel Save Controller continuously monitors the operating state of the gensets and loads and adjusts the output power of the SMA inverters accordingly, where necessary.

Connection and disconnection of the gensets

In the PV diesel hybrid system, the connection and disconnection of the gensets is performed exclusively by the genset controllers. The SMA Fuel Save Controller issues setpoints or recommendations to the genset controllers for this.

In combined operation with the genset controllers, the SMA Fuel Save Controller must fulfill the following tasks for this:

- Recording data on the current operating state of the gensets
- Specifying sufficient reserve power of the gensets

Recording data on the current operating state of the gensets

The SMA Fuel Save Controller requires continuous data on the current operating state of the gensets, e.g. the active and reactive power as well as the operating mode. The SMA Fuel Save Controller records information on the current operating state by measuring electrical parameters or via communication with a genset controller. For successful communication, the SMA Fuel Save Controller and the genset controller must have communication interfaces that are based on identical principles and industry standards (see Section 4, page 8).

Specifying sufficient reserve power of the gensets

In order that the energy supply in the PV diesel hybrid system can be assured independently of the fluctuating PV energy supply, the gensets must be able to make sufficient reserve power available at all times. The SMA Fuel Save Controller can support this by directly or indirectly specifying the reserve power of the gensets.

- **Direct specification of the reserve power**

  The SMA Fuel Save Controller sends a setpoint with the required reserve power directly to the genset controller. The genset controller controls the connection and disconnection of the gensets corresponding to this setpoint. For this, the SMA Fuel Save Controller and genset controller must have communication interfaces that are based on identical principles and industry standards (see Section 4, page 8).

- **Indirect specification of the reserve power**

  The SMA Fuel Save Controller issues setpoints for the power output to the PV power plant. When determining the setpoint, the SMA Fuel Save Controller takes into consideration the connection and disconnection thresholds of the genset controllers. The prerequisite for this is that the power management of the SMA Fuel Save Controller and the genset controllers operate on the same principles (see Section 3, page 5).

3 Power Management

3.1 Power Management Principles

In this document, power management is considered to be the load-dependent connection and disconnection of the genset in a PV diesel hybrid system. Here, the gensets can be either connected and disconnected manually or be operated with an automatic power management system that issues the commands for connection and disconnection. The power management of the SMA Fuel Save Controller works exclusively with gensets that have an automatic power management system. Depending on the current load situation and the current PV generation, the SMA Fuel Save Controller issues recommended actions to the power management system of the gensets.

The SMA Fuel Save Controller supports the following principles, with which the genset controller power management can operate:

- Absolute power management with reserve power requirement in kW
- Relative power management with consideration of the gensets remaining active after disconnection
- Relative power management with consideration of the currently active gensets

Absolute power management with reserve power requirement in kW

The reserve power of a genset is the difference between the nominal power and the current active power output and, with power management, is taken into consideration as follows:

- The connection of the gensets is dependent on the current reserve power of all active gensets.
- The disconnection of the gensets is primarily dependent on the reserve power of the remaining active gensets after a disconnection. A disconnection hysteresis is also taken into consideration. If the reserve power threshold is only reached temporarily, the disconnection hysteresis prevents the premature disconnection of the genset.
- Furthermore, a setpoint for the reserve power requirement of the PV power plant can be transmitted to the genset system if the communication interface is capable of this (see Section 4, page 8).

The use of the absolute power management is recommended for a known reserve power requirement, because the system behavior of the gensets is more closely oriented to the current load situation than to the nominal power of the gensets.

Relative power management with consideration of the gensets remaining active after disconnection

With relative power management, the connection and disconnection thresholds are determined in relation to the nominal power of the gensets and issued as a percentage value. The connection and disconnection thresholds are defined according to the following principle:

- Connection of the gensets is dependent on the nominal power of the currently active gensets. A typical connection threshold is 90% of the nominal power.
- Disconnection of the gensets is dependent on the nominal power of the gensets still active after a disconnection. A typical disconnection threshold is 70% of the nominal power.

Relative power management with consideration of the currently active gensets

With relative power management, the connection and disconnection thresholds are determined in relation to the nominal power of the gensets and issued as a percentage value. The connection and disconnection thresholds are defined according to the following principle:

- Connection of the gensets is dependent on the nominal power of the currently active gensets. A typical connection threshold is 90% of the nominal power.
- Disconnection of the gensets is dependent on the nominal power of the gensets currently active. A typical disconnection threshold is 40% of the nominal power.

Operation with a genset controller that does not operate in accordance with one of the power management principles presented here

If the genset controller does not operate in accordance with one of the power management principles presented here, the SMA Fuel Save Controller power management must be deactivated and the operator of the PV diesel hybrid system must ensure the constant availability of sufficient reserve power via the genset system.

If the genset controller does not operate in accordance with one of the power management principles presented here and the SMA Fuel Save Controller power management is not deactivated, this can lead to the repeated connection and disconnection of gensets in the PV diesel hybrid system and therefore to an inefficient operation. Furthermore, the reserve power availability can be insufficient in certain operating states, which can trigger a power outage in the entire PV diesel hybrid system.

Coordination with SMA Solar Technology AG

Genset controllers can, in principle, also operate with power management principles or with communication interfaces that are not described in this document. Whether these genset controllers can be installed with the SMA Fuel Save Controller must be coordinated with SMA Solar Technology AG on a case by case basis.

3.2 Power Management Examples

Three gensets with differing nominal powers and priorities are connected and disconnected by one shared power management system. The priorities of the gensets are stored in the genset controller.

Genset	Nominal power	Priority
Genset 1	500 kW	3
Genset 2	430 kW	2
Genset 3	550 kW	1

Example 1: Absolute power management with reserve power requirement

reserve power requirement: 220 kW

Disconnection hysteresis: 60 kW

Switching procedure	Initial situation	Connection or disconnection condition
Connection	Genset 3 is active.	At a load of more than 330 kW (550 kW – 220 kW), genset 2 will start.
	Genset 2 and genset 3 are active.	At a load of more than 760 kW (430 kW + 550 kW – 220 kW), genset 1 will start.
Disconnection	Genset 2 and genset 3 are active.	At a load of less than 270 kW (550 kW - 220 kW – 60 kW), genset 2 will stop.
	Genset 1, genset 2 and genset 3 are active.	At a load of less than 700 kW (430 kW + 550 kW - 220 kW – 60 kW), genset 1 will stop.

Example 2: Relative power management with consideration of the gensets remaining active after disconnection

Connection threshold: 90% of the nominal power

Disconnection threshold: 70% of the nominal power

Switching procedure	Initial situation	Connection or disconnection condition
Connection	Genset 3 is active.	At a load of more than 495 kW (90% of 550 kW), genset 2 will start.
	Genset 2 and genset 3 are active.	At a load of more than 882 kW (90% of (430 kW + 550 kW)), genset 1 will start.
Disconnection	Genset 2 and genset 3 are active.	At a load of less than 385 kW (70% of 550 kW), genset 2 will stop.
	Genset 1, genset 2 and genset 3 are active.	At a load of less than 686 kW (70% of (430 kW + 550 kW)), genset 1 will stop.

Example 3: Relative power management with consideration of the currently active gensets

Connection threshold: 90% of the nominal power

Disconnection threshold: 40% of the nominal power

Switching procedure	Initial situation	Connection or disconnection condition
Connection	Genset 3 is active.	At a load of more than 495 kW (90% of 550 kW), genset 2 will start.
	Genset 2 and genset 3 are active.	At a load of more than 882 kW (90% of (430 kW + 550 kW)), genset 1 will start.
Disconnection	Genset 2 and genset 3 are active.	At a load of less than 392 kW (40% of (430 kW + 550 kW)), genset 2 will stop.
	Genset 1, genset 2 and genset 3 are active.	At a load of less than 592 kW (40% of (500 kW + 430 kW + 550 kW)), genset 1 will stop.

4 Communication

The SMA Fuel Save Controller can communicate with the genset controllers of one or more gensets via various communication interfaces.

Genset controllers of the Woodward easYgen 3000 series

Genset controllers of the Woodward easYgen 3000 series offer the following communication interfaces:

- CAN communication interface at the connection **CAN#1** of the genset controller (recommended)
- Modbus/TCP communication interface with Ethernet gateway ESENET by proconX

The genset controllers of the Woodward easYgen 3000 series are capable of processing a setpoint for the dynamic reserve power requirement of the PV power plant. In order that the dynamic reserve power requirement of the SMA Fuel Save Controller can be transmitted to the genset controllers, the respective function must be activated in the SMA Fuel Save Controller user interface.

The genset controllers of the Woodward easYgen 3000 series must be configured for use with the SMA Fuel Save Controller (see Section 5, page 9).

Genset controllers without compatible communication interface

If the genset controller does not have a communication interface that is compatible with the SMA Fuel Save Controller, direct data exchange between the genset controller and the SMA Fuel Save Controller is not possible. In this case, the SMA Fuel Save Controller must take measurements of the electrical power at the gensets. Furthermore, the SMA Fuel Save Controller must receive feedback signals from the circuit breakers of the gensets (GCBs) via its digital inputs. Without direct data exchange, the priorities defined in the genset controller can not be taken into consideration by the SMA Fuel Save Controller.

Coordination with SMA Solar Technology AG

Genset controllers can, in principle, also operate with power management principles or with communication interfaces that are not described in this document. Whether these genset controllers can be installed with the SMA Fuel Save Controller must be coordinated with SMA Solar Technology AG on a case by case basis.

5 Settings on the Genset Controller

Observe manufacturer documentation

When using the SMA Fuel Save Controller with a genset controller of the Woodward easYgen 3000 series, the following settings must be made on the genset controller. At the same time, the specifications stated in the manufacturer documentation must be observed at all times (see Woodward easYgen 3000 series documentation).

ID	Parameter	Setting
1702	Device number	This parameter assigns each genset controller with a unique address. Each genset controller requires a unique device number.
4071	Alarm class	The alarm class of the multi-system parameter alignment may only be set to A or B. This will ensure that the multi-system parameter alignment is not able to lead to the gensets being stopped.
5747	Droop tracking	Droop tracking must be set to active.
5748	Load sharing in droop mode	Load sharing in droop mode must be set to active.
5752	Start stop mode	The function **Start stop mode** for load-dependent connection and disconnection must be set to the value **[Reserve power]**.
5761	IOP Hysteresis	The value **IOP Hysteresis** specifies the disconnection hysteresis for absolute power management and must be set to a value suitable for the PV diesel hybrid system: • If the parameter **IOP Hysteresis** is set to too low a value, the gensets will have to start and stop too frequently. Frequent starting and stopping of the gensets can lead to disturbances in the operating procedure. • If the parameter **IOP Hysteresis** is set to too great a value, the gensets will have to run without interruption for too long and will be subject to greater wear and tear. The PV power plant can not be used optimally.
8950	Node-ID CAN-Bus 1	The parameter **Node-ID** specifies the address with which the genset controller is identified at the CAN bus. The **Node-ID** must be set to the same value as the device number (parameter 1702).
8962	Selected Data Protocol	The Selected Data Protocol must be set to the value **5003**.
9600	COB-ID	The COD-ID is an identification number with which the genset controllers communicate via the Selected Data Protocol (parameter 8962). Each genset controller requires a unique COB-ID.
9923	Load share Interface	The function **Load share Interface** must be set to the value **CAN #1**. This specifies the interface for communication between genset controller and SMA Fuel Save Controller.
12510	Operat. mode AUTO	The operating state **AUTO** must be activated.

ID	Parameter	Setting
12930	LD start stop	The function **LD start stop** for the load-dependent connection and disconnection must be activated.
33040	2. Node ID	If a genset controller of the Woodward easYgen 3000 series is connected to the SMA Fuel Save Controller via a CAN communication interface, and the Ethernet gateway ESENET is set in parallel, e.g. for an additional monitoring function, then so-called Service Data Objects (server SDOs) must be configured in the genset controller. Here, the identification numbers of the server SDOs **2. Node ID** must be set to values from 33 to 65.

SMA Solar Technology

www.SMA-Solar.com