



## DESIGNER'S HANDBOOK



## ASC-4

### Automatic Sustainable Controller



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# 1. General information

## 1.1 Warnings, legal information and safety

### 1.1.1 Symbols for hazard statements



#### DANGER!



**This shows dangerous situations.**

If the guidelines are not followed, these situations will result in death, serious personal injury, and equipment damage or destruction.



#### WARNING



**This shows potentially dangerous situations.**

If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.



#### CAUTION



**This shows low level risk situation.**

If the guidelines are not followed, these situations could result in minor or moderate injury.

#### NOTICE

**This shows an important notice**

Make sure to read this information.

### 1.1.2 Symbols for general notes

**NOTE** This shows general information.



#### More information

This shows where you can find more information.



#### Example

This shows an example.



#### How to ...

This shows a link to a video for help and guidance.

### 1.1.3 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the generator set or switchgear. If there is any doubt about how to install or operate the engine/generator or switchgear controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the equipment must be contacted.

**NOTE** The Multi-line 2 unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

### **Disclaimer**

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

## **1.1.4 Safety during installation and operation**

When you install and operate the equipment, you may have to work with dangerous currents and voltages. The installation must only be carried out by authorised personnel who understand the risks involved in working with electrical equipment.



### **DANGER!**



#### **Hazardous live currents and voltages**

Do not touch any terminals, especially the AC measurement inputs and the relay terminals, as this could lead to injury or death.

## **1.1.5 Electrostatic discharge awareness**

Sufficient care must be taken to protect the terminal against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

## **1.1.6 Automatic and remote-controlled starts**



### **CAUTION**



#### **Unexpected starts can be dangerous**

The power management system can automatically start gensets, the PV system and the ESS. These can also be started remotely. To avoid personal injury, the design, layout and maintenance procedures must take this into account.

## **1.1.7 Factory settings**

The ASC is delivered with default settings. These are not necessarily correct for the genset, inverter and power converter. Check the ASC settings before starting the genset, inverter and power converter.

# **1.2 About the Designer's handbook**

## **1.2.1 General purpose**

This Designer's Handbook includes function descriptions, a presentation of display unit and menu structure, the procedure for parameter setup and reference to parameter lists.

The general purpose of this document is to provide useful overall information about the functionality of the controller and its applications. This document also offers the user the information needed to successfully set up the parameters needed in the specific application.





## CAUTION



### Lack of knowledge can be dangerous

Read this document before starting to work with the controller and the genset to be controlled. Failure to do this could result in human injury or damage to the equipment.

## 1.2.2 Intended users

This Designer's Handbook is mainly intended for the panel builder designer. On the basis of this document and the Installation instructions, the panel builder designer will give the electrician the information he needs to install the controller, for example, detailed electrical drawings.

## 1.2.3 Software version

This document is based on ASC-4 software version 4.18.

## 1.3 Terms and abbreviations

Term	Abbreviation	Explanation
Automatic Sustainable Controller	ASC-4 Solar ASC-4 Battery	DEIF's controller to integrate photovoltaic and/or battery in an application with other power sources.
AGC	AGC 150 AGC-4 Mk II AGC-4	An ML-2 controller to control a genset (DG), bus tie breaker (BTB) or a mains (grid) connection.
Back of module temperature	BOM	The temperature measured at the back of the PV panel. BOM affects the PV panel efficiency and output.
Battery Control Unit	BCU	The control unit for the ESS. The BCU handles all the internal ESS controls. The BCU is the interface between the ESS and the energy management system.
Battery Management System	BMS	The monitoring system of the battery/energy clusters. The BMS monitors the SOC, and the maximum charge and discharge values.
Busbar	BB	The equipment for the electrical connection of all the sources and the loads. The busbar can also be connected to the mains (grid).
Charge		Power flows to the ESS.
Discharge		Power flows from the ESS.
Energy management	EM	To run the PV, ESS and/or gensets optimally, the ASC and AGC-4 Mk II/AGC-4 controllers work together to run at the configured set points and follow the energy management rules.
Energy management system	EMS	The ASCs work with each other, as well as with AGC-4 Mk II/AGC-4 Genset and Mains controllers, as an energy management system. The AGC-4 Mk II or AGC-4 Genset controllers start, stop and run at the load required by energy management. The ASC Battery controllers charges and discharges according to the energy management rules.  This can also be called an integrated system.
Energy storage breaker	ESB	The breaker between the ESS and the conventional power system. The ASC Battery can control this breaker.
Energy storage system	ESS	A container-sized assembly that acts as a battery.
Frequency response	FR	ASC Battery: some power converters (the primary regulator) respond immediately to a frequency.
Global horizontal irradiation	GHI	The irradiation from the sky, as measured on the horizontal.

Term	Abbreviation	Explanation
Grid		National or local electricity grid. Also known as mains.
Grid-tied		The PV and/or ESS system is connected to grid/mains power.
Inverter		Equipment that changes the direct current from the PV system to alternating current for the busbar.
Load-dependent start or stop	LDSS	Controller settings that use the system load to determine when to start and stop gensets.
Mains breaker	MB	The breaker between the PV and/or ESS system and the grid/mains power.
M-Logic		DEIF's PLC-like configurable logic tool.
Multi-line 2	ML-2	DEIF's controller series. The controllers work together to provide energy management.
Off-grid		The PV and/or ESS system is not connected to grid/mains power.
Photovoltaic	PV	A system that converts sunlight to electrical power. The system may consist of several solar panels and an inverter.
Photovoltaic breaker	PVB	The breaker between the PV system and the conventional power system. The ASC Solar can control this breaker.
Plane of array	POA	The angle of the PV panels.
Power conversion system	PCS	<p>The PCS controls the AC/DC power. During discharging, the power converter changes the direct current from the ESS to alternating current to supply the busbar. During charging, the power converter changes the alternating current from the busbar to direct current to charge the ESS.</p> <p>The PCS also ensures that the ESS is grid forming (island), grid following (grid tie), or has droop control (grid tie-grid V/f support).</p>
Power management	PM	DEIF's name for energy management.
Radio Ripple Control Receiver	RRCR	Binary inputs are used for external set point control.
Source	BA	A power source. This can be a PV system, an ESS or a genset.
Spinning reserve		Partially loaded and synchronised power sources that can quickly respond to load changes.
State of charge	SOC	The charge in the ESS [%].
State of energy	SOE	The energy in the ESS [kWh].
State of health	SOH	The degree of degradation in the ESS. Could for example be based on the amount of charge and discharge cycles of the ESS.
Utility software	USW	DEIF's software to configure the application and controllers. The USW can also be used to monitor the application, as well as to configure M-Logic.
Watts (peak)	Wp	Solar panel rating unit.

## 2. General ASC information

### 2.1 ASC Solar

#### 2.1.1 Overview

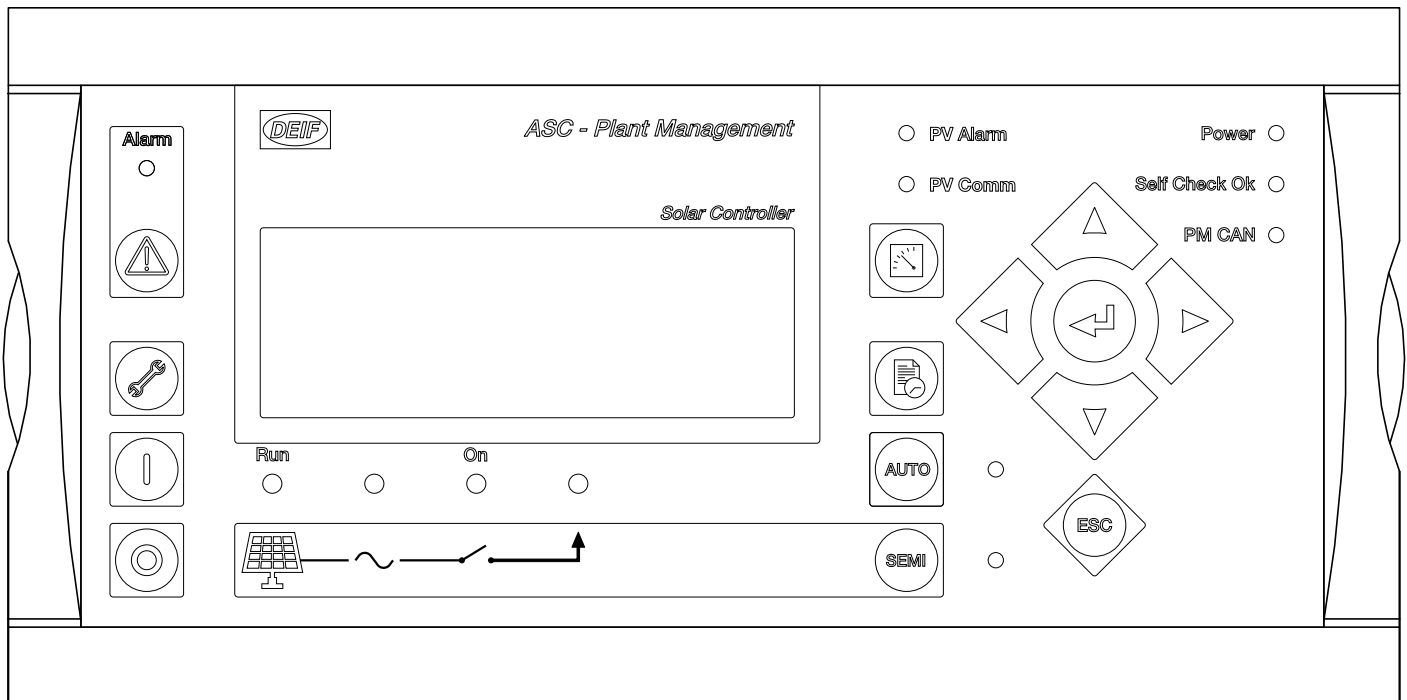
The ASC Solar controller is the link between the PV plant and the other sources. Depending on the other sources, the ASC transmits (unicast or broadcast) the power set points to the PV plant. The ASC can also make the set points available for the inverters to read.

The DEIF solution offers the PV control using regulation (rather than cascade coupling). Regulation has the following advantages:

1. Better curtailment and control for self-consumption.
2. Better regulation mode set points for import or export of power.
3. Minimised installation compared to a cascade-coupled system.
4. Control of the load of the genset plant according to engine requirements.

Once configured, the ASC Solar can run automatically. Alternatively, the display unit allows an operator to start and stop the PV system, and open and close the PV breaker.

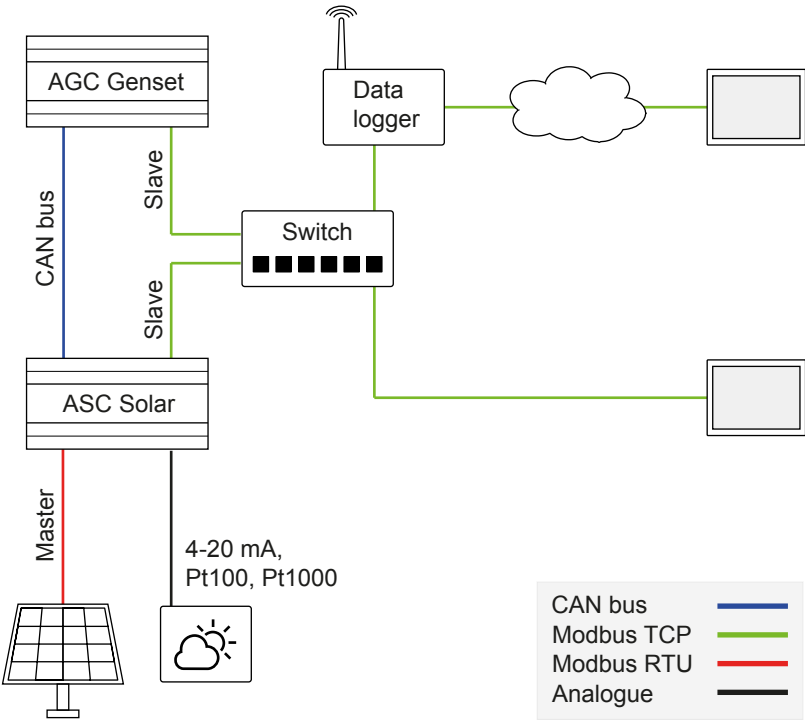
#### ASC Solar display unit folio



#### 2.1.2 ASC Solar communication

The ASC can communicate as the master and/or the slave device.

Example of ASC Solar communication



- NOTE** The ASC can get analogue weather data and/or use a Modbus RTU interface.
- NOTE** If required, you can use an RTU to TCP/IP converter for the communication between the ASC and the inverters. See the **ASC-4 Commissioning guidelines** for more information.

2.2 ASC Battery

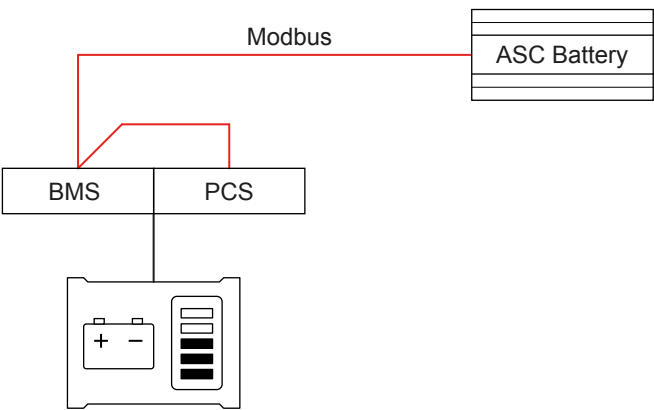
2.2.1 Overview

The ASC Battery is the link between the ESS and other sources.

Communication with the battery management system and power conversion system

If the ESS does not have a BCU, the ASC Battery communicates with the battery management system (BMS) over Modbus. The ASC Battery also communicates with the power conversion system (PCS) over Modbus.

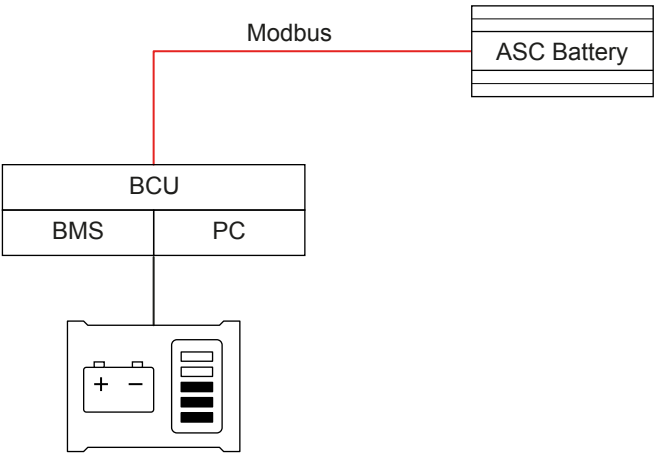
Figure 2.1 Battery management system and power conversion communication



Communication with the battery control unit

If the ESS has a battery control unit (BCU), the ASC Battery communicates with the BCU over Modbus.

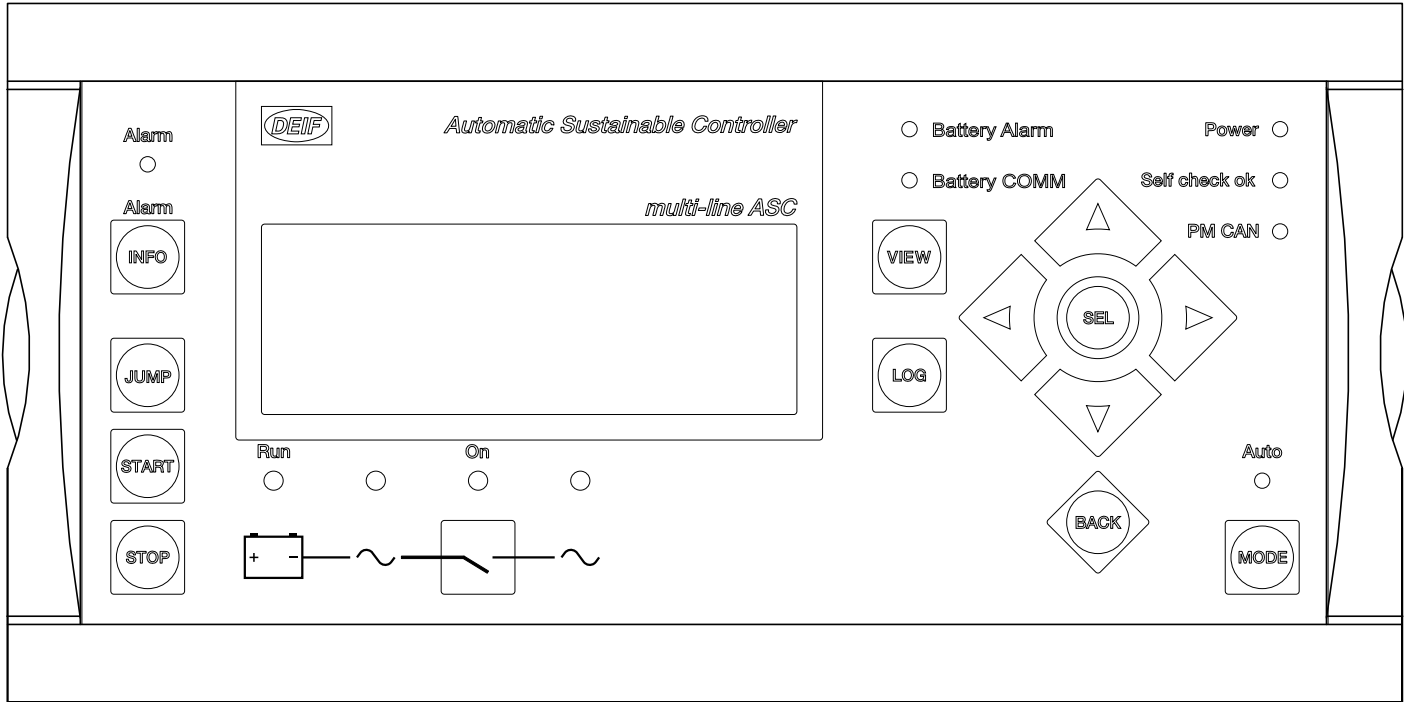
**Figure 2.2** Battery control unit communication



**Operation**

Once configured, the ASC Battery can run automatically. Alternatively, the display unit allows an operator to start and stop the ESS, and open and close the ES breaker.

**ASC Battery display unit folio**

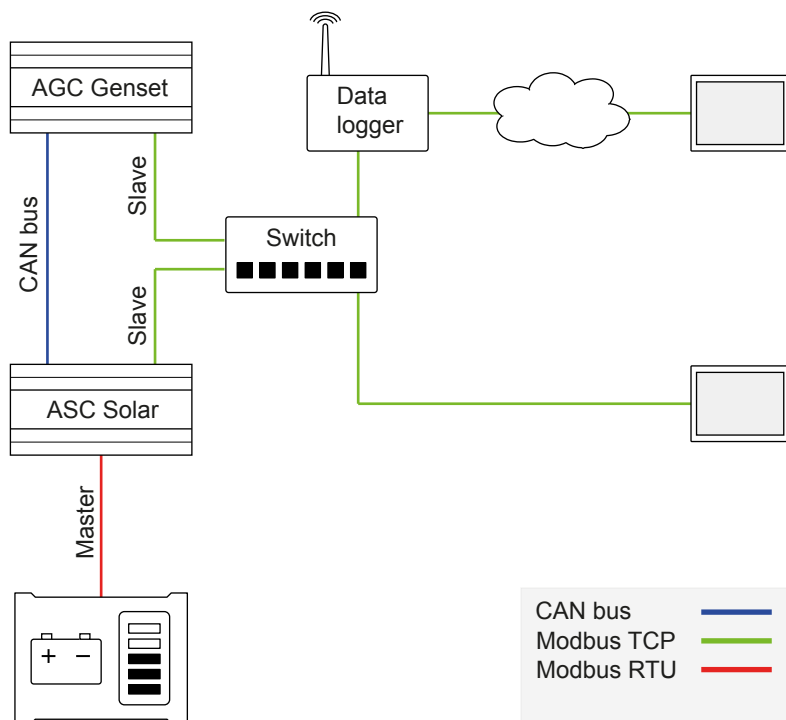


**NOTE** In some cases, the ASC Battery does not control the ESS stop. If an ESS stop is required, the ASC Battery sends a power set point of 0 kW to the ESS. This effectively stops the ESS.

**2.2.2 ASC Battery communication**

The ASC can communicate as the master and/or slave device.

## Example of ASC Battery communication



**NOTE** You can use an RTU to TCP/IP converter for the communication between the ASC and the battery. See the **ASC-4 Commissioning guidelines** for more information.

## 2.3 ASC combinations

### 2.3.1 Energy management system

ASC Solar, ASC Battery, AGC Genset, AGC Mains and ALC can work together as an energy management system. The application configuration and controller parameters allow a wide range of applications.

The controllers use CAN bus to share the information needed for energy management. Option G5 is required for energy management.



#### Quick overview

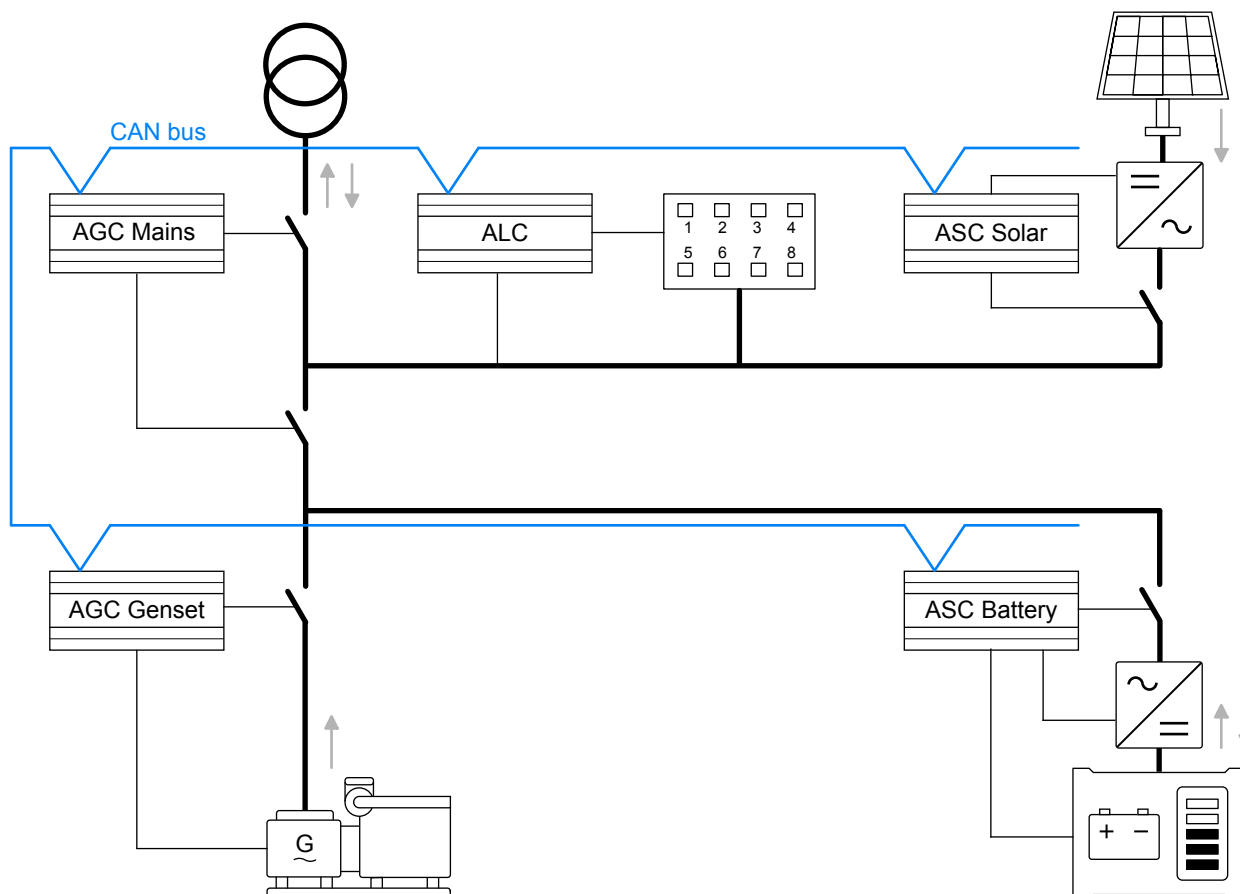
See [DEIF - Hybrid Solutions](#) for a quick introduction to energy management systems.



#### Webinar

See [Hybrid Microgrids Specialists](#) for a one hour energy management webinar.

## Example of energy management system



## Controller functions

Controller	Controls	Functions
ASC Solar	PV	<ul style="list-style-type: none"> <li>• P and Q control</li> <li>• Control PV breaker</li> <li>• Inverter communication</li> </ul>
ASC Battery	ESS	<ul style="list-style-type: none"> <li>• P and Q control</li> <li>• ESS charging and discharging</li> <li>• Control ES breaker</li> <li>• Power converter communication</li> <li>• Battery management system communication</li> </ul>
AGC Genset	Genset	<ul style="list-style-type: none"> <li>• Governor control</li> <li>• AVR control</li> <li>• Control genset breaker</li> <li>• ECU communication</li> </ul>
AGC Mains	Mains connection	<ul style="list-style-type: none"> <li>• Power import or export</li> <li>• Control breakers</li> <li>• Synchronise the plant to the mains</li> </ul>
ALC	Load groups	<ul style="list-style-type: none"> <li>• Connect and disconnect load groups</li> <li>• Manage heavy consumer requests</li> </ul>

**NOTE** ASC Battery and ESS require energy management. ASC Solar and PV systems can work alone and do not require energy management.

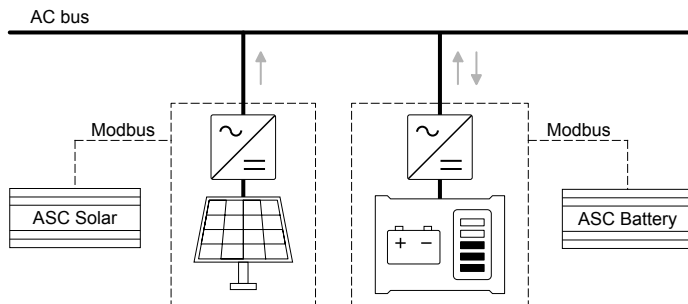
## 2.3.2 AC and DC connections

### AC-coupled

The system can include both PV, controlled by ASC Solar, and an ESS, controlled by ASC Battery. These can each be connected to the AC busbar separately.

You can then configure parameters for the ESS charging and discharging. You can also determine which sources (for example, PV, mains and/or gensets) can charge the ESS.

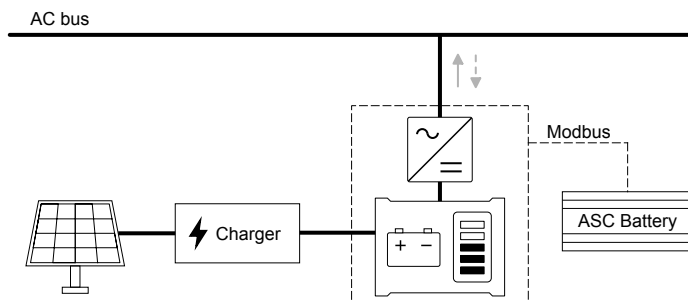
**Figure 2.3** PV and ESS with separate AC connections to the busbar



### DC-coupled

Alternatively, the photovoltaic and battery systems can have a DC power connection to each other. They then only have one AC connection to the grid, and only need one power converter. The PV system does not need an inverter, only a charger for the ESS. The ASC Battery controller is not responsible for the ESS charging.

**Figure 2.4** PV and ESS with one AC connection to the busbar



#### More information

See **Battery functions, AC- or DC-coupled** for more information.

## 2.3.3 PV and ESS combinations

An ASC application can include any combination of:

- Gensets and PV
- Gensets and ESS
- Gensets, PV and ESS
- PV and ESS
- Mains and PV
- Mains and ESS
- Mains, Gensets and PV
- Mains, Gensets and ESS
- Mains, Gensets, PV and ESS

For an application with gensets, AGC Genset controllers control the gensets.



For an application with a mains connection, an AGC Mains controller controls the mains connection. A stand-alone ASC Solar controller can only receive the mains measurement and do mains power export (MPE).

**NOTE** Externally controlled bus tie breakers and AGC BTB controllers can also be included in an ASC application.



**More information**

See **Applications** for more information.

## 2.4 ASC as part of ML-2

### 2.4.1 ASC as part of Multi-line 2

The ASC is part of the DEIF Multi-line 2 product family. Multi-line 2 is a complete range of multi-function protection and control products.

ASC is designed as a cost-effective solution for solar power and energy storage. It offers flexible protection and control for medium to large PV and ESS applications. As part of the Multi-line product family, the standard functions can be supplemented with a variety of optional functions.

### 2.4.2 Type of product

The Automatic Sustainable Controller, ASC, is a micro-processor based control unit containing all necessary functions for protection and control of an inverter.

It contains all necessary 3-phase measuring circuits, and all values and alarms are presented on the LCD display. The ASC offers TCP/IP Modbus interface for communication to various parties, for example SCADA or HMI.

### 2.4.3 Options

DEIF supplies a range of basic controllers that can be supplemented with flexible options. The options cover various protections for inverter generator, busbar and mains, voltage/var/PF control, various outputs, power management, serial communication, additional operator display, and so on.

**NOTE** A complete list of available options is included in the data sheet.

#### Required option

Option	Type	Function
H2.8	Hardware	Modbus communication

#### Recommended options

Option	Type	Function
G5	Software	Power management
M4	Hardware	CAN communication (required by option G5)

### 2.4.4 Compatibility with other ML-2 products

The ASC-4 can be used in power management systems with AGC-4 Mk II, AGC-4, AGC 150, and ALC-4. The controllers share power management information over CAN bus.

## 3. Functions

### 3.1 Standard functions

#### Operation modes

Grid-tied, off-grid or combination (grid-tied and off-grid), depending on the conditions the following modes apply:

- Island operation
- Fixed power/base load
- Peak shaving
- Mains power export
- Power management
  - An AGC Mains or Genset controller decides the operating mode.

#### Protection

##### PV/ESS protection (ANSI)

- 5 x overload (32)
- 4 x over-current (50/51)
- 2 x over-voltage (59)
- 3 x under-voltage (27)
- 3 x over-/under-frequency (81)
- 1 x power-dependent reactive power import (40)
- 1 x power-dependent reactive power export (40)

##### Busbar protection (ANSI)

- 3 x over-voltage (59)
- 4 x under-voltage (27)
- 3 x over-frequency (81)
- 4 x under-frequency (81)

#### Other

##### Display

- Prepared for remote monitoring
- Push-buttons for start and stop
- Push-buttons for breaker operations
- Status texts

##### M-Logic

- Simple logic configuration tool
- Selectable input events
- Selectable output commands

##### Miscellaneous


- Multi-inputs (digital, 4-20 mA, 0-40 V DC, Pt100, Pt1000 or RMI)
- Digital inputs

## 3.2 Measurement systems

The ASC is designed for measurement of voltages between 100 and 690 V AC. For further reference, the AC wiring diagrams are shown in the Installation Instructions. In menu 9130, the AC configuration can be three-phase, single phase or split phase.

**NOTE** The settings can be changed using the display. Press the JUMP push-button and go to menu 9130 or use the USW.

### Menu 9130 AC configuration example for ASC-4 Solar

 Automatic Sustainable Controller

multi-line ASC

PV 0 0 0V

9130 AC config.

3 phase L1L2L3

RESET SAVE



### CAUTION



#### Incorrect configuration is dangerous

Configure the ASC to match the plant's AC configuration. When in doubt, contact the switchboard manufacturer for information about plant AC configuration.

### 3.2.1 Three-phase system

By default, the three-phase system is selected. All three phases must then be connected to the ASC.

Adjustment these parameters to make the system ready for three-phase measuring (for example, 400/230 V AC):

Parameter	Name	Description	Adjust to value
6004 <sup>1</sup>	Nom. U voltage	Phase-phase voltage of the source	400 V AC
6041	BA transformer	Primary voltage of the source voltage transformer (if installed)	$U_{NOM}$
6042	BA transformer	Secondary voltage of the source voltage transformer (if installed)	$U_{NOM}$
6051 <sup>2</sup>	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	$U_{NOM}$
6052	BB transformer set 1	Secondary voltage of the BB voltage transformer (if installed)	$U_{NOM}$
6053	BB nom. voltage set 1	Phase-phase voltage of the busbar	$U_{NOM}$

**NOTE** 1: The ASC has four sets of nominal settings. Use parameter 6045 to select which set is used.

**NOTE** 2: The ASC has two sets of BB transformer settings. Use parameter 6054 to select which set is used.

### 3.2.2 Single-phase system

A single phase system consists of one phase and the neutral.

The following adjustments must be made to make the system ready for single-phase measuring (example 230 V AC):

Setting	Adjustment	Description	Adjust to value
6004 <sup>1</sup>	Nom. voltage	Phase-phase voltage of the source	230 V AC <sup>3</sup>
6041	BA transformer	Primary voltage of the source voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
6042	BA transformer	Secondary voltage of the source voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$

Setting	Adjustment	Description	Adjust to value
6051 <sup>2</sup>	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
6052	BB transformer set 1	Secondary voltage of the BB voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
6053	BB nom. voltage set 1	Phase-phase voltage of the busbar	$U_{NOM} \times \sqrt{3}$

**NOTE** 1: The ASC has four sets of nominal settings. Use parameter 6045 to select which set is used.

**NOTE** 2: The ASC has two sets of BB transformer settings. Use parameter 6054 to select which set is used.

**NOTE** 3: The voltage alarms use  $U_{NOM}$  (230 V AC).

### 3.2.3 Phase-phase or phase-neutral measurements

The AC protections can be configured for either a phase-phase or a phase-neutral measurement. These settings also influence other protections and settings in the ASC.

#### AC measurement parameters

Parameter	Name	Range	Default	Details
1201	Solar: PV voltage trip Battery: ES voltage trip	Ph-Ph Ph-N	Ph-Ph	To set this parameter, look at how the loads in the application are connected. If many of the loads are connected as phase-neutral, the setting should be phase-neutral.  This setting determines how the ASC uses the voltage measurements on the source side of a breaker.
1202	BB voltage trip	Ph-Ph Ph-N	Ph-Ph	This setting determines how the ASC uses the busbar voltage measurements.

#### Parameters affected by parameter 1201

Parameters	Name
1150, 1160	Source over-voltage protection 1 and 2
1170, 1180, 1190	Source under-voltage protection 1, 2 and 3

#### Parameters affected by parameter 1202

Parameters	Name
1270, 1280, 1290	Busbar over-voltage protection 1, 2 and 3
1300, 1310, 1320, 1330	Busbar under-voltage protection 1, 2, 3 and 4

## 3.3 Nominal settings

The ASC allows four sets of nominal settings, configured in parameters 6001 to 6036. By default, nominal settings 1 (6001 to 6007) are used. See "Switch between the nominal settings" for more information.

The ASC allows two sets of nominal settings for the busbar, configured in parameters 6051 to 6063. Each set consists of a nominal as well as a primary and secondary voltage value. "U primary" and "U secondary" define the primary and secondary voltages if measurement transformers are installed.

### 3.3.1 Switch between the nominal settings

Four sets of nominal settings can be configured. The ASC can switch between different sets of nominal settings. This enables the use of a specific set of nominal settings for a specific application.

Activation

Switching between the nominal set points can be done in the following ways:

- Digital input
- AOP
- Parameter 6045
- M-Logic (any event)

Digital input

In M-Logic, select **Events, Inputs, Dig. Input No#** as the input event. Select **Output, Command, Set parameter #** in the output.

M-Logic example for using a digital input to select the nominal settings

Logic 1

ASC uses nominal parameters set 1 for no input

Event A

☒ Dig. Input No23: Inputs

×

Event B

☐ Not used

×

Event C

☐ Not used

×

Operator

OR

OR

Delay (sec.)

0

Output

Set parameter 1: Command

×

Enable this rule

☐

Logic 2

ASC uses nominal parameters set 2 when digital input 23 is activated

Event A

☐ Dig. Input No23: Inputs

×

Event B

☐ Not used

×

Event C

☐ Not used

×

Operator

OR

OR

Delay (sec.)

0

Output

Set parameter 2: Command

×

Enable this rule

☐

AOP

In M-Logic, select the AOP tab. Select the push-button as the input event. Select the nominal settings in the outputs.

AOP Example

Event A		Event B		Event C	Output
Button07	or	Not used	or	Not used	Set nom. parameter settings 1
Button08	or	Not used	or	Not used	Set nom. parameter settings 2

**NOTE** See the *Help* file in the PC utility software for details.

Parameter setting

Use parameter 6045 to select the nominal settings.

3.3.2 Scaling

The default voltage scaling is 100 V to 25000 V (parameter 9030). To handle applications above 25000 V and below 100 V, adjust the input range to match the primary voltage transformer. Master password level access is required to change this parameter.

Changing the voltage scaling also influences the nominal setting ranges:

Scaling (9030)	Range for power nominal settings	Range for voltage nominal settings	Range for transformer primary settings (6041, 6051, 6061)
10 V to 2500 V	1.0 to 900.0 kW	10.0 V to 2500.0 V	10.0 V to 2500.0 V
100 V to 25000 V	10 to 20000 kW	100 V to 25000 V	100 V to 25000 V



## CAUTION



### Incorrect configuration is dangerous

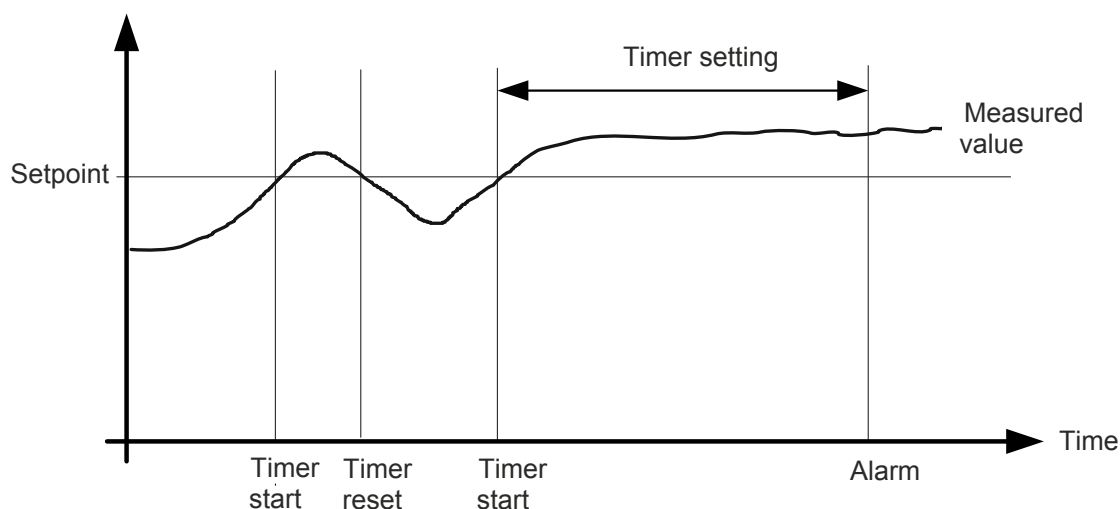
All nominal settings and the primary VT settings must be corrected after the scaling has been changed in parameter 9030.

## 3.4 Protections

### 3.4.1 General

The protections are all of the definite time type, which means that a set point and time is selected.

If, for example, the function is over-voltage, the timer will be activated if the set point is exceeded. If the voltage value falls below the set point value before the timer runs out, the timer will be stopped and reset.

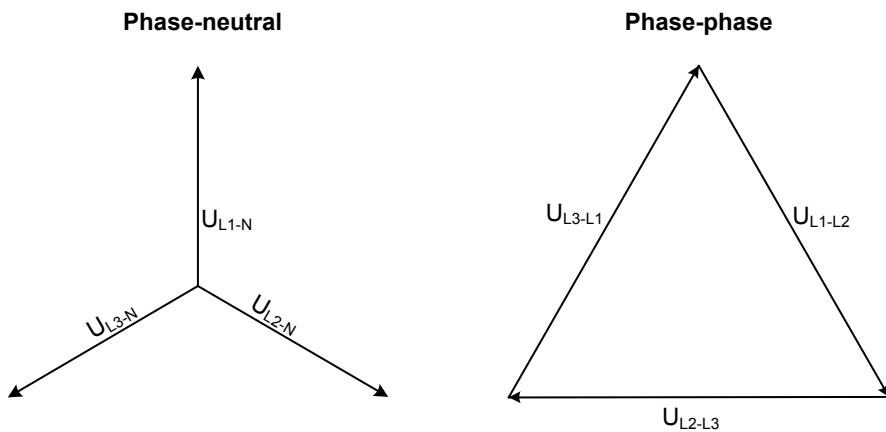


When the timer runs out, the output is activated. The total delay will be the delay setting + the reaction time.

**NOTE** When parameterising the DEIF controller, the measuring class of the controller and an adequate "safety" margin must be taken into consideration.  
For example, a power generation system must not reconnect to a network when the voltage is  $85\% \text{ of } U_n \pm 0\% \leq U \leq 110\% \pm 0\%$ . In order to ensure reconnection within this interval, a control unit's tolerance/accuracy (Class 1 of the measuring range) has to be taken into consideration. It is recommended to set a control unit's setting range 1 to 2 % higher/lower than the actual set point, if the tolerance of the interval is  $\pm 0\%$ , to ensure that the power system does not reconnect outside the interval.

### Phase-neutral voltage trip

If the voltage alarms are to work based on phase-neutral measurements, you must adjust menus 1200 and 1340 accordingly. Depending on the selections, either phase-phase voltages or phase-neutral voltages will be used for the alarm monitoring.



As indicated in the vector diagram, there is a difference in voltage values at an error situation for the phase-neutral voltage and the phase-phase voltage.

The table shows the actual measurements at a 10 % under-voltage situation in a 400/230 volt system.

	Phase-neutral	Phase-phase
Nominal voltage	400/230	400/230
Voltage, 10 % error	380/207	360/185

The alarm will occur at two different voltage levels, even though the alarm set point is 10 % in both cases.

**Example**

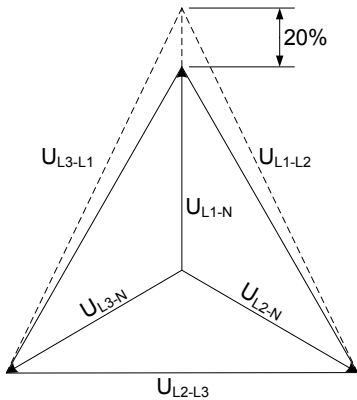
The below 400 V AC system shows that the phase-neutral voltage must change 20 %, when the phase-phase voltage changes 40 volts (10 %).

**Example:**  
 $U_{NOM} = 400/230 \text{ V AC}$

**Error situation:**  
 $U_{L1L2} = 360 \text{ V AC}$   
 $U_{L3L1} = 360 \text{ V AC}$

$U_{L1-N} = 185 \text{ V AC}$

$\Delta U_{PH-N} = 20 \%$



**NOTE** Phase-neutral or phase-phase: both the generator protections and the busbar/mains protections use the selected voltage.

## 4. Applications

### 4.1 Stand-alone

#### 4.1.1 Stand-alone applications

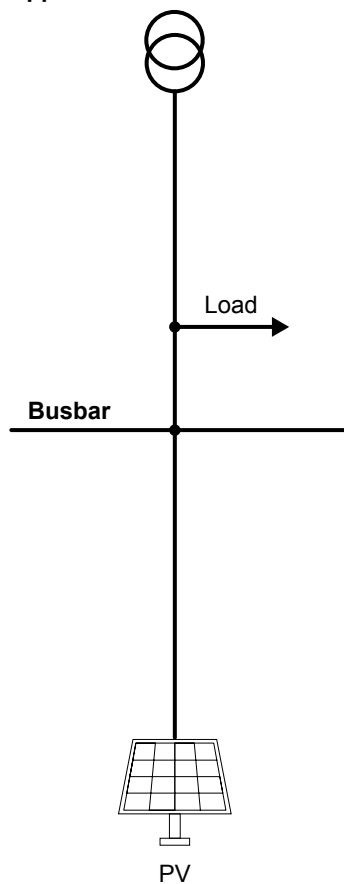
In a stand-alone application, the ASC Solar controller operates as the only DEIF controller in the system. The ASC is the link to the inverter. For stand-alone control, the ASC requires the power (P and Q) measurements from the other sources in the system.

Stand-alone mode is typically used if the ASC is installed in a pre-existing plant.

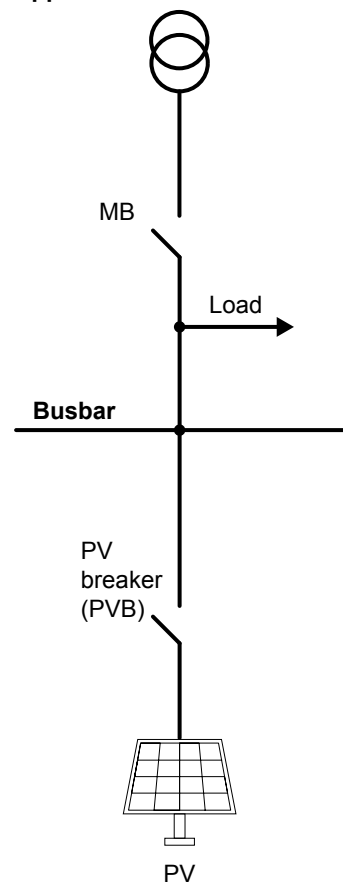
##### Breaker control

The ASC Solar controller can control a PV breaker (optional). If a mains breaker is present, the ASC cannot control the mains breaker. The ASC only receives the breaker feedback (open/closed).

Application without PV and mains breaker



Application with PV and mains breaker



##### Power measurement

For a stand-alone application, the genset power (active and reactive) and the mains power (active and reactive) (imported or exported) must be measured. You can use the following parameters to select power meters and/or measurement transducers for each measurement.

Function	Description	Menu
Mains power	Measuring import or export kW	7490
Mains reactive power	Measuring import or export kvar	7490
Genset power	Measuring the kW production from gensets 1 to 16	7330 to 7480
Genset reactive power	Measuring the kvar production from gensets 1 to 16	7330 to 7480



## Power meters

The ASC supports a wide range of power meters, including the standard DEIF Power meters MIC and MIB. The ASC must have option H2.8 for Modbus communication with the power meter.



### More information

See the **DEIF hybrid controller compatibility** documents for a list of compatible power meters.

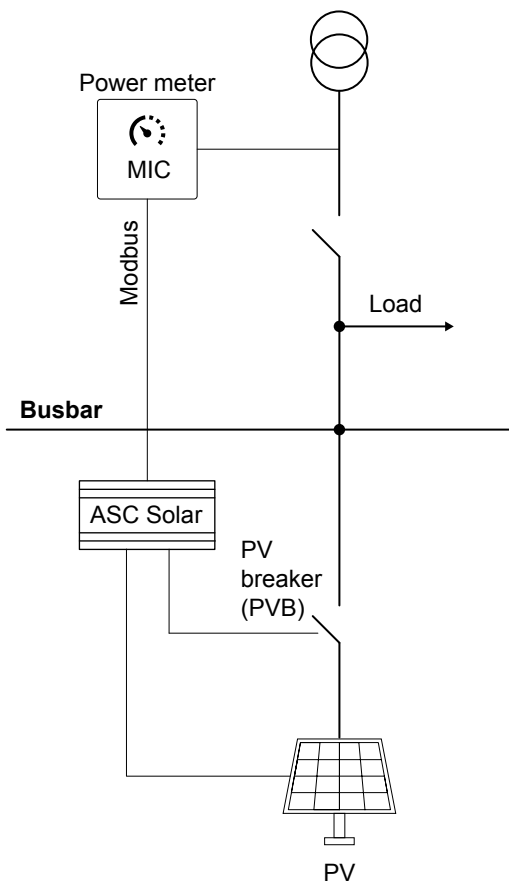
## Measurement transducers

The genset power (active and reactive) and the mains power (active and reactive) (imported or exported) can be measured with a DEIF TAS-331DG or an MTR-3 measurement transducer (see [www.deif.com](http://www.deif.com)). One TAS-331DG is required for each power or reactive power measurement. One MTR-3 can measure both power and reactive power.

Note that the maximum and minimum ranges are adjusted in the analogue input setup. For example, for input 102, these are adjusted in menu 4120.

## Grid-tied applications

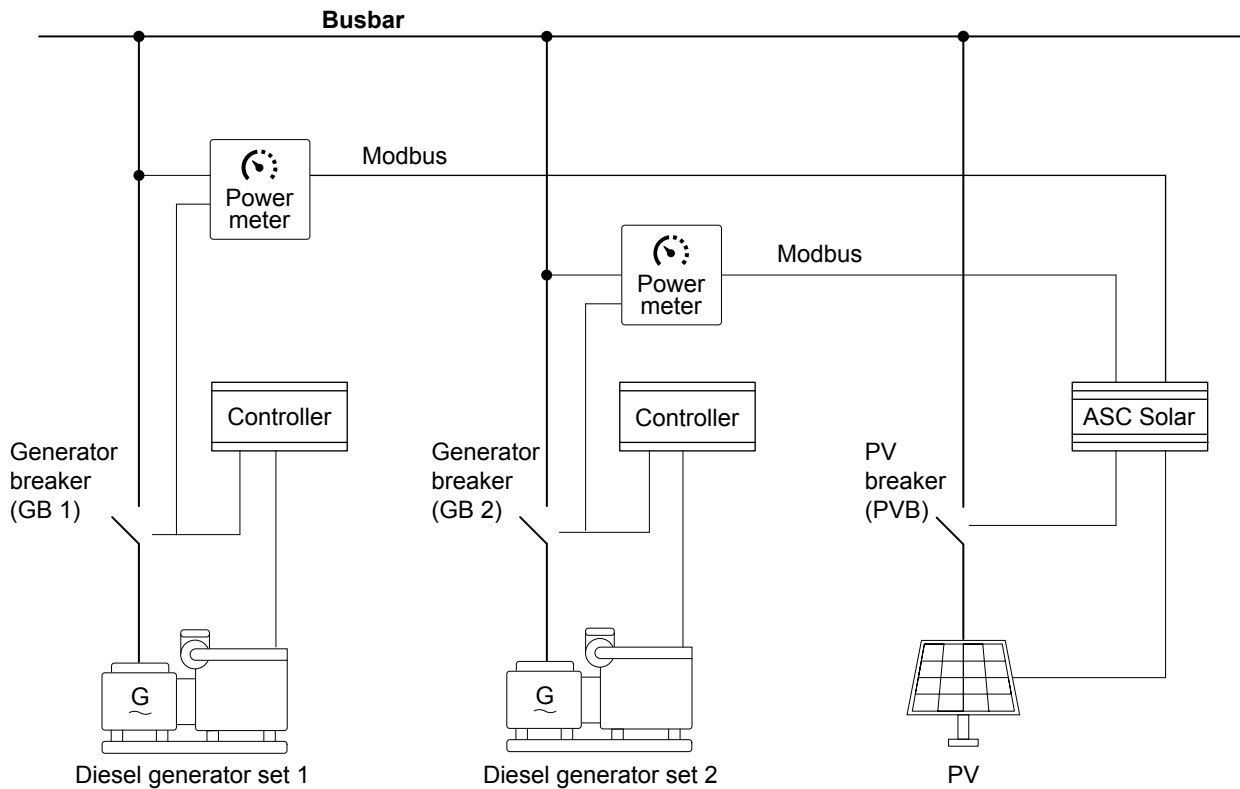
In this example, the PVs produce power for the consumers (and/or the grid). A DEIF MIC power meter measures the mains power import or export.



## Off-grid applications

In off-grid applications, the genset output must be measured.

In this example, the ASC Solar is in a stand-alone configuration. The application includes two gensets controlled by DEIF or third-party controllers. To make the PV controls work, measure the output of the gensets (kW and kvar) and transmit this information to the ASC. In the example, DEIF MIC power meters are used. They each use Modbus to provide the GB position and the active and reactive power to the ASC.



Alternatively, feedback from the breakers could be connected directly to the ASC. A power meter can measure the active and reactive power. As an alternative to a power meter, you can connect transducers to CTs to sum up the currents from each of the gensets.

### 4.1.2 Modes of operation

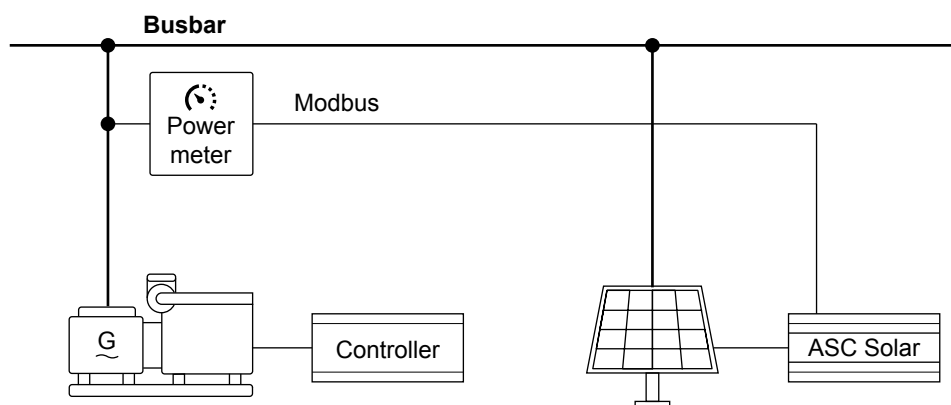
ASC can be used in applications that are off-grid, grid-tied, or a combination. There is a maximum of 16 grid connections, and there can be up to 16 gensets. If there is more than 1 grid connection, the ASC interacts with the grid connections as if there was only 1 grid connection.

#### Off-grid applications

In a stand-alone off-grid application, the ASC can have the following mode of operation:

- Island mode

#### Stand-alone off-grid PV application



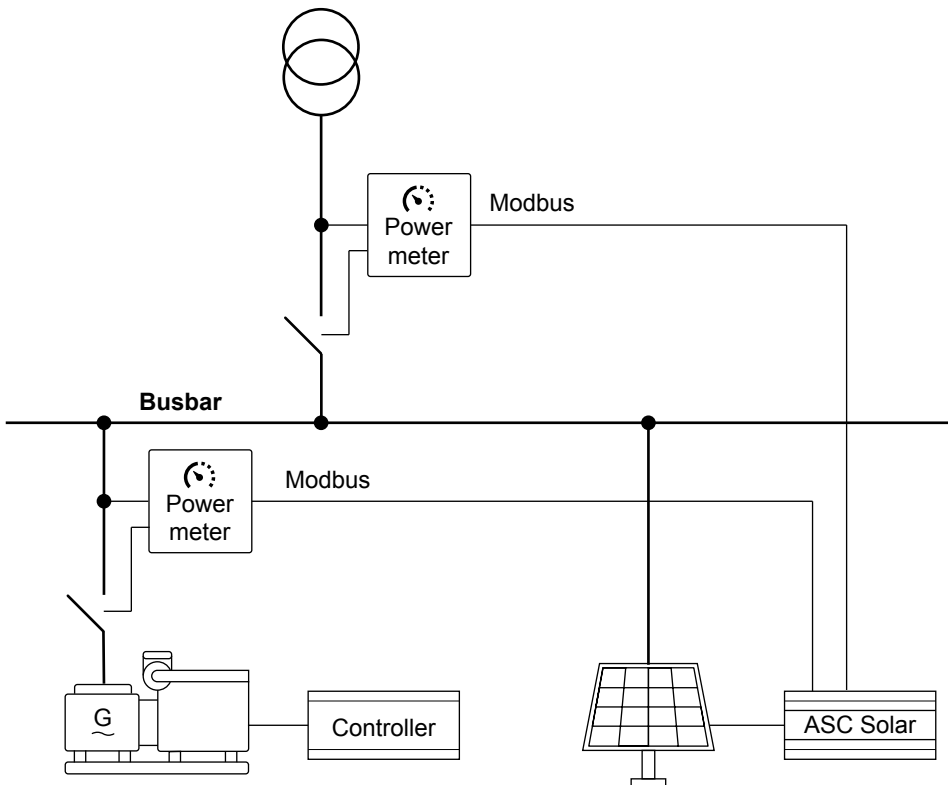
#### Grid-tied applications

In a stand-alone grid-tied application, the ASC can have the following modes of operation:

- MPE (Mains Power Export)
- Peak shaving

- Fixed power

### Stand-alone grid-tied PV application



**NOTE** Gensets are not required in a grid-tied application.

### Combination applications

In a stand-alone combination application, the ASC can have the following modes of operation:

- Mains breaker open (that is, off-grid):
  - Island mode
  - AMF (Automatic Mains Failure)
  - LTO (Load Take Over)
- Mains breaker closed (that is, grid-tied):
  - MPE (Mains Power Export)
  - Peak shaving
  - Fixed power

#### 4.1.3 Gensets in stand-alone applications

Power management is not possible in a stand-alone application. The stand-alone application can be off-grid or grid-tied. For stand-alone applications, one or more gensets must be available. The ASC requires the genset nominal ratings:

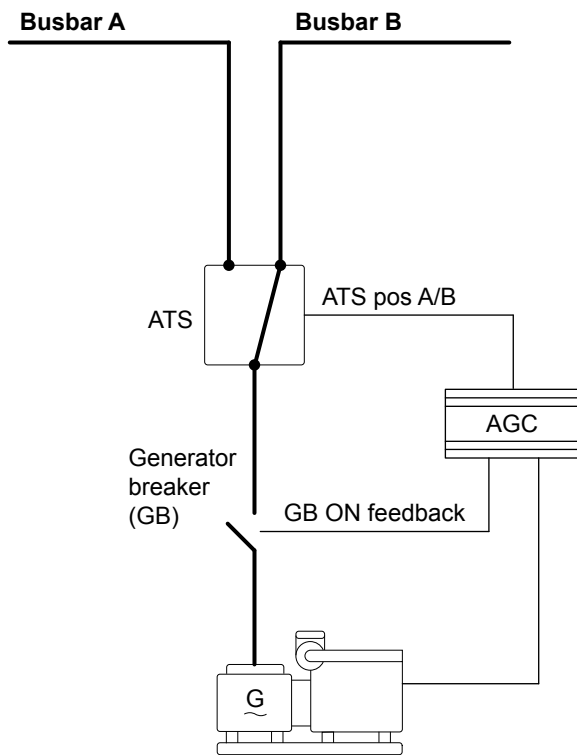
Mains	★	7331	DG1 nom. power	250	kW
Mains	★	7341	DG2 nom. power	300	kW
Mains	★	7351	DG3 nom. power	150	kW
Mains	★	7361	DG4 nom. power	150	kW
Mains	★	7371	DG5 nom. power	250	kW
Mains	★	7381	DG6 nom. power	300	kW
Mains	★	7391	DG7 nom. power	300	kW
Mains	★	7401	DG8 nom. power	300	kW
Mains	★	7411	DG9 nom. power	250	kW
Mains	★	7421	DG10 nom. power	250	kW
Mains	★	7431	DG11 nom. power	350	kW
Mains	★	7441	DG12 nom. power	150	kW
Mains	★	7451	DG13 nom. power	150	kW
Mains	★	7461	DG14 nom. power	250	kW
Mains	★	7471	DG15 nom. power	250	kW
Mains	★	7481	DG16 nom. power	300	kW

The ASC also needs to know which gensets are connected. Use the I/O settings in the USW to configure breaker feedback.

The application can include up to sixteen (16) gensets.

#### 4.1.4 Split busbar

In a stand-alone application, the generators can be enabled and disabled. This is useful if the generators are able to connect to two busbars.



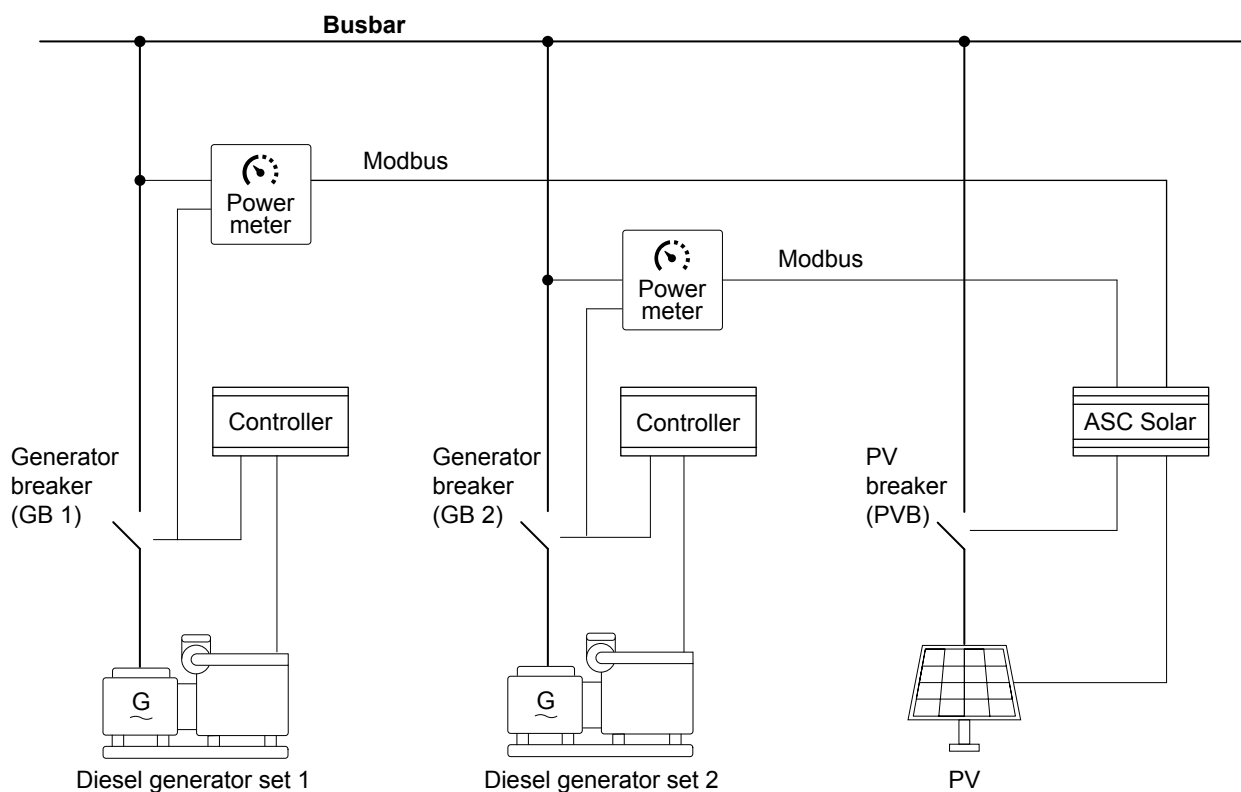
In M-Logic, it can be programmed whether the genset is connected to the PV side (enabled) or connected to the side without the PV (disabled):

Logic 1		Item description (optional and saved in project file only)	
Event A	Operator	Event B	
NOT <input type="checkbox"/> Dig. Input No23: Inputs	OR	NOT <input type="checkbox"/> Not used	
Enable this rule <input checked="" type="checkbox"/>		Output	Enable DG1: DG Ena/Dis
Logic 2			
Event A	Operator	Event B	
NOT <input checked="" type="checkbox"/> Dig. Input No23: Inputs	OR	NOT <input type="checkbox"/> Not used	
Enable this rule <input checked="" type="checkbox"/>		Output	Disable DG1: DG Ena/Dis

#### 4.1.5 Off-grid, stand-alone mode

This application is used if the gensets already have a control system (shown by *Controller* in the diagram).

The ASC requires the GB breaker feedbacks (open or closed), and the active and reactive power from the gensets. If a DEIF MIC power meter is used, this can provide the GB position and the active and reactive power from the genset.



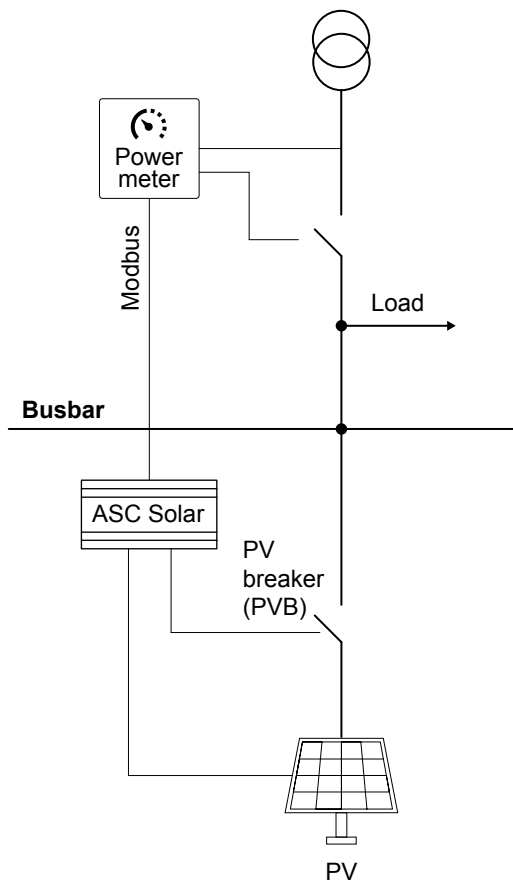
Alternatively, the ASC could be connected for direct feedback from the breakers, and active and reactive power from the power meters.

### Setting in ASC

Parameter	Name	Setting
6071	Operating mode	Island operation

### 4.1.6 Grid-tied, stand-alone

This application is used if no AGC mains is installed to facilitate the power management parallel to mains functions. The ASC needs inputs from the MB feedback (open/closed) and the active and reactive power from the mains (export or import). A power meter or transducer can be used.



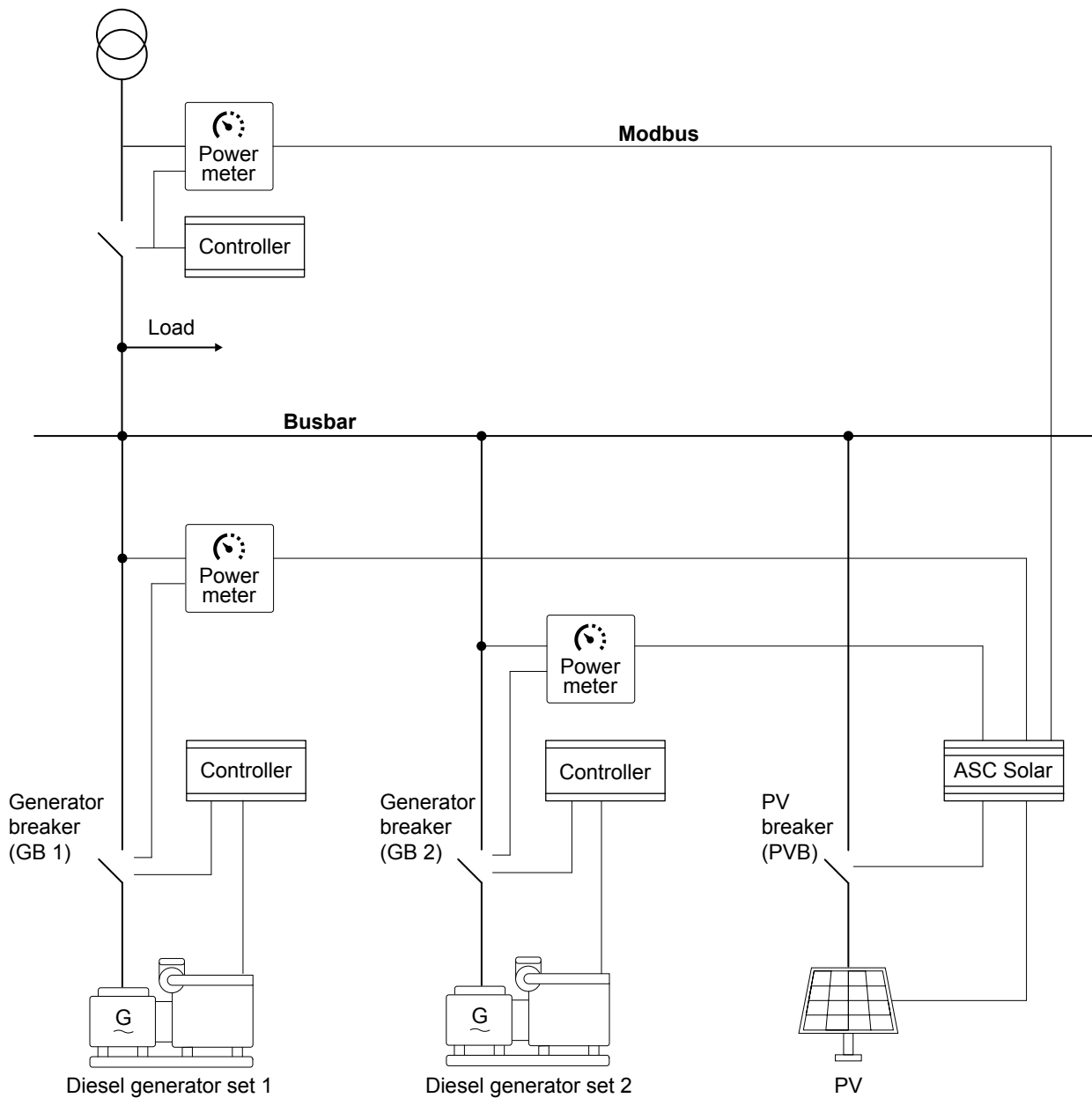
Alternatively, the ASC could be connected for direct feedback from the breaker, and active and reactive power from the power meter.

### Setting in ASC

Parameter	Name	Range
6071	Operating mode	Island operation Fixed power Peak shaving Main power export

### 4.1.7 Combination (off-grid + grid-tied), stand-alone

This application is used when the application has to be available in grid-tied modes as well as off-grid (islanded) modes. In this example, third party controllers are installed (shown by *Controller* in the diagram). The ASC needs feedback from the breakers (GBs and MB), the mains power and reactive power, and the sum of the genset power and reactive power.



Alternatively, you can hardwire feedback from the breakers (GBs and MB).

### Setting in ASC

Parameter	Name	Range
6071	Operating mode	Island operation Fixed power Peak shaving Mains power export

## 4.2 Energy management

### 4.2.1 Power management applications

The ASC can be included in power management (also known as energy management). This allows the mains (if present), gensets, PV and/or ESS to work together in an integrated system. Power management includes:

1. Automatic rotation of diesel priority.
2. Fuel-optimised diesel priority.
3. Control of plant spinning reserve.



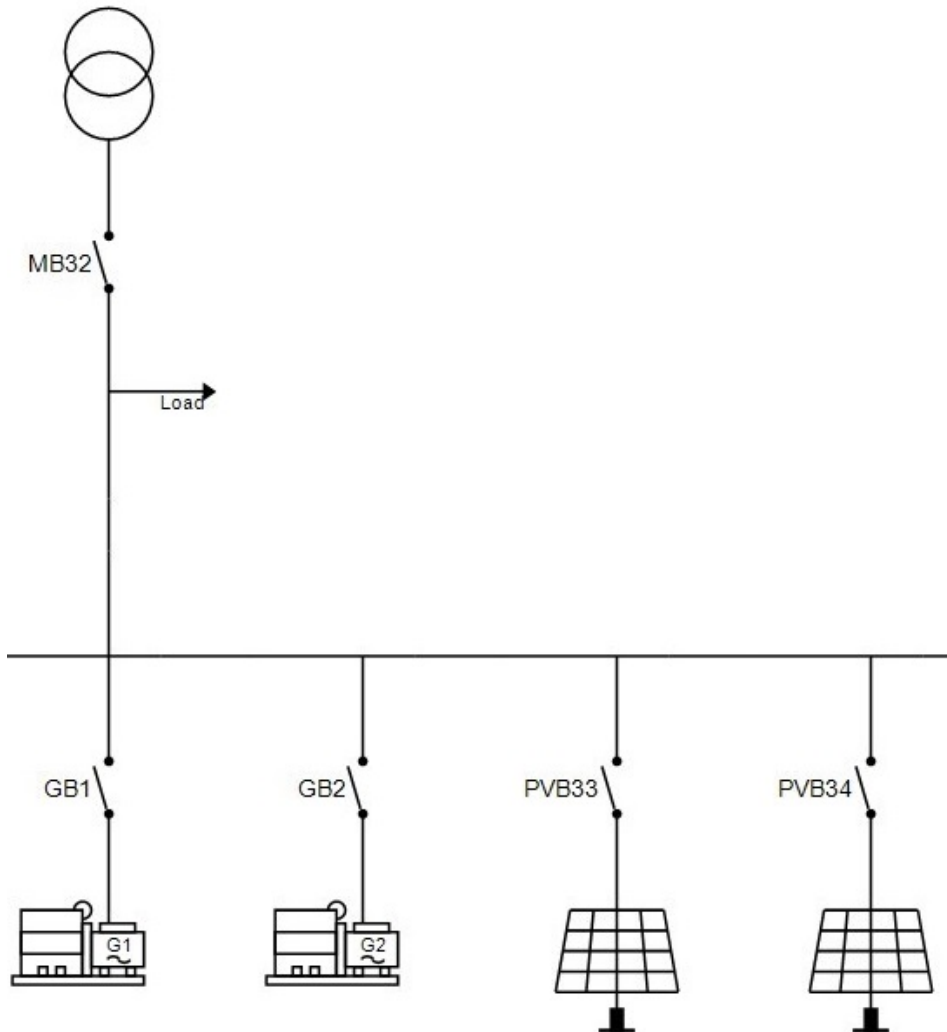
4. Flexible application support with common grid-tied, combination, off-grid applications.

### ASC and PV on the utility software application drawing

The ASC controls and monitors the inverters(s) of the PV plant. In the application single line drawing, the ASC is shown as a PV module. There can be up to 16 PV modules. Each PV module represents either an inverter, or a string of inverters.

### Breaker control

The ASC can control a PV or ESS breaker like an AGC controls a generator breaker. For PV, this can be useful if there is a breaker in front of the string of inverters.



The PV or ESS breakers are controlled by the ASCs. Closure is possible when the busbar is live and Hz/voltage is normal. If the busbar is outside its limits, the ASC can open the PV or ESS breaker but not close it.

One ASC can control one PV or ESS breaker. For PV, the breaker can disconnect the PV if a sudden drop in the load forces reverse power to the gensets (risking a generator trip).

If the ASC is in full automatic (AUTO), the ASC will close the breaker when the busbar is live (and then the inverter or power converter starts). The ASC does not require a manual start signal if AUTO is selected.

If SEMI is selected, an operator needs to put the breaker close and start buttons on the display unit. Alternatively, this signal can be sent by Modbus, digital input and so on.

## 4.2.2 Modes of operation

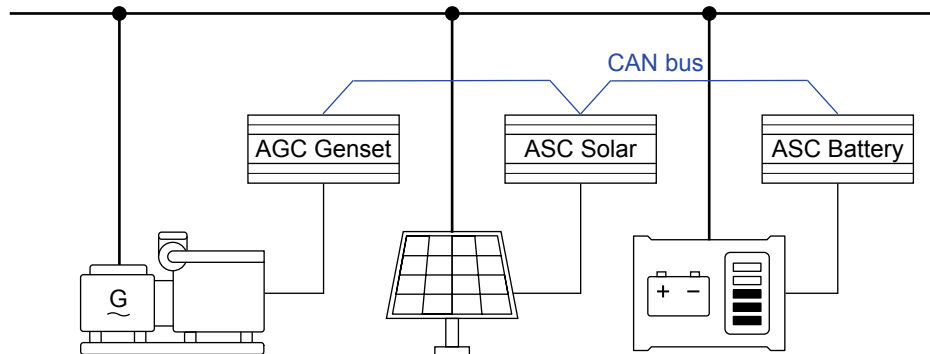
ASC can be used in applications that are grid-tied, off-grid, or a combination. There is a maximum of 1 grid connection, and there can be up to 32 gensets.

### Off-grid applications

In a power management off-grid application, the ASC can have the following mode of operation:

- Island mode

#### Power management off-grid application example

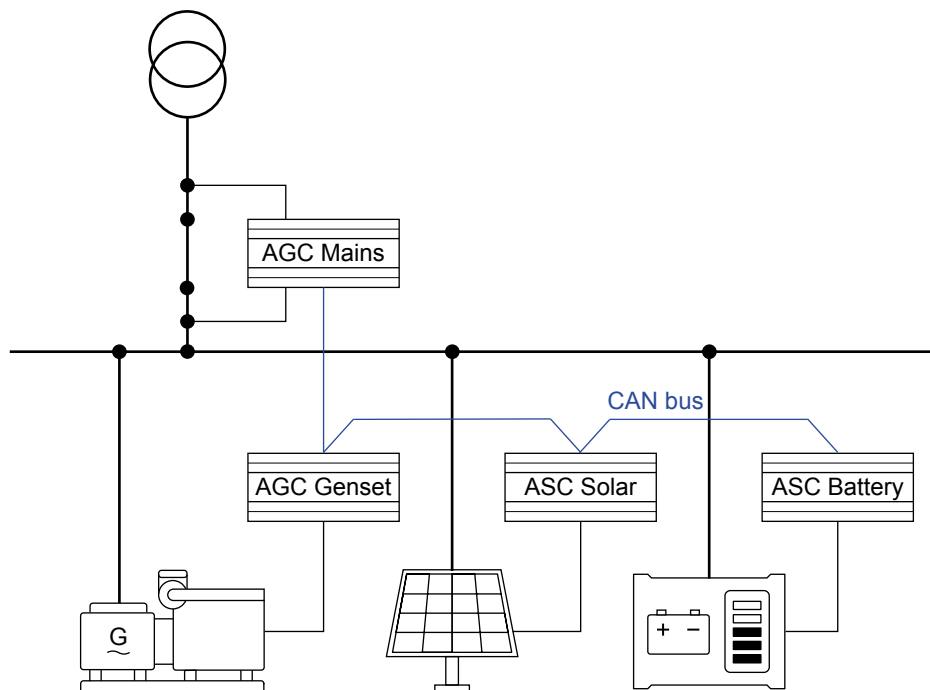


### Grid-tied applications

In a power management grid-tied application, the ASC can have the following modes of operation:

- MPE (Mains Power Export)
- Peak shaving
- Fixed power

#### Power management grid-tied application example



**NOTE** Gensets are not required in a grid-tied application.

### Combination applications

In a power management combination application, the ASC can have the following modes of operation:

- Mains breaker open (that is, off-grid):

- Island mode
- AMF (Automatic Mains Failure)
- LTO (Load Take Over)
- Mains breaker closed (that is, grid-tied):
  - MPE (Mains Power Export)
  - Peak shaving
  - Fixed power

### 4.2.3 System limitations

When the ASC is used for power management (option G5), the number of controllers is limited.

	Share pool of IDs with	Maximum number
AGC Mains	AGC Genset	32
AGC Genset	AGC Mains	32
ASC Solar	ASC Battery, AGC BTB, Externally controlled BTB, ALC-4	16
ASC Battery	ASC Solar, AGC BTB, Externally controlled BTB, ALC-4	16
ALC-4	ASC Solar, ASC Battery, AGC BTB, Externally controlled BTB	16
AGC Battery/Externally controlled BTB	ASC Solar, ASC Battery, ALC-4	8

#### Example

If you have a system with one mains feeder, then you have  $32-1=31$  IDs left for the gensets. If you have two mains feeders, you have  $32-2=30$  IDs left for the gensets.

If you have a system with 14 ASC Solar controllers, you can have  $16-14=2$  bus tie breakers.

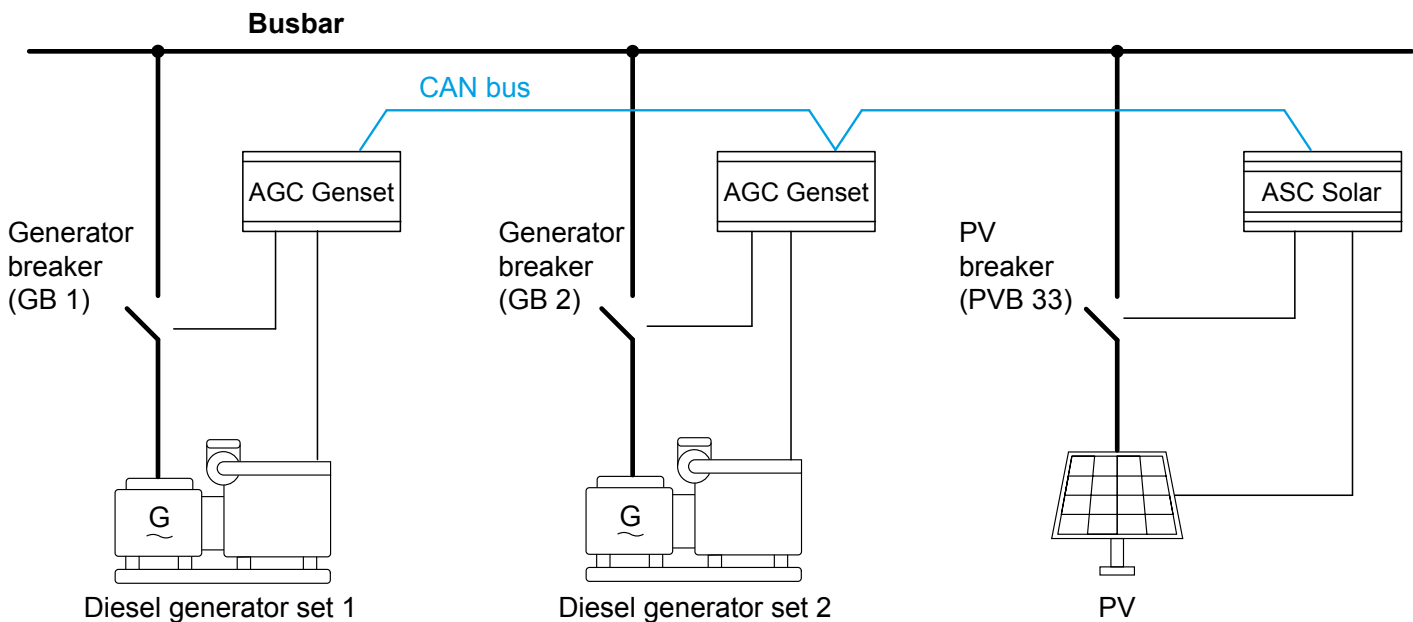


#### More information

See **Option G5 Power management AGC-4 Mk II** for more information.

### 4.2.4 Off-grid applications, power management

This application uses a CAN bus power management communication between the DEIF controllers. It is therefore not necessary to install additional hard wiring between the ASC and the gensets.



### ASC configuration

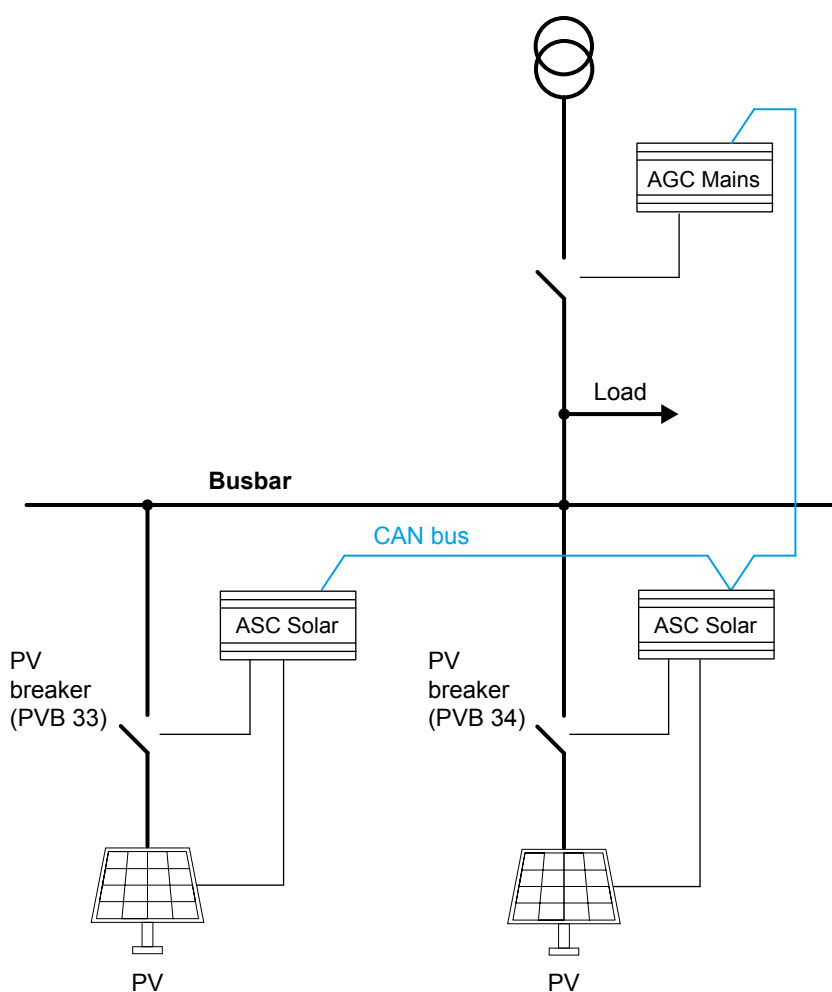
Parameter	Name	Setting
6071	Operating mode	Power management

### AGC genset configuration

Parameter	Name	Setting
6071	Operating mode	Power management

## 4.2.5 Grid-tied applications, power management

This application uses CAN bus power management communication between the DEIF controllers. It is therefore not necessary to install additional hard wiring between the ASCs and the AGC.



### ASC configuration

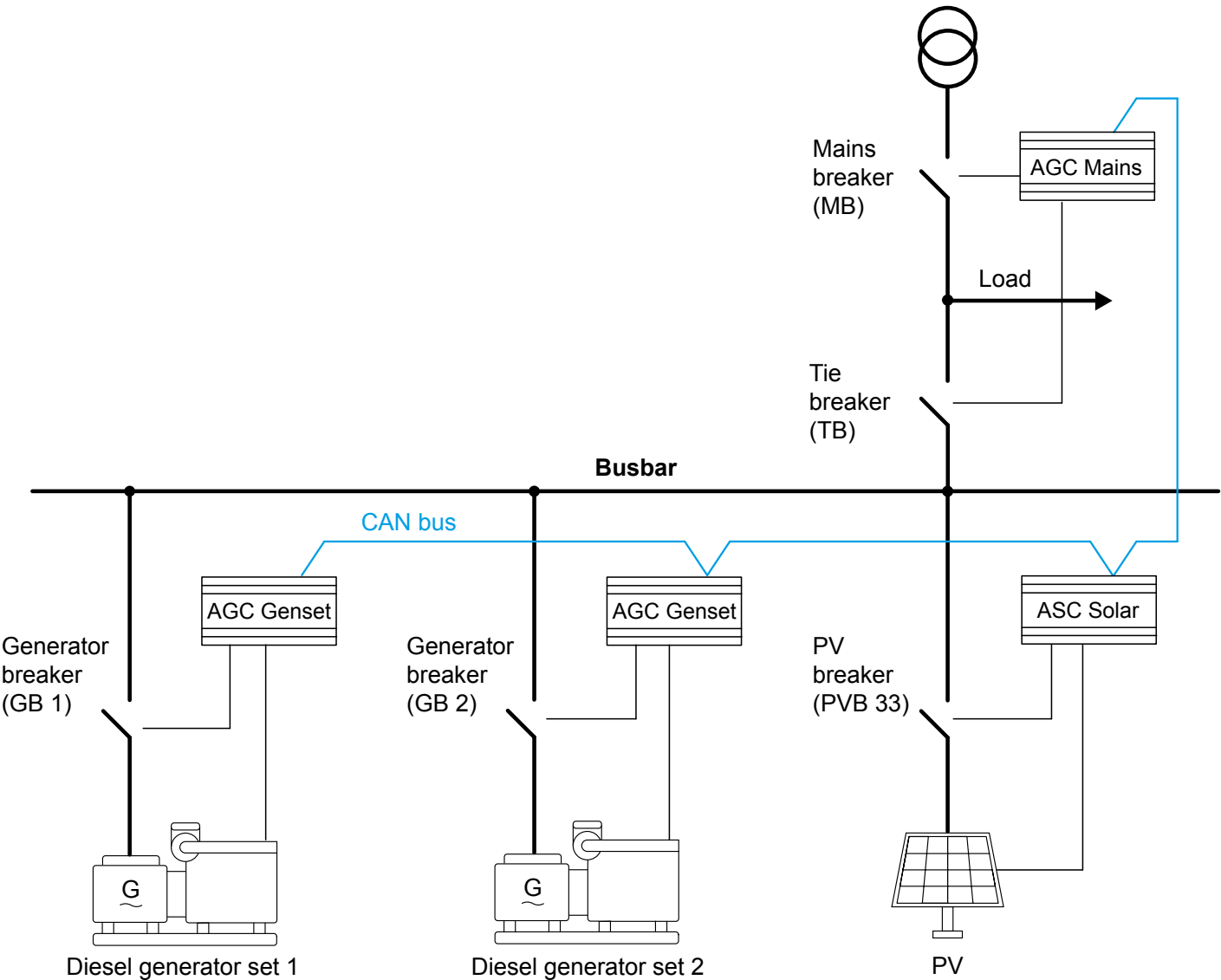
Parameter	Name	Setting
6071	Operation mode	Power management

### AGC mains configuration

Parameter	Name	Setting
6070	Plant mode	Select a plant mode (in the AGC mains controller). For example, Mains Power Export.

4.2.6 Combination (off-grid + grid-tied) power management

This application is used for grid-tied and off-grid (islanded) modes. There is CAN bus communication between the AGC mains, AGC gensets and the ASC. All necessary power management data is available over CAN bus. Additional measurements and hard wiring are not required.



ASC configuration

Parameter	Name	Setting
6071	Operating mode	Power management

AGC genset configuration

Parameter	Name	Setting
6071	Plant mode	Power management

AGC mains configuration

Parameter	Name	Setting
6071	Plant mode	Select a plant mode (in the AGC mains controller). For example, Mains Power Export.

## 5. Display unit and menu structure

## 5.1 Display unit (DU-2)

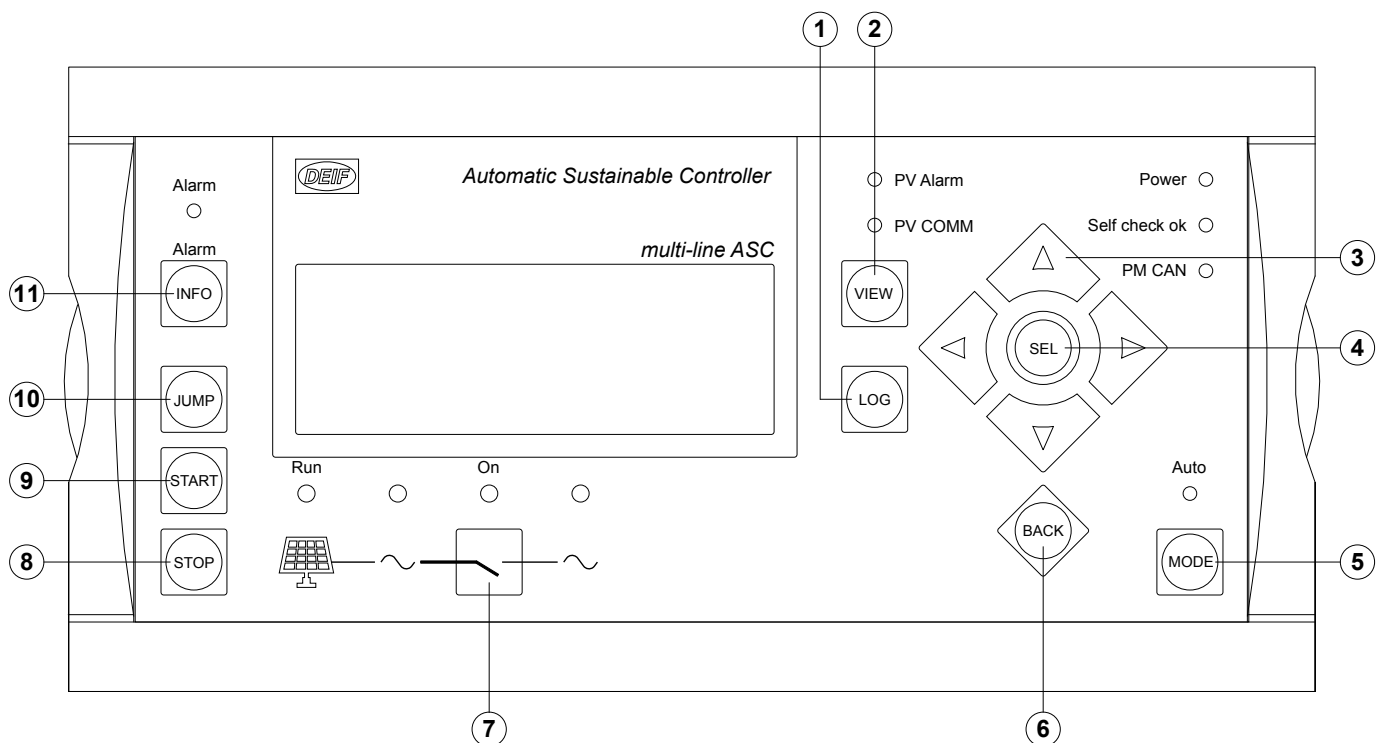
The display has a screen with four lines. Each line has 20 characters. It includes a number of push-button and LED functions.

The display dimensions are H x W = 115 x 220 mm (4.528" x 9.055").

### 5.1.1 Push-button functions

The description uses the locations of the ASC-4 Solar display push-buttons as an example. The push-buttons for the ASC-4 Battery are located in the same positions on the display as the ASC-4 Solar.

## ASC Solar display unit push-button locations



Button	Name	Notes
1	LOG	Displays the LOG SETUP window where you can choose between the Event and Alarm logs. The logs are not deleted when the auxiliary supply is switched off.
2	VIEW	Shifts the first display line in the setup menus. No function in the View screen (V1-V2-V3). Push 2 sec. to change the display to the master display when more than one display is connected.
3	UP/DOWN/ LEFT/RIGHT	Up, down, left and right are used for navigating in the display unit.
4	SEL	Selects the underscored entry in the fourth line of the display.
5	MODE	Opens the mode selection menu to choose between AUTO and SEMI mode.
6	BACK	Jumps one step backwards in the menu (to previous display or to the entry window).
7	PVB/ESB (On/ Off)	Breaker is open: Press to start the close breaker sequence if SEMI mode is selected. Breaker is closed: Press to start the open breaker sequence if SEMI mode is selected
8	STOP	Stops the PV plant if SEMI mode is selected.

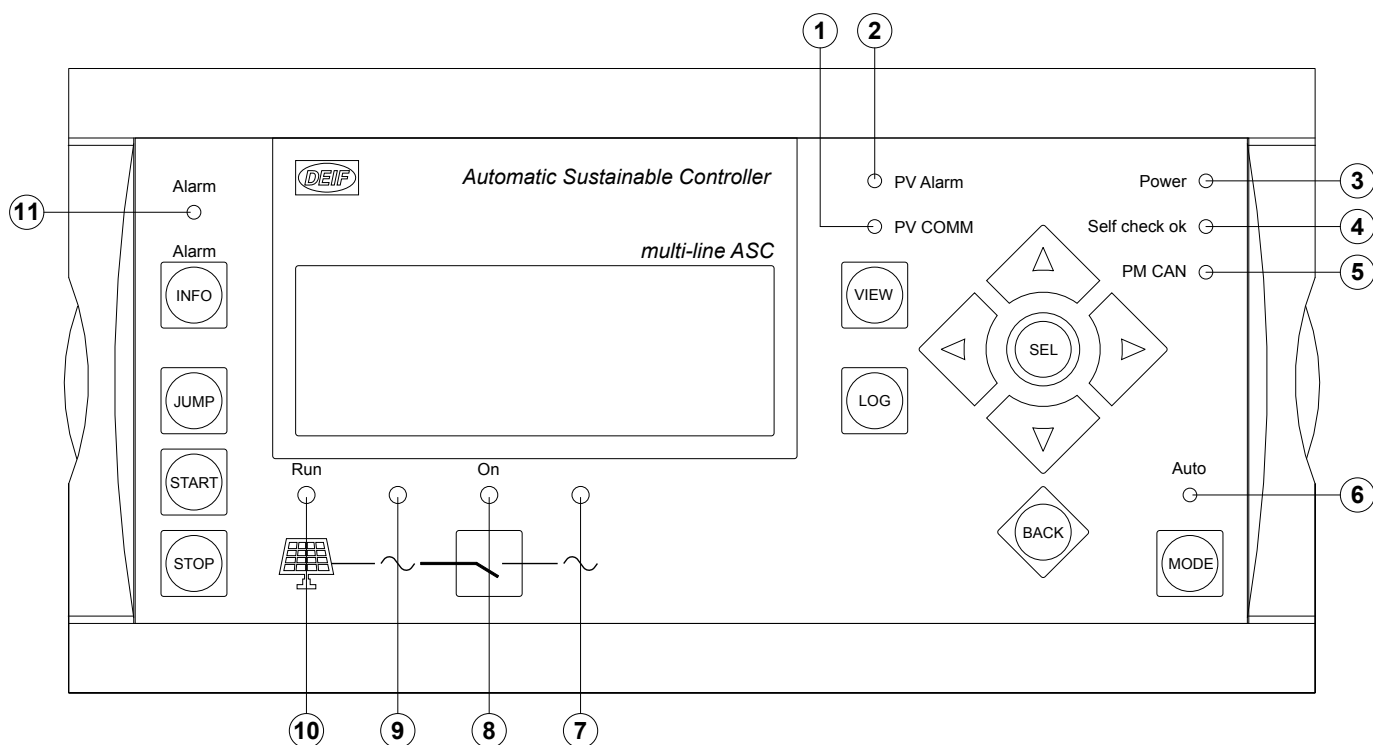
Button	Name	Notes
9	START	Starts the PV plant if SEMI mode is selected.
10	JUMP	Enters a specific menu number selection. All settings have a specific number attached to them. The JUMP button enables the user to select and display any setting without having to navigate through the menus. See <b>Display unit and menu structure &gt; Menu structure</b> for more information.
11	INFO	Changes the lower three display lines to show the alarm list. Press the button for 2 seconds to acknowledge all alarms.

## 5.1.2 LED functions

The ASC-4 Solar and Battery display units have 11 LEDs. Depending on the situation, the LED colour is green, red or yellow.

The description uses the locations of the ASC-4 Solar display LEDs as an example. The LEDs for the ASC-4 Battery are located in the same positions on the display as the ASC-4 Solar.

### ASC-4 Solar display unit LED locations



LED	Name	Notes
1	PV/Battery COMM	Red (flashing): Commucniation with the PCS/BMS is faulty. Off: There is no communication with the PCS/BMS.
2	PV/Battery Alarm	Red (flashing): Alarms are present on the PCS/BMS. Go to the PCS/BMS to see which alarms are present. Off: There are no PCS/BMS alarms.
3	Power	Green: The power supply is on.
4	Self check OK	Green: The ASC is OK ( $\mu$ P supervision).
5	PM CAN	Green: The power management CAN bus is working without faults. Yellow: Power management is not selected as the operation mode. Red: There is a fault on the power management CAN bus.
6	Controller mode	Green: AUTO mode is selected.

LED	Name	Notes
		Off: SEMI mode is selected.
7	Busbar status	Green: Busbar voltage and frequency is OK. Off: There is no busbar voltage.
8	Breaker status	Green: PV/ES breaker is closed. Yellow (flashing): PV/ES breaker load time has not expired. Off: PV/ES breaker is open.
9	Source busbar status	Green: PV/ES voltage and frequency is OK. Off: There is no PV/ES voltage.
10	Source status	Green: PV inverter/ESS converter is running. Off: PV inverter/ESS converter is not running.
11	Alarm status	Red (flashing): Unacknowledged alarms are present on the controller. Red: All alarms acknowledged, but alarms are present on the controller. Off: No alarms are present on the controller.

## 5.2 Menu structure

The display includes two menu systems which can be used without password entry:

### View menu system

This is the commonly used menu system. 15 windows are configurable and can be entered by using the arrow push-buttons.

### Setup menu system

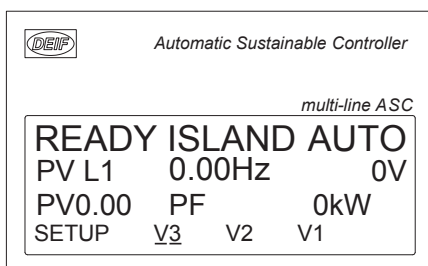
This menu system is used for setting up the unit, and if the user needs detailed information that is not available in the view menu system. Changing of parameter settings is password-protected.

### 5.2.1 Entry window

When the unit is powered up, an entry window appears. The entry window is the starting point for menu navigation. It can always be reached by pressing the BACK push-button a maximum of three times.

**NOTE** The alarm information page appears at power up if an alarm is present.

### ASC-4 Solar entry window

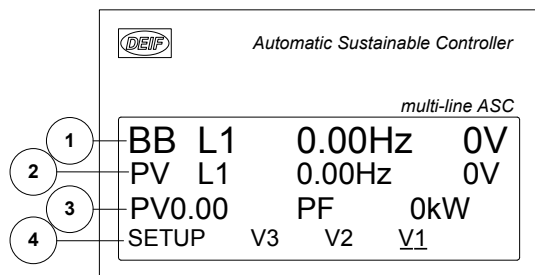


### 5.2.2 View menu

The view menus (V1, V2 and V3) are the most commonly used menus of the unit.



## View 1 (V1) of the entry window



1. First display line: Operational status or measurements
2. Second display line: Measurements relating to operational status
3. Third display line: Measurements relating to operational status
4. Fourth display line: Selection of setup and view menus

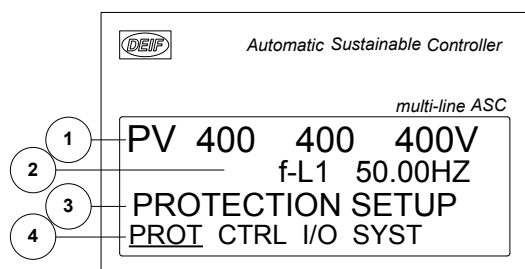
In the view menus, various measured values are on display.

- Setup menu – access to the following sub-menus:
  - Protection setup
  - Control setup
  - I/O setup
  - System setup
- View 3 – window displays operational status and selected measurements
- View 2 – access to up to 20 selectable windows displaying selected measurements
- View 1 – access to up to 20 selectable windows displaying selected measurements

**NOTE** The factory settings for view 1 and view 2 are identical.

### 5.2.3 Setup menu

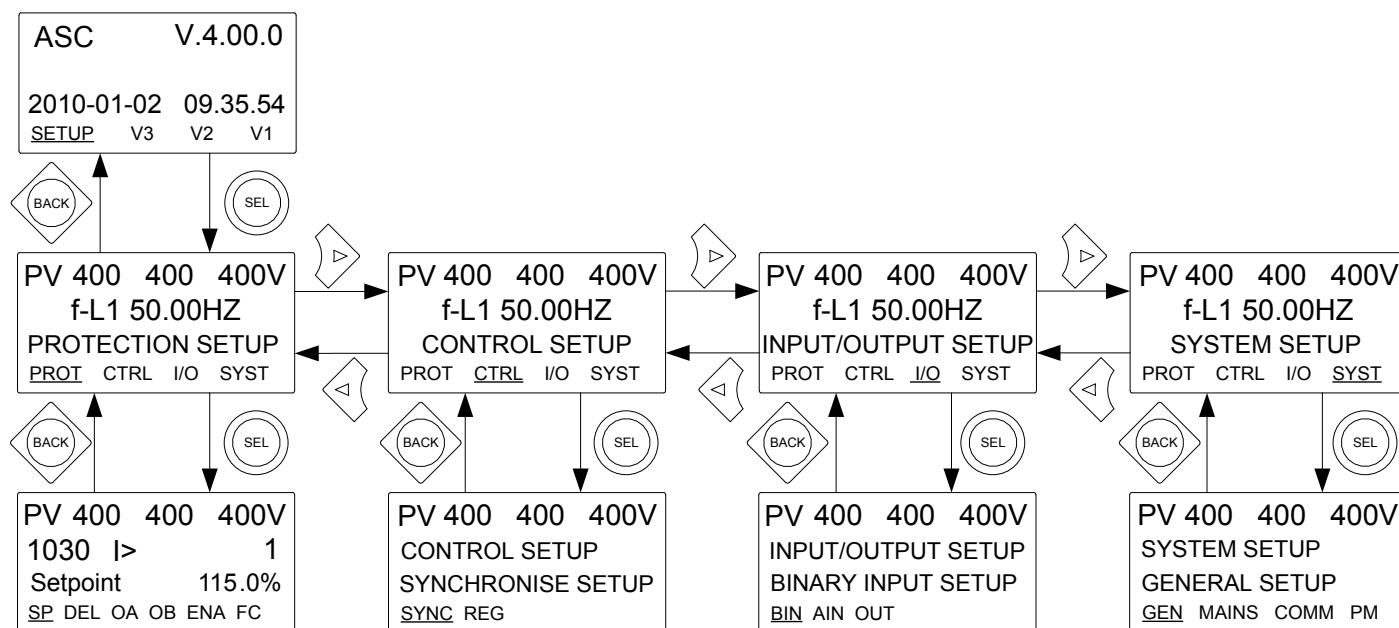
The setup menu system is used for parameter setup of the unit. It is also helpful if the user needs detailed information that is not available in the view menu system. Enter the Setup menu from the entry window, by selecting the entry SETUP in the fourth display line.



**Table 5.1** Display screen lines

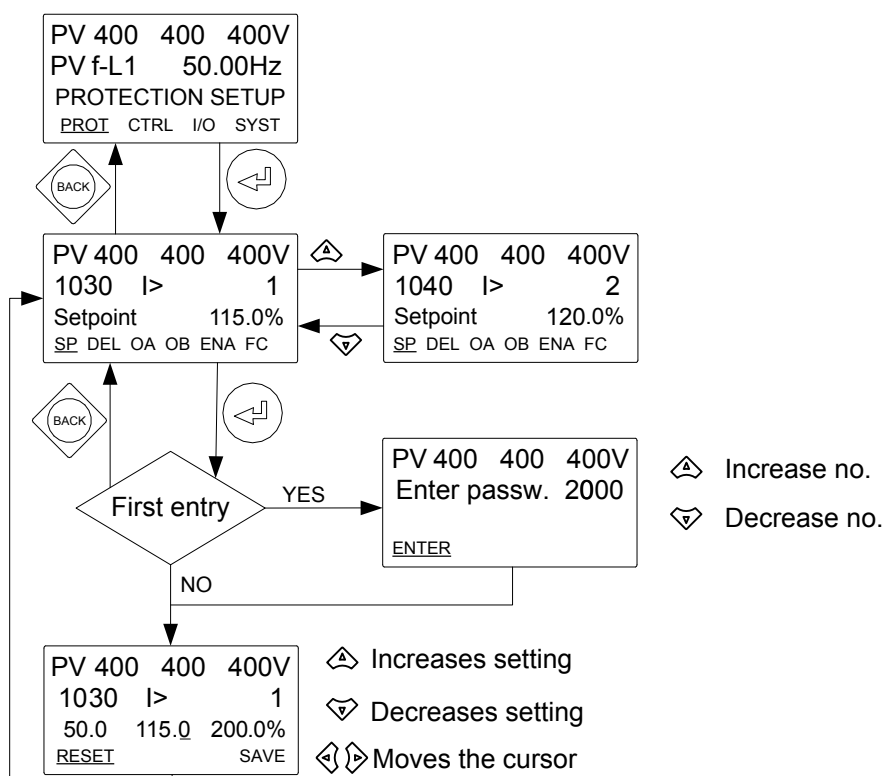
Line	Daily use	Setup menu	Alarm/event list
1	Source and busbar values.		
2	Display various values.	Info on the selected parameter number.	The latest alarm/event.
3	Info on the line 4 cursor selection.	The current setting for the selected function. If changes are made, the max. and min. values for the setting.	
4	Selection for the setup menu.	Sub-functions for the individual parameters, for example limit.	

**Figure 5.1** Setup structure



The following example illustrates how a specific setting is changed in the setup menu.

**Figure 5.2** Changing the over-current set point example



## 5.3 Mode overview

ASC can run in **Auto** or **Semi-auto** mode. The mode is selected by pressing the mode button on the display unit. Alternatively, the mode can be changed using the utility SW, digital inputs, or Modbus.

### Auto

In auto mode, the controller operates automatically. The operator cannot initiate any sequences manually.

**Semi-auto**

In semi-auto mode, the operator has to initiate all sequences. This can be done using the push-button functions, Modbus commands, digital inputs, or M-Logic.

**5.4 Password**

**5.4.1 Password management**

The controller includes three password levels. All levels can be adjusted in the PC software.

Password level	Factory setting	Access		
		Customer	Service	Master
Customer	2000	X		
Service	2001	X	X	
Master	2002	X	X	X

A parameter cannot be entered with a password that is ranking too low. But the settings can be displayed without password entry.

Each parameter can be protected by a specific password level. To do so, the PC utility software must be used. Enter the parameter to be configured and select the correct password level.

Parameter "-P> 1" (Channel 1000)

Set point :

-200

-5 %

0

Timer :

0.1

10 sec

100

Fail class :

Trip GB

Output A

Not used

Output B

Not used

Password level :

customer

customer

service

master

☒ Enable

☐ High Alarm

☐ Inverse proportional

☐ Auto acknowledge

Inhibits...

Actual timer value

0 sec

10 sec

Write

OK

Cancel

The password level can also be changed from the parameter view in the column "Level". Right-click the field, select "Change access level" and then select the required password level.

alarm	Level	Inhibits	FailClass
	customer	<input type="checkbox"/>	Tri
			Tri
			Wa
			Tri
	customer	<input type="checkbox"/>	Tri
	service	<input type="checkbox"/>	Tri
	master	<input type="checkbox"/>	Tri
	customer	<input type="checkbox"/>	
	customer	<input type="checkbox"/>	

### 5.4.2 Parameter access

To change parameters, the user must be logged on with the required access level (master, service or customer). If the user is not logged on at the correct access level, it is not possible to change the parameters.

The customer password can be changed in jump menu 9116, the service password in 9117, and the master password in 9118. The factory passwords must be changed if the operator is not allowed to change the parameters. It is not possible to change the password for a higher level than the password entered.

## 6. Solar functions

### 6.1 Spinning reserve

This parameter is set to adjust the amount of spinning reserve on the busbar and it is set up in the ASC controller. There is a setting for the spinning reserve in off-grid mode (island mode) and in grid-tied mode (parallel to mains mode). Their settings are common set points, so if more than one ASC is configured, the setting is transmitted to the other ASCs.

The value of spinning reserve is calculated depending on the setting 8003: *ASC settings, PV communication* or *Forecast communication*. The setting of *PV communication* can only be used if you have the SMA product FSC ver1 or are using *DEIF open protocol*.

The spinning reserve can be set to *ASC settings*. It means that the spinning reserve is calculated not from the PV production but only from the adjusted percentage. It is calculated based on the PV nominal power.

#### Example

	Full load capacity [kW]	Present dispatch [kW]	Spinning reserve [pct-kW]
Gensets of	400	100	
PVs total	500	500	50 % = 250 kW
	[~]	[kW]	
Present load	-	600	
Penetration ratio (PV:Diesel)	500:400 ~ 55:45 %		
Present spinning reserve	-	300	

With a spinning reserve setting of 50 % (of actual PV dispatch), the genset cannot be loaded more than  $P_{\text{NOMINAL}} - P_{\text{SPINNING RESERVE}}$ :  $400 - 250 = 150 \text{ kW}$ .

At 150 kW loading, it will request another genset to start (observing automatic start set points).

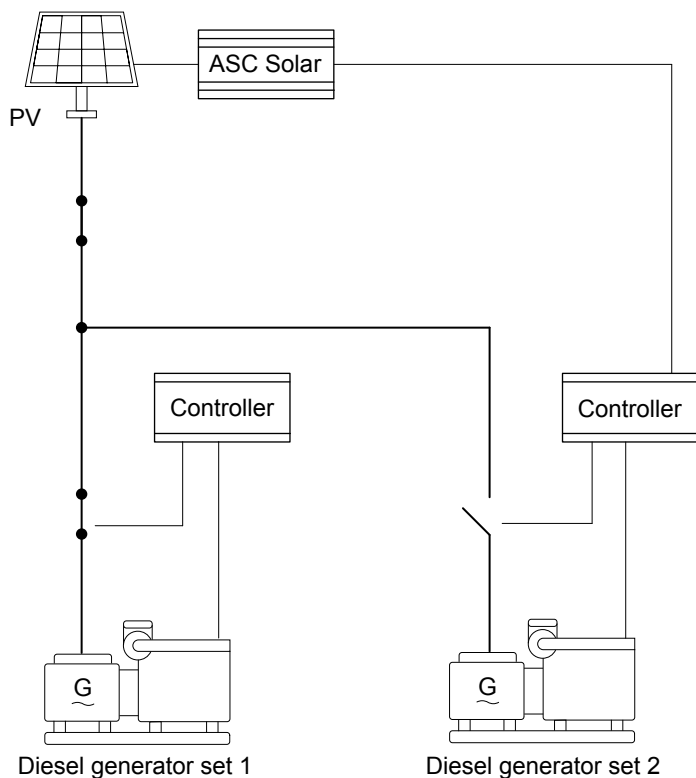
#### 6.1.1 Alarms for spinning reserve

Two alarms are available for the spinning reserve function (menus 7090 and 7100). These alarms can be used in power management applications or in “stand-alone” applications (that is, fuel save but no genset power management).

The alarms can be configured to activate above or below the set point, along with a set point, timer, and fail class.

##### Using the spinning reserve alarm to start the next genset

If there is no power management system, you can configure one of the spinning reserve alarm's outputs to send a start command to the next genset. This is shown in the diagram and screenshot below. The digital output on terminal 5 of the ASC is configured to activate if the spinning reserve is too low. ASC terminal 5 is wired as a start input to the genset controller.



**Parameter "Spinning res. 1" (Channel 7090)**

**Set point :** 0 30 % 100

**Timer :** 0,1 10 sec 3200

**Fail class :** Warning

**Output A :** Terminal 5

**Output B :** Not used

**Password level :** customer

☒ Enable  
☐ High Alarm  
☐ Inverse proportional

☒ Auto acknowledge  
 Inhibits... "MB on"

**Commissioning**  
**Actual value : 0 %**  
**Actual timer value**  
 0 sec 10 sec

★ Write OK Cancel

## Using the spinning reserve alarm for load management

You can configure the spinning reserve alarm to send a signal to disconnect load groups.

### 6.1.2 Genset reverse power

The ASC monitors the genset production using the measurements from the power meter (over Modbus) (or, alternatively, input from transducers). The ASC can activate an alarm if the genset has reverse power. The alarm is typically used in ASC stand-alone mode (fuel saving, without power management). In the full power management solution, the power management system is automatically given the state via the PMS data from the gensets.

The alarm action can be selected in the fail class menu. For example, a shutdown stops the PV and thereby pushes load onto the diesel engine.

Parameter "DG P< 1" (Channel 7070)

**Set point :**

-200 -5 % 100

**Timer :**

0,1 10 sec 3200

**Fail class :** Warning

**Output A** Not used

**Output B** Not used

**Password level :** customer

☒ Enable  
☐ High Alarm  
☐ Inverse proportional

☐ Auto acknowledge  
Inhibits... "MB on"

**Commissioning**

Actual value : 0 %

Actual timer value

0 sec 10 sec

Write OK Cancel

The alarm has a wide range. You can combine this with the high alarm selection for *DG reverse power* or *DG positive power*.

## 6.2 Penetration ratio

### 6.2.1 Optimal stability

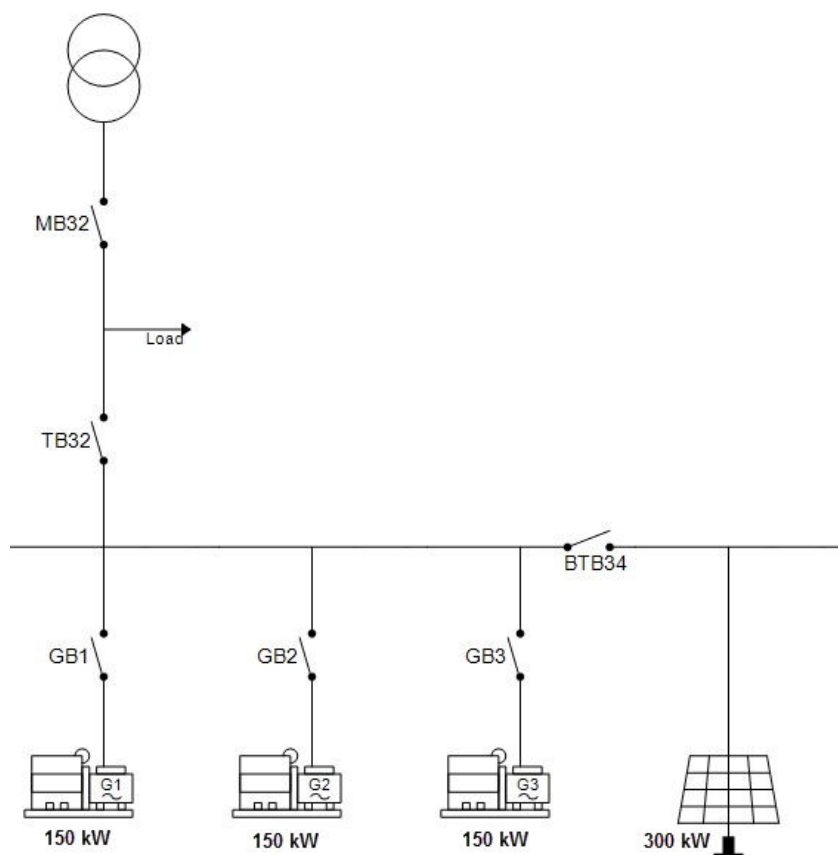
The inverter manufacturers describe a certain penetration rate. Different manufacturers could have different ratios. This could be (example in percent) 25:75, 40:60, 50:50 or 60:40 (PV:Diesel).

It relates to the gensets and inverters connected to the busbar in order to get optimal stability. So for a 400 kW PV plant connected to the busbar, you need to design the system with at least 600 kW diesel machinery for a 40:60 ratio.

There is no setting for this since it is part of the design phase. However, with the DEIF Power management system, a minimum number of gensets connected to the busbar can be adjusted.

If one genset is too small compared to the PV facility and more than one genset is needed to achieve the correct penetration ratio then a BTB can be used.

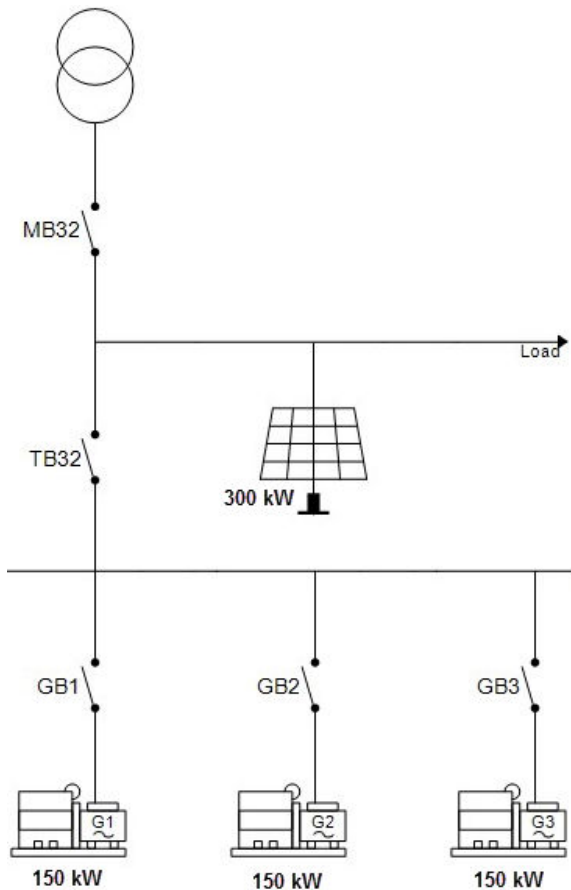
## Application example with PV plant and a bus tie breaker



Keep BTB34 open unless grid-tied or if MB32 is open, then close BTB34 only if more than one (two or three) gensets are connected.



## Application example with PV plant in the load point



Alternatively, use the mains controller tie breaker to separate the gensets from the PV plant.

## 6.3 Production curtailment

The ASC has a counter that measures the curtailment of the PV penetration.

### 6.3.1 Curtailment definition

Curtailment is defined by assuming that there is overhead of PV availability if the penetration is less than the capacity of the PV capacity caused by the required set point being decreased.

### 6.3.2 PV capacity

The PV capacity is calculated based on the installed number of panels and their back of module temperatures. The irradiation is also affecting the total PV capacity.

### 6.3.3 Curtailment example

If the PV capacity is 100 kW and the set point requires 100 kW, the PV inverters are not curtailed. If the set point requires 80 kW and the ASC regulates the inverters to run at 80 kW and measures 80 kW, the curtailment is recorded in the curtailment counters. In this example, the curtailment is 20 kW (the difference between 80 and 100 kW).

You can see in the display unit whether the curtailment counter is operating. When there is curtailment, the value after “act” switches from 0 to 1. The value shown on the display (80 %) is the PV penetration.

Curt.	80.0%	act:1
PV P	80kW	
PV Q	36kVAr	
SETUP	V3	V2 V1

### 6.3.4 Irradiation

If there is a change in the irradiation, the penetration changes. For example, during dusk hours, the capacity decreases. If the ASC measures less power than required from the PV side, the curtailment counter is switched off because it is no longer possible for the PV plant to dispatch the requested power.

Curt.	80.0%	act:0
PV P	50kW	
PV Q	22kVAr	
SETUP	V3	V2 V1

### 6.3.5 Curtailment threshold

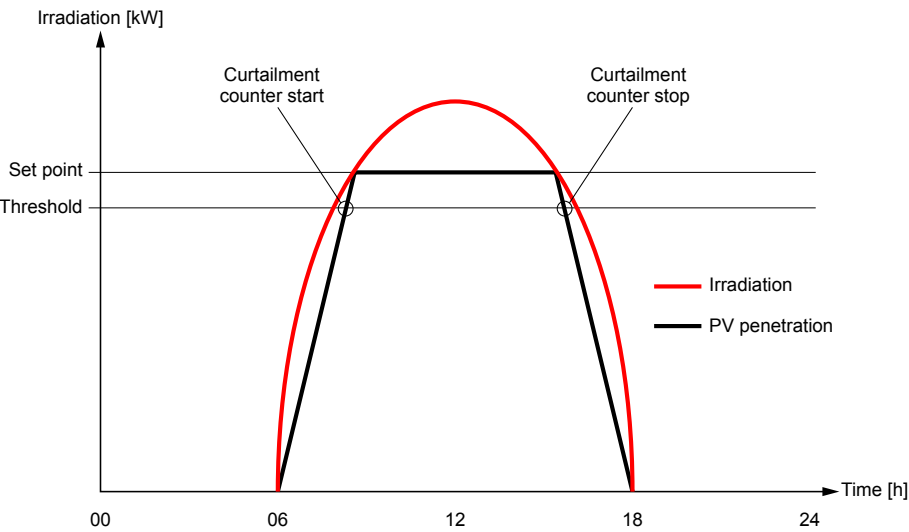
The PV penetration is measured by the ASC. If there are variations from the output of the PV panels compared to the power measured by the ASC, there can be false or missing increments of the curtailment counter.

As an example, the ASC transmits a request to the inverters to deliver 80 kW using the SunSpec Modbus communication. When the ASC measures less than 80 kW, the curtailment counters are off. When the power reaches 80 kW, the curtailment counters are turned on, since it is assumed that more than 80 kW could be available.

The inverters produce the power requested by the ASC. Note that a set point is transmitted, not a regulation signal. Therefore the ASC measurement can differ from the PV measurement, for example, 79.8 instead of 80 kW (depending on CT classes and so on). This can still be considered within the expected range.

The threshold can be adjusted to match the expected deviation between the two systems, so that the curtailment counter starts at the correct level. The curtailment threshold can be up to 100 % (parameter 7052).

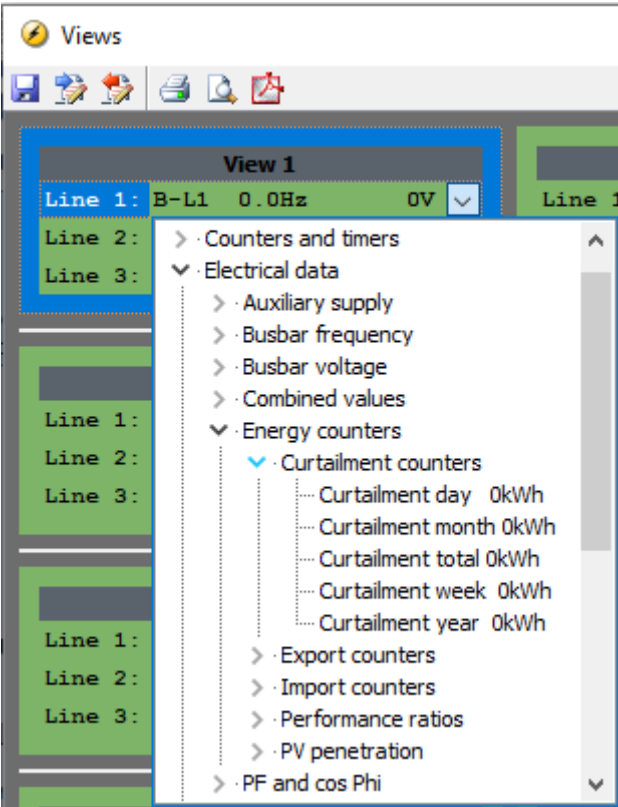
#### Simplified curtailment threshold diagram



### 6.3.6 Curtailment counters in the display unit

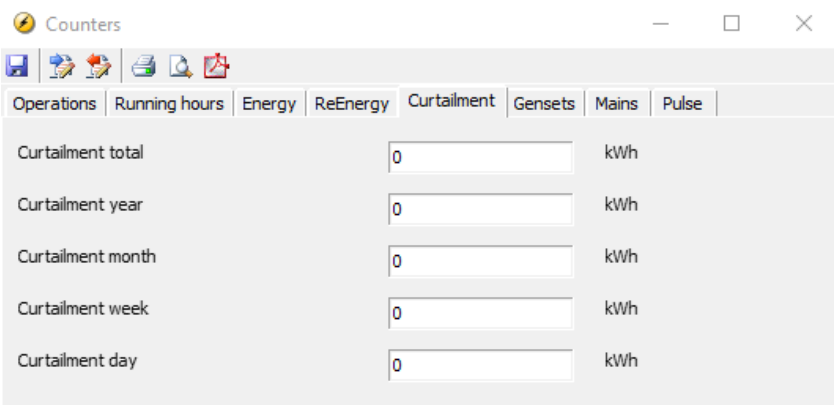
Use the USW to set up the display unit views to show the required curtailment counters.

#### Curtailment counter options for the display unit views



You can also see the curtailment counters in the USW.

#### Curtailment counters in the USW



## 6.4 Weather data

### 6.4.1 Connection to weather data

The ASC has various inputs available. Each input can be used for connection to weather data using an analogue input, PV communication, DEIF open communication, or weather station communication.

Sensor	Abbreviation	Function
Plane of array	POA	POA is used for determining the maximum active P that the PV plant can produce. There are three POA sensors (parameters 6271, 6273 and 6275) and they can be weighted against each other. This could depend on the physical position of the PV modules.
Back of module temperature	BOM	BOM measurements are used for determining the maximum active P that the PV plant can produce. There are three BOM sensors (parameters 6281, 6283 and 6285) and they can be weighted against each other. This could for instance depend on the physical position of the PV modules or the number of modules installed on each roof top.
Global horizontal irradiation	GHI irr.	Readings only (parameter 6311)
Ambient temperature	Ambient temp.	Readings only (parameter 6313)
Relative humidity	Rel. humidity	Readings only (parameter 6315)
Barometric pressure	Barometric pres	Readings only (parameter 6321)
Wind speed		Readings only (parameter 6323)
Wind direction		Readings only (parameter 6325)
Rain fall		Readings only (parameter 6331)
Snow depth		Readings only (parameter 6333)

Three numbers of BOM and three of the POA sensor inputs can be configured, but only 1, 2 or 3 of each kind can be used. For calculating the possible P<sub>max</sub> with either the BOM or the POA sensors, a standard value will be used for the missing sensor (1000 W/m<sup>2</sup>) and (25 °C).

The POA and BOM sensor can be weighted from 0 to 100 %. This is useful if the installation has two or three physical locations.

Location	Number of panels	Panel rating Wp	POA weight	BOM weight
South East	500	250	32 %	32 %
South West	450	250	28 %	28 %
South	600	265	40 %	40 %
<b>Total</b>		<b>396.5 kWp</b>		

## 6.4.2 Forecast

Use the following parameters to configure the weather forecast. The ASC uses the forecast to adjust the power management to anticipate any photovoltaic power reduction due to weather.

Parameter	Name	Range	Default	Details
7514	Forec. comm. ID	1 to 247	3	Modbus ID of the forecasting device.
7570	Weat. comm err	-	-	If this parameter is active then the communication between the controller and weather station is interrupted.  Check the communication cable for faults, and if the communication ID in the controller parameters is the same as the weather station ID.
7631	Forecast prot.	OFF SteadySun SteadyEye	OFF	See <a href="#">Compatible weather stations</a> .

Parameter	Name	Range	Default	Details
		Reuniwatt SkyInSight		
7632	Forecast start	1 to 60	1	For starting genset(s): The time horizon in minutes that the ASC should look ahead. The lowest forecast within the time is used. Any forecast reduction in PV affects the available power, which in turn may activate a load-dependent genset start.
7633	Forecast stop	1 to 60	1	For stopping genset(s): The time horizon in minutes that the ASC should look ahead. The lowest forecast within the time is used. Any forecast reduction in PV affects the available power, which in turn may delay a load-dependent genset stop.
7634	Forecast method	GHI POA Power	GHI	See below.
7635	Forec statistic	Mean Max Min P[10 to 90]	Mean	The statistical method for selecting the forecast.  P10 is a 90 % probability that actual value is greater than or equal to the forecast.
7640	Forecast err.	-	-	Forecast error alarm.

### Forecast method

**GHI:** This requires both GHI and POA sensors. The ASC uses a simple conversion to convert the GHI forecast to POA. The forecast POA is then calculated using this formula:  $POA\_forecast = GHI\_forecast / GHI\_measured * POA\_measured$

**POA:** This requires a POA sensor. The ASC can use a power temperature coefficient model to correct for the panel temperature.

**Power:** No reference sensor is required. The forecast is used directly.

## 6.4.3 Compatible weather stations and forecast systems



### More information

See **DEIF Hybrid controller compatibility** for the list of weather stations and forecast systems that the ASC supports.

## 6.5 Derate inverter

The inverters are rated with an apparent power so the derate is based on S [kvar]. The inverters can be derated for example based on the ambient temperature.

Note also the chapter about the weather data concerning Instant P max derating based on BOM and POA readings (P max relates to the Wp of the installed panels).

Note also the chapter about the derating of the Q [kvar] production.

Derate function		Term used
S	kVA	Instant S-max
P	kW	Instant P-max
Q	kvar	Instant Q-max

The purpose of the derate function is to be able to reduce the maximum output power of the inverter if specific conditions require this. Up to three derate curves can be made to derate the inverter genset independently of each other. The first curve active will derate the inverter to the adjusted set point.

6.5.1 Input selection

The derate function can be configured to one of the following inputs:

Input	Comment
Multi-input 102 (slot #7)	0 to 40 V DC 4 to 20 mA Pt100/Pt1000 RMI Digital
Multi-input 105 (slot #7)	
Multi-input 108 (slot #7)	
Analogue input (M15.X)	4 to 20 mA
M-Logic	

Select the needed inputs in **6240-6250-6260 Instant S-max derate**.

6.5.2 Derate parameters

The parameters that define the derate characteristics are the following:

Start derate point (6240/6250/6260 Instant S max derate)

This is the setting where the derating must start. The setting can be in mA (max. 20 mA) or in Celcius °C (max. 200°C).

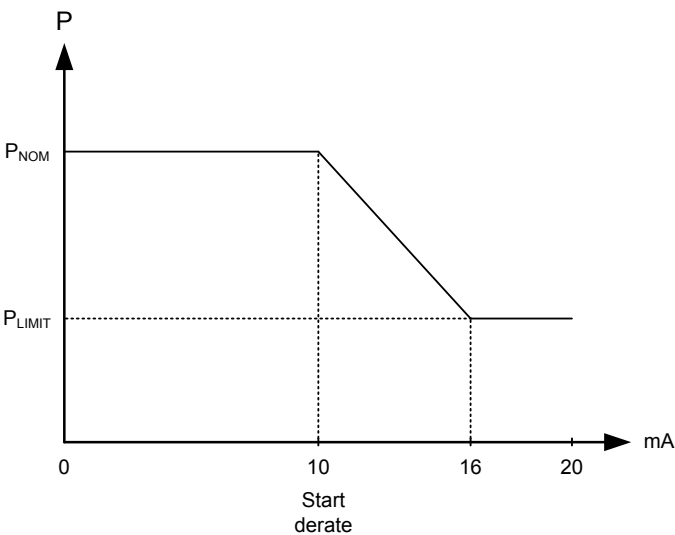
Slope (6243/6253/6263 Instant S max derate)

Adjust the derating speed. The adjustment is in percent per unit, which means that if the 4 to 20 mA input is used, the derating will be in %/mA, and if the Pt100/Pt1000/RMI input is used, the derating will be in %/C.

**NOTE** Be aware that the 4 to 20 mA input can be configured with different minimum and maximum settings. In this case, the settings "start derate point" and "slope" use these new settings.

Derate limit (6246/6256/6266 Instant S max derate)

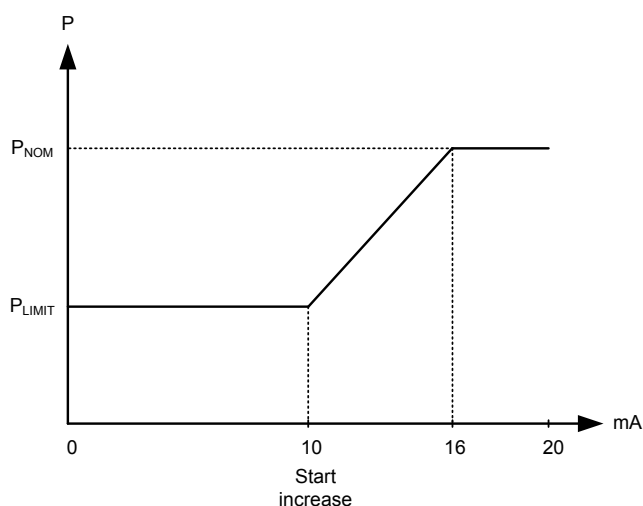
This is the lowest derate level:



6.5.3 Derate characteristic

It can be selected whether the characteristic of the derating should be proportional or inverse proportional. The drawing above shows the inverse characteristic.

The proportional characteristic is illustrated below.



The inverter is derated when the control value is lower than the set point (in the example above, the control value is an mA signal).

The derate characteristic is selected in **6240/6250/6260 Instant S max derate**

Setting OFF: Inverse characteristic

Setting ON: Proportional characteristic

## 6.6 Derate inverter instant P-max

Three POA (Plane Of Array) sensors and three BOM (Back Of Module) sensors can be connected. See [Connection to weather data](#).

The POA/GHI and BOM are weighed together (parameter 6301) to calculate an instant P-Max of the inverters (panels). For example, if the module temperature increases, the capacity of the modules decreases. In general, the instant P-max derate follows a power temperature coefficient model (parameter 6303). The default is -0.38 %/°C.

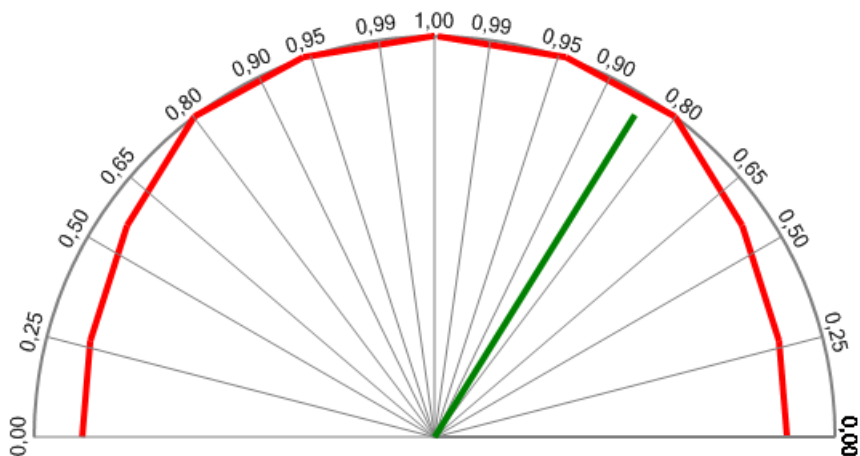
**Table 6.1** Parameters

Parameter	Name	Range	Default	Details
6301	Instant P max.	POA + BOM GHI + BOM	POA + BOM	Select the basis for the instant P max calculation.
6303	P temp. coeff.	-0.99 to 0 %/°C	-0.38 %/°C	Select the power derating coefficient.
6305	Irradia. sensor	50 to 200 %	100 %	Multiplier for the POA/GHI irradiance sensor input.

## 6.7 Derate inverter instant Q-Max (capability curve)

Some brands of inverters have limitations of the reactive power they can produce. It is therefore necessary to derate based on Q rather than S or P. This can be due to the inverter design.

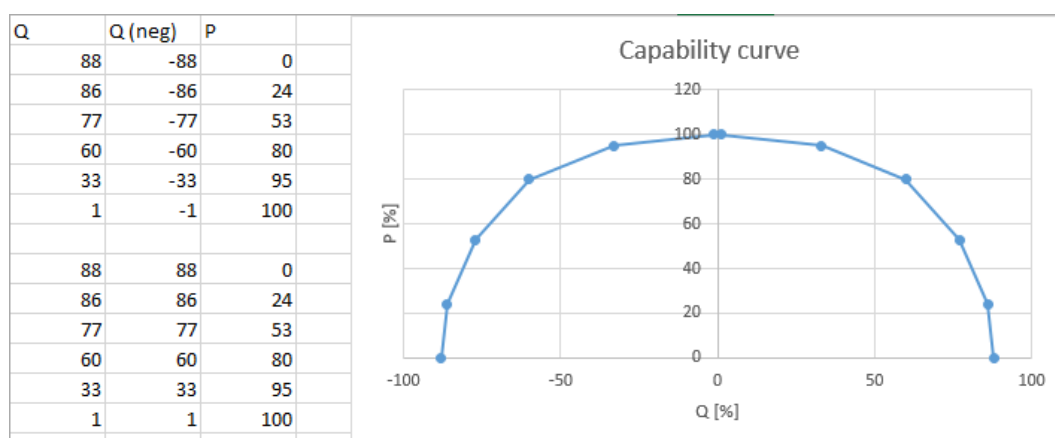
In this case, it is necessary to describe the curve of the inverter.



The curve is described by 6 points on the capacitive side and 6 points on the inductive side using these settings:

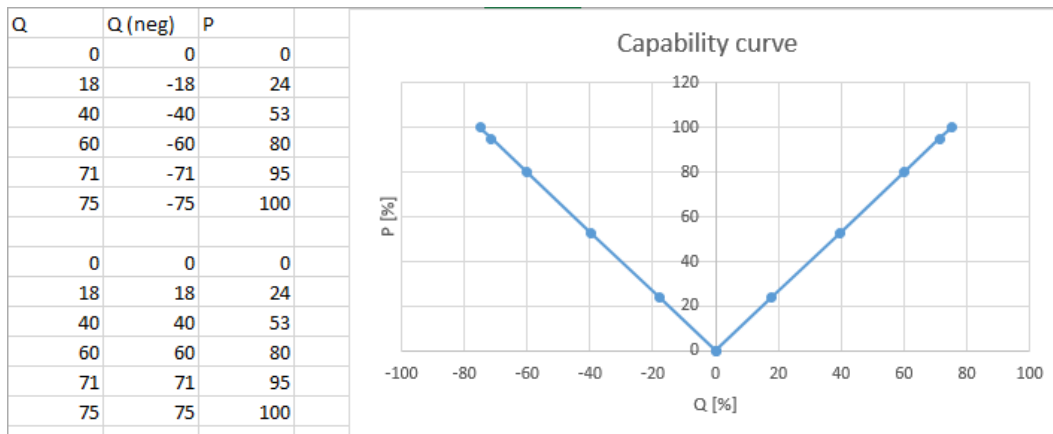
Capacitive side				Inductive side			
1741	P dep Q< Q1	88	%	1771	P dep Q> Q1	88	%
1742	P dep Q< P1	0	%	1772	P dep Q> P1	0	%
1743	P dep Q< Q2	86	%	1773	P dep Q> Q2	86	%
1744	P dep Q< P2	24	%	1774	P dep Q> P2	24	%
1745	P dep Q< Q3	77	%	1775	P dep Q> Q3	77	%
1746	P dep Q< P3	53	%	1779	P dep Q> P3	53	%
1751	P dep Q< Q4	60	%	1781	P dep Q> Q4	60	%
1752	P dep Q< P4	80	%	1782	P dep Q> P4	80	%
1753	P dep Q< Q5	33	%	1783	P dep Q> Q5	33	%
1754	P dep Q< P5	95	%	1784	P dep Q> P5	95	%
1755	P dep Q< Q6	1	%	1785	P dep Q> Q6	1	%
1756	P dep Q< P6	100	%	1786	P dep Q> P6	100	%

Microsoft Excel is a good tool to use for visualising the graph.



If the inverter has a limit of 0.8 Ind/Cap, the graph looks like this:

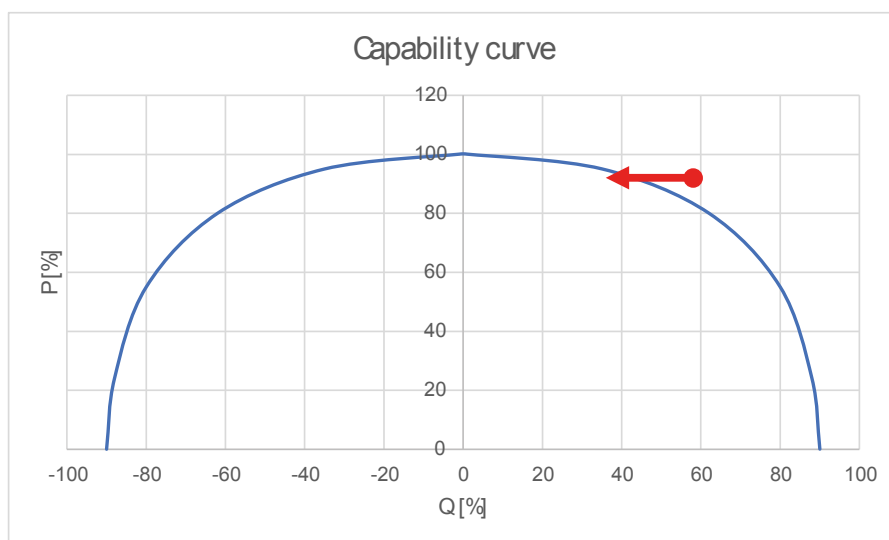




The curve is available in the ASC with six (twelve) points. The information about the actual settings must come from the inverter manufacturer.

### 6.7.1 Derate principle, capability curve

The main principle behind the capability curve derating (Q) is the following: If the set point ends exceeding the capability curve, the Q will be reduced in order to get back inside the capability curve. This is shown in the picture:



If the inverter has some limitations that it can only operate within for example  $\pm 0.8$ PF, it must be adjusted in the curve. In that case, the ASC will behave according to this, and the set points in the ASC system will take the limitations into account.

It means for instance that if the capability curve is adjusted with those limitations (0.8c to 0.8i) then the allowed Q production will be held within the limits. The remaining Q will be supplied from utility or gensets. If the PV is grid parallel and the power factor set point is for example 0.79, the ASC will still maintain inverter set point at 0.8 hence not exceeding the limit.

This is also the case if the genset and the PV is load (var) sharing. This means equal var sharing (in percent) between the PV and the genset but if the required dispatch exceeds the limits of the PV settings, the genset will supply the rest.

If the inverter can supply the complete range of Q without supplying P (for example night mode), please note that the curve should be adjusted without limitations.

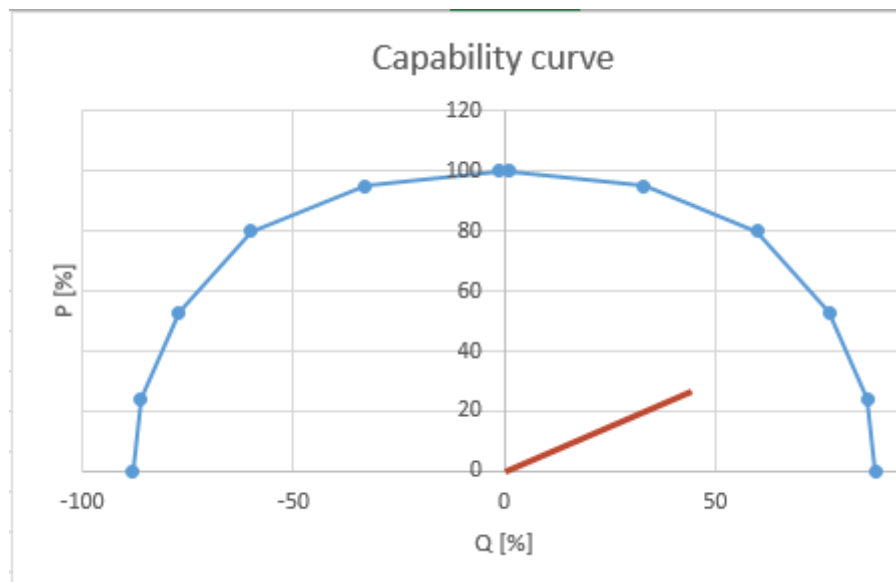
### 6.7.2 Genset-controlled Power Factor (PF)

The capability curve is also used if there are power factor limits on the genset. In some cases, the inverter should carry the reactive load and the genset only the active load.

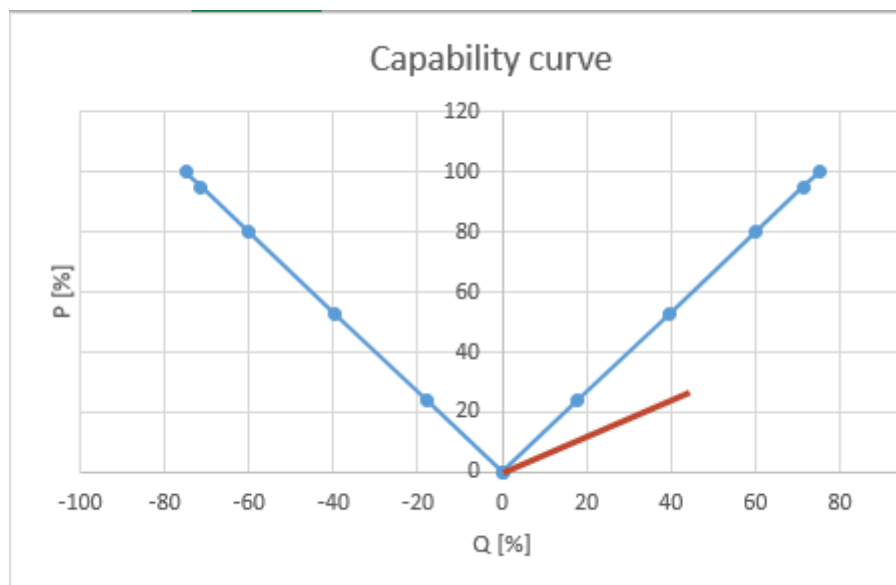
This is done by adjusting the DG limits as requested:

7031 (DG limit inductive)	1.00
7032 (DG limit capacitive side)	1.00
7033 (enable var sharing)	OFF

In this case, the requested setting of the genset power factor is 1.00 at all times, and then let vars be supplied by the inverters. This will happen if the inverters support it and the ASC settings are opened up.



If on the other hand the inverters have limitations, the gensets will not be regulated as adjusted.



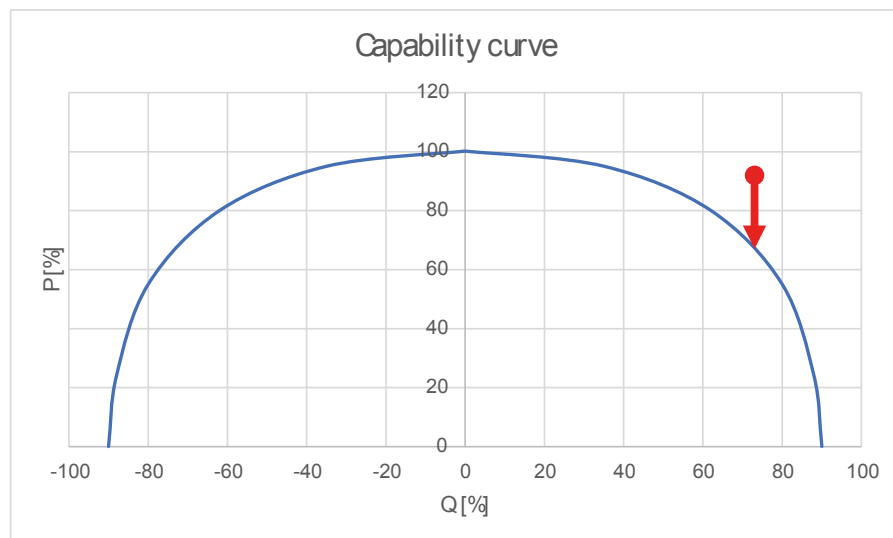
It can be seen that the current running condition is out of the capabilities of the inverters and the set point will (typically) be ignored (depends on inverter design).

In this particular case, the genset will carry the vars instead.

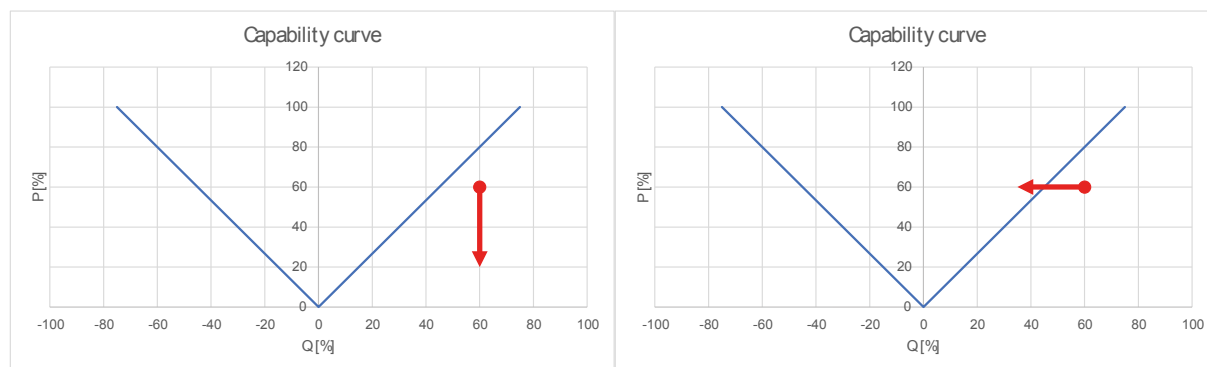
### 6.7.3 P derate based on capability curve

As it is described above, the reactive production can be limited and derated by using the capability curve and not letting the var set point exceed the described limit.

In a similar manner, the power P can be derated based on the curve so it is not exceeded. This means that if the ideal set point calculated by the ASC is above the capability curve, the P is derated to get the set point inside the curve limitations.



**NOTE** If the curve is set up like below, P derate cannot be used since the derate does not improve the situation. Only Q derate can bring the set point inside the limitations.



## 6.8 Flowcharts

### 6.8.1 Functions

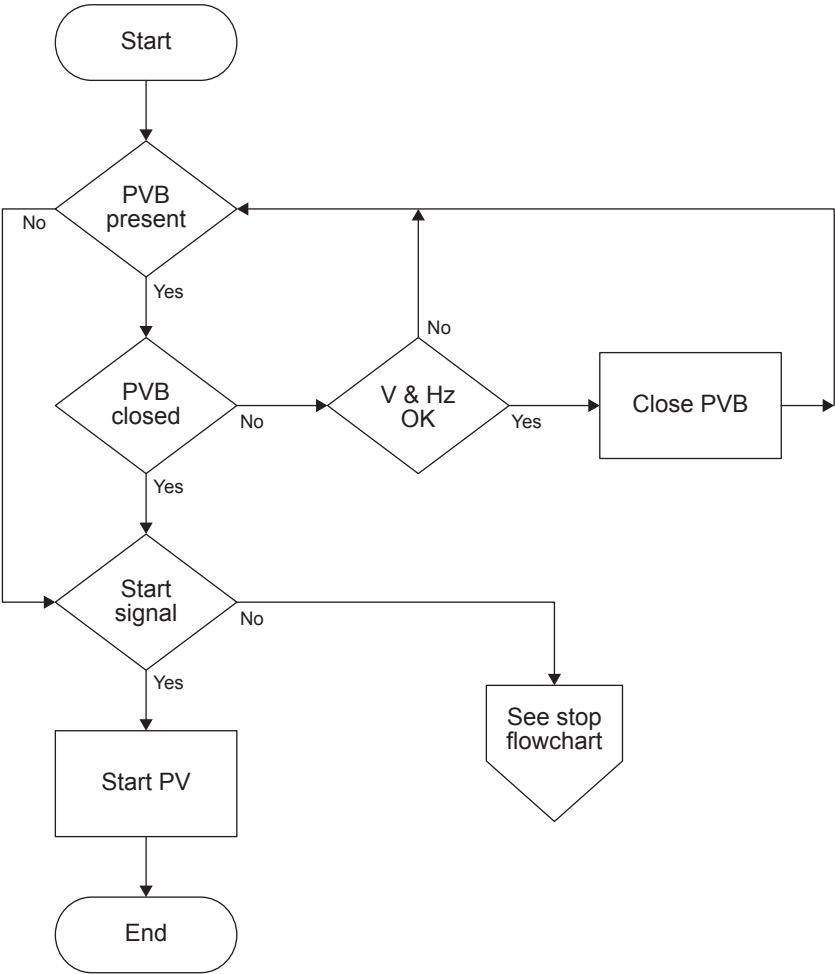
The following flowcharts show the most important function principles. The functions included are:

- Start sequence
- Stop sequence

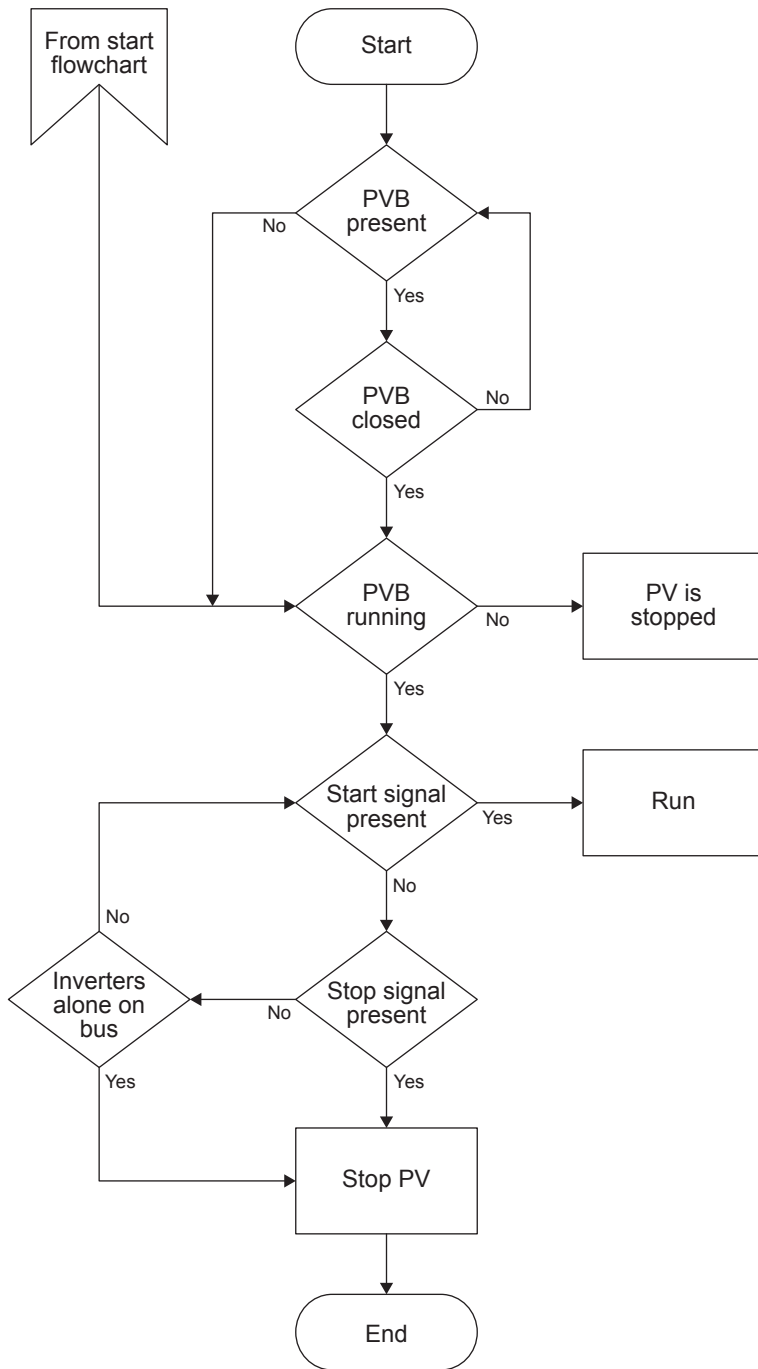
Flowcharts for the mode descriptions are in the **AGC Designer's handbook**.

**NOTE** These simplified flowcharts are only for guidance.

6.8.2 Start sequence



### 6.8.3 Stop sequence



## 6.9 Modes of operation

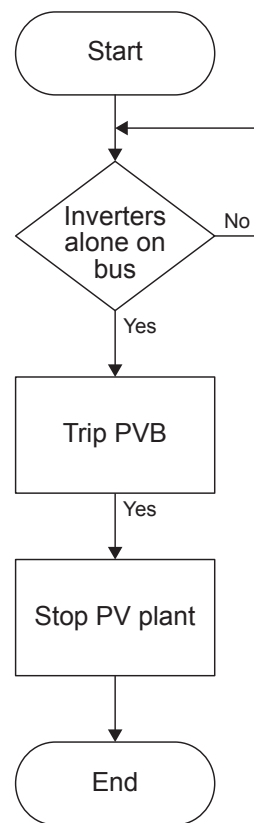
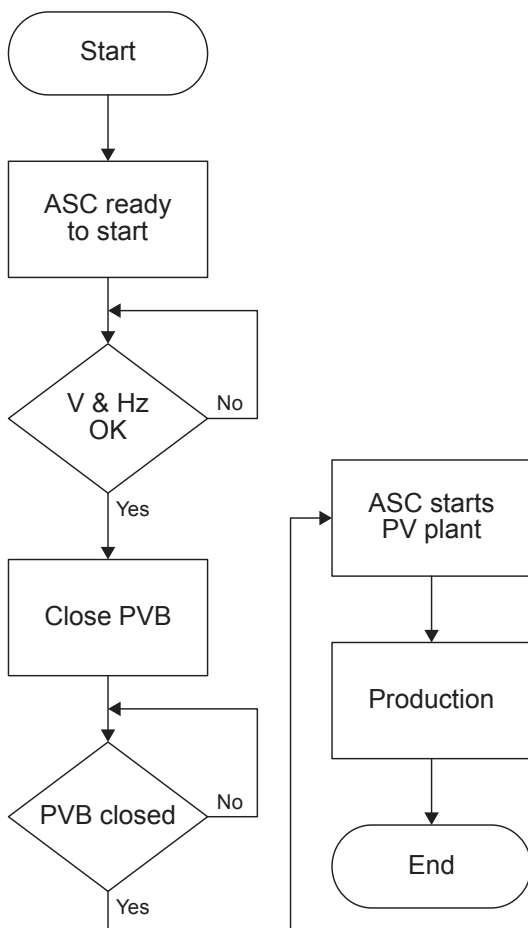
### 6.9.1 Operation mode

The ASC can be operated in semi mode (local) or in automatic mode (remote). In automatic, the system will close the PV breaker (if present) and start PV penetration if the plant has a start signal.

Rules for PV operation:

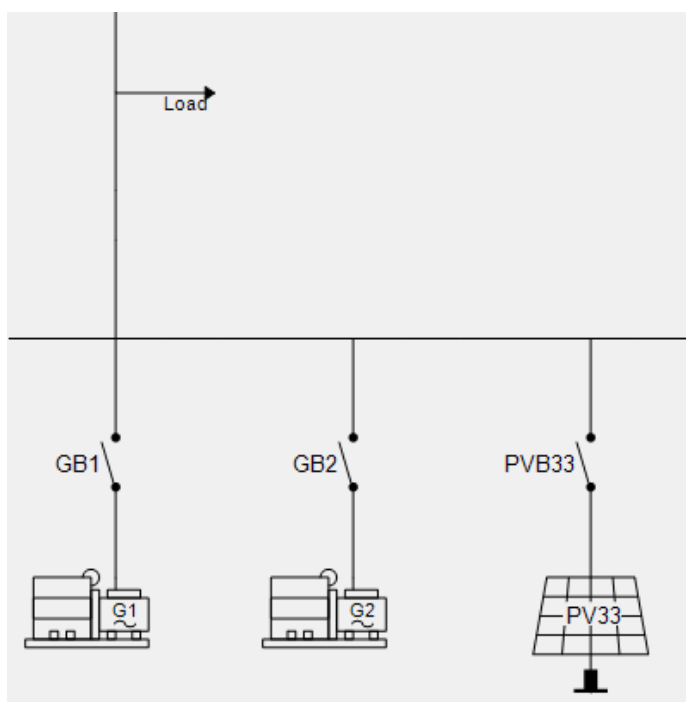
- The PV plant can only be started if the PVB (if present) is closed.
- The PVB can only be closed if the busbar voltage and frequency are inside the defined window.
- The PV plant can only be started if the PV voltage and frequency are inside the defined window.
- If neither a DG nor mains is connected to the busbar, the PVB is opened.

- If the PVB is open, the PV plant is stopped.



## 6.9.2 Island start

This is how the plant starts in island mode (with the controllers in AUTO and power management on).

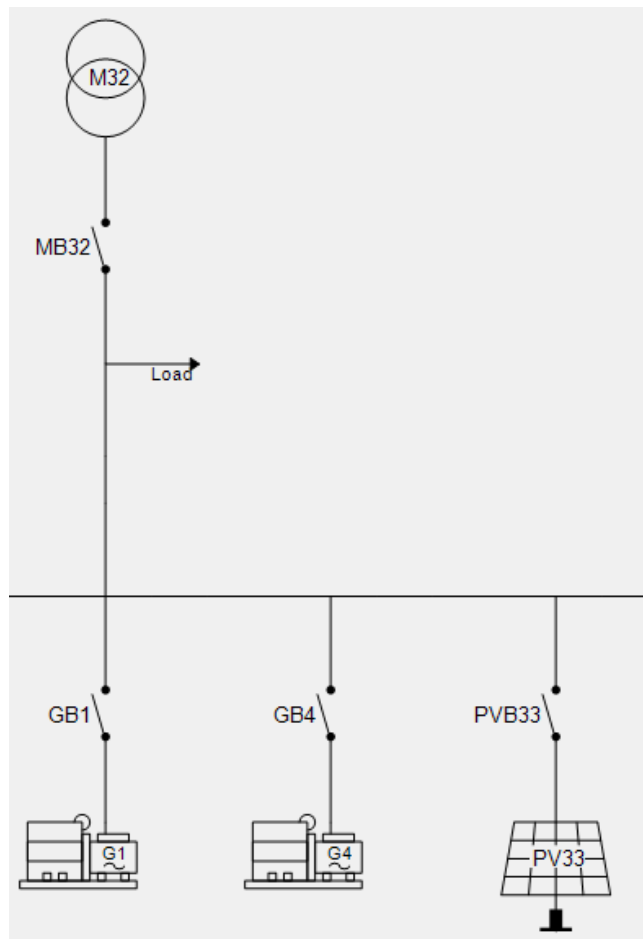


1. Activate the start signal on the AGC DG.

2. The genset(s) start and connect to the busbar.
3. When the busbar is energised, the ASC starts and connects the inverters.
4. The inverters follow the ASC ramp up curves. The inverters ramp up until the genset minimum load is reached.

### 6.9.3 Parallel mains start

This is how the plant starts when there is a mains connection (with the controllers in AUTO and power management on).



1. Activate the start signal on the AGC Mains.
2. When the mains breaker is closed and the busbar is energised, PV penetration starts.
3. The required number of gensets start (minimum zero, one or two in this example).
4. When the plant is operational and the requested set point is reached, the minimum number of gensets run, according to the run settings and load demand.

## 6.10 Load ramps

To avoid oscillations, load ramps (up and down) can be configured for both power and reactive power.

Parameter	Name	Range	Default	Details
2611	P ramp up	0.1 to 20 %/s	2 %/s	Limits the rate of power increase from the PV system.
2621	P ramp down	0.1 to 20 %/s	2 %/s	Limits the rate of power decrease from the PV system.
2622	Ramp open point	1 to 20 %	5 %	The breaker cannot open after the ramp down until the load is below this point.
2641	Q ramp up	0.1 to 100 %/s	2 %/s	Limits the rate of reactive power increase from the PV system.
2651	Q ramp down	0.1 to 100 %/s	2 %/s	Limits the rate of reactive power decrease from the PV system.

The reactive power ramp rates are adjusted according to the nominal rating of the inverters ( $S=[kVA]$ ).

If the genset has reverse power, the ramps are ignored.

## 6.11 Compatible PV systems



### More information

See **DEIF Hybrid controller compatibility** for the list of compatible PV systems.

## 6.12 Fail class

All activated alarms must be configured with a fail class. The fail classes define the category of the alarms and the subsequent alarm action.

Two fail classes can be used:

- Warning
- Shutdown

These fail classes have different actions that depend the running status of the inverter.

### 6.12.1 Inverter running

Fail class/action	Alarm horn relay	Alarm display	Trip PV breaker	Stop inverter
Warning	X	X		
Shutdown	X	X	X	X

Example: An alarm with the fail class *Shutdown* is activated:

- The ASC activates the alarm horn relay.
- The ASC displays the alarm on the alarm info screen.
- The ASC opens the inverter breaker immediately.
- The ASC stops the inverter immediately.
- The inverter cannot be started from the ASC (see next table).

### 6.12.2 Inverter stopped

Fail class/action	Alarm horn relay	Alarm display	Block inverter start	Block PVB sequence
Warning	X	X		
Shutdown	X	X	X	X

### 6.12.3 Fail class configuration

The fail class can be selected for each alarm function either via the display or the PC software.

To change the fail class via the PC software, the alarm function to be configured must be selected. Select the desired fail class in the fail class roll-down panel.



Parameter "I"> 1" (Channel 1030) X

Set point :

50 115 % 200

Timer : 0.1 10 sec 3200

Fail class : Warning

Output A Warning Shutdown

Output B Not used

Password level : customer

☒ Enable  
☒ High Alarm  
☐ Inverse proportional

☐ Auto acknowledge  
Inhibits...

★ Write OK Cancel

## 6.13 Other functions

### 6.13.1 Inverter connection limitations

If the system consists of an inverter type where only a limited number can be connected, additional ASC Solar controllers can be needed.

For example: For a specific brand of string inverters, up to 42 inverters can be connected. If the plant requires more than 42 inverters, additional ASC(s) must be used.

### 6.13.2 Continuous writing of P/Q enable

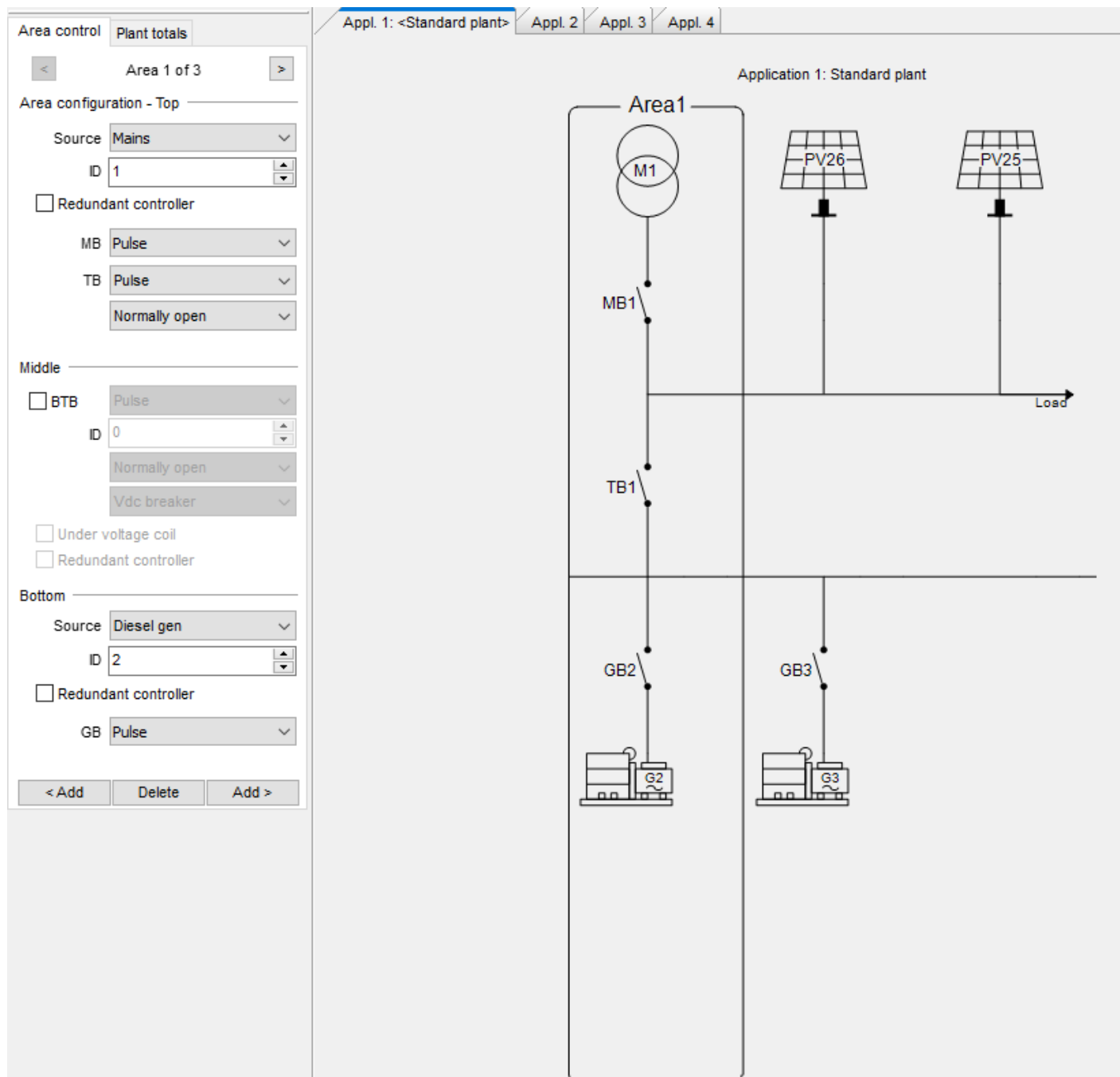
For inverters that are not able to process high volume parameter writing within a time period it is recommended to disable continuous writing of the **P enable** and **Q enable** parameters. This features is only available when using the **SunSpec Generic PV** protocol.

Parameter	Name	Range	Default	Details
2783	P ref. Enable	Enabled Not enabled	Enabled	<p><b>Enabled:</b> The controller continuously sends the state of the <b>P reference</b> parameter to the inverter.</p> <p><b>Disabled:</b> The controller only sends the state of the <b>P reference</b> parameter to the inverter when the state changes.</p>
2784	Q ref. Enable	Enabled Not enabled	Enabled	<p><b>Enabled:</b> The controller continuously sends the state of the <b>Q reference</b> parameter to the inverter.</p> <p><b>Disabled:</b> The controller only sends the state of the <b>Q reference</b> parameter to the inverter when the state changes.</p>

### 6.13.3 PV connected to load point or busbar

The ASC-4 Solar controller allows inverters to be connected to the load point and/or the busbar.

The image below is an example of a plan with two gensets, a mains feeder and two PV power sources connected to the load point.



#### More information

See **Single line diagram, Power management application configuration** in the **Commissioning guidelines** for more information about how to configure such a system in the DEIF Utility Software.

## 6.13.4 Other parameters

### Set point control

Parameter	Name	Range	Default	Details
7501	Comm. bus control P	Enabled Not enabled	Not enabled	<p><b>Enabled:</b> Allows the <b>P reference</b> value to be changed over Modbus or Profibus.</p> <p><b>Not enabled:</b> The <b>P reference</b> value cannot be changed over Modbus or Profibus.</p>
7502	Comm. bus ctrl cosphi	Enabled Not enabled	Not enabled	<p><b>Enabled:</b> Allows the <b>cosphi reference</b> value to be changed over Modbus or Profibus.</p> <p><b>Not enabled:</b> The <b>cosphi reference</b> value cannot be changed over Modbus or Profibus.</p>
7503	Comm. bus control Q	Enabled Not enabled	Not enabled	<p><b>Enabled:</b> Allows the <b>Q reference</b> value to be changed over Modbus or Profibus.</p> <p><b>Not enabled:</b> The <b>Q reference</b> value cannot be changed over Modbus or Profibus.</p>

### Inverter communication configuration (ASC is Modbus master)

Parameter	Name	Range	Default	Details
7511	Ctrl. comm. ID	1 to 247	3	ID number of external communication 1.
7512	Mon. comm. ID	1 to 247	3	Lowest communication ID of the inverter included in the PV monitoring scheme.
7515	Ext. Comm. 1 Spd	9600 Baud 19200 Baud	9600 Baud	Communication speed selection for external communication 1.
7520	Ext. Comm. 1 Mod	RTU ASCII	RTU	External communication 1 type.

## 7. Battery functions

### 7.1 AC- or DC-coupled

**AC and DC connections** includes sketches of the ESS AC- and DC-coupled with the PV. Configure the following parameter to match the plant configuration.

Parameter	Name	Range	Default	Description
8082	Operation mode	DC-Coupled Battery AC-Coupled Battery	DC-Coupled Battery	For DC-Coupled Battery, the PV is not connected to the busbar, but supplies the ESS directly. The ASC Battery ignores the charge scheme parameters.

### 7.2 Energy or power source

If PV is present, it is always the first priority source. You can configure whether the ESS is the next priority source. Selecting *Battery Energy Source* gives the gensets the higher priority.

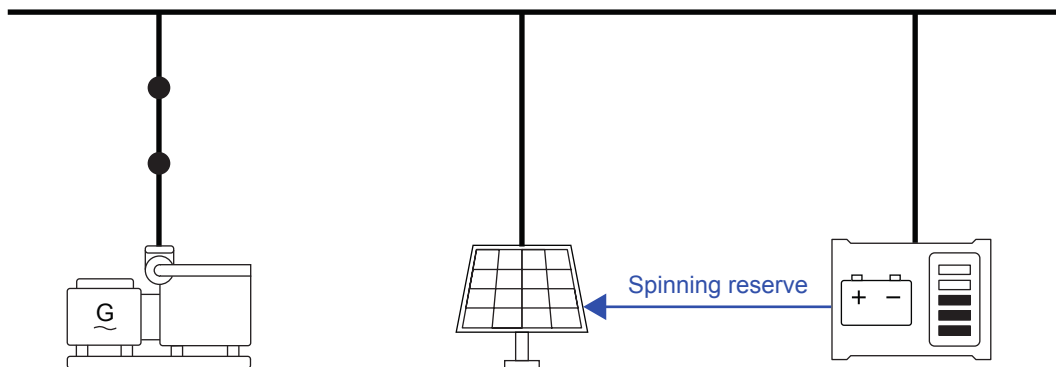
Parameter	Name	Range	Default	Description
8081	Operation mode	Battery Energy Source Battery Power Source	Battery Power Source	See the details below.

#### Battery Power Source

The ESS is used to supply peak loads while gensets are starting, and to improve power quality. The ESS is not designed to be the only source connected to the busbar.

The power management system includes the ESS generation capacity in the spinning reserve requested from PV. This stops the system from connecting excessive gensets.

**Figure 7.1** ESS acts as a battery power source

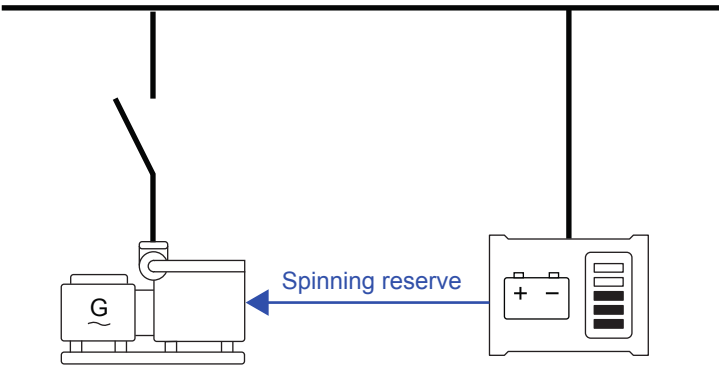


#### Battery Energy Source

The ESS is designed to supply the load, and can be the only source connected to the busbar.

The ASC Battery controller includes the ESS generation capacity in the spinning reserve. If there is enough spinning reserve, the power management system can stop all the gensets.

**Figure 7.2** ESS acts as a battery energy source



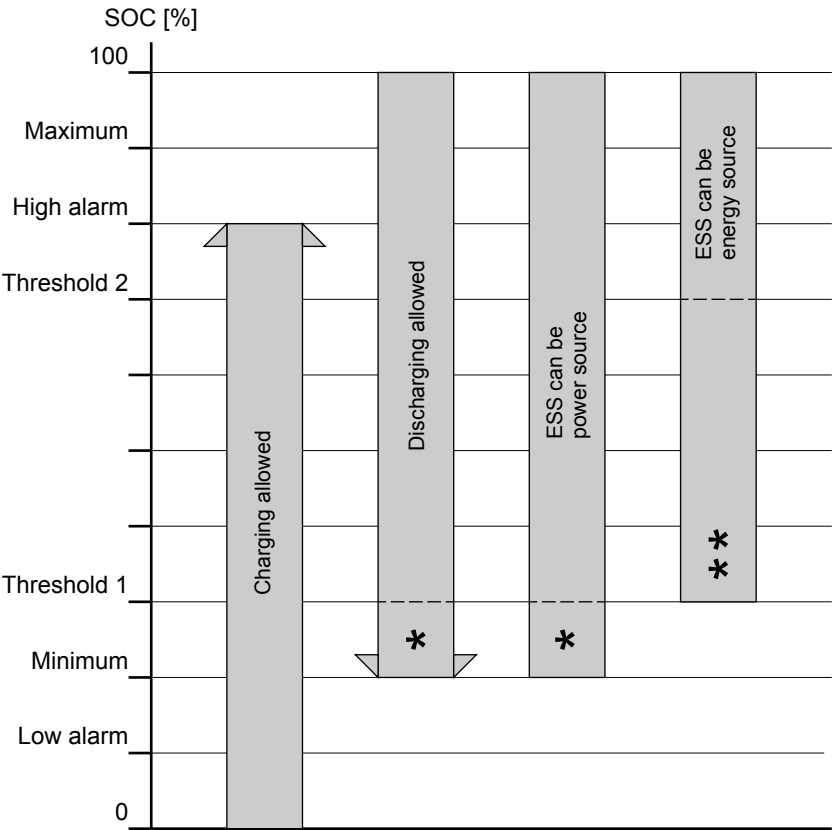
If the state of charge falls below *Threshold 1*, the ASC automatically changes to power source operation, and starts the required number of gensets. The ASC remains in power source operation until the state of charge reaches *Threshold 2*.

### 7.3 Energy management

#### 7.3.1 State of charge

The ASC reads the state of charge from the ESS. The energy management system ensures that the state of charge (SOC) conditions are met.

##### State of charge conditions



**Charging:** If the SOC is below maximum, the ESS can charge.

**Discharging:** If the SOC is above minimum, the ESS can discharge. \*Below threshold 1: The ESS can discharge until the SOC reaches the minimum. The ESS must then recharge to threshold 1 before it can discharge again.

**Power source:** The ESS can be a power source if the SOC is above threshold 1. \*Below threshold 1: The ESS can discharge as a power source until the SOC reaches the minimum. The ESS must then recharge to threshold 1 before it can discharge again.

**Energy source:** The ESS can be an energy source if the SOC is above \*\*Below threshold 2: The ESS can discharge as an energy source until the SOC reaches threshold 1. The ESS must recharge to threshold 2 before it can be an energy source again.

### State of charge parameters

Parameter	Name	Range	Default	Details
8055	SOC Settings	SOC Setting 1, 2, 3	SOC Setting 1	ASC Battery has three sets of state of charge parameters. This parameter selects which set to use.
7110	SOC Low	0 to 100 %	20 %	The SOC low alarm.
8051, 8061, 8071	SOC. Minimum 1, 2, 3	0 to 100 %	20 %	The ESS must not discharge when this minimum is reached. The ESS is not allowed to provide any power until the SOC reaches threshold 1.
8053, 8063, 8073	SOC. Thr. 1.1, 1.2, 1.3	0 to 100 %	40 %	Below threshold 1, the ESS can discharge as a power source until the SOC reaches the minimum. The ESS must then recharge to threshold 1 before it can discharge again.  Below threshold 1, the ESS cannot discharge as an energy source. The ESS must recharge to threshold 2 before it can be an energy source again.
8054, 8064, 8074	SOC. Thr. 2.1, 2.2, 2.3	0 to 100 %	80 %	Below threshold 2, the ESS can discharge as a power source until the SOC reaches the minimum. The ESS must then recharge to threshold 1 before it can discharge again.  Below threshold 2, the ESS can discharge as an energy source until the SOC reaches threshold 1. The ESS must recharge to threshold 2 before it can be an energy source again.
8052, 8062, 8072	SOC. Maximum 1, 2, 3	0 to 100 %	90 %	The ESS must not charge when this maximum is reached. The ESS can be a power or energy source.  Between threshold 2 and this maximum, only PV is allowed to charge the ESS.
7120	SOC High	0 to 100 %	80 %	The SOC high alarm.

### 7.3.2 Source for ESS charging

The ESS can recharge from PV, gensets and/or mains. Use the ASC parameters to configure which source(s) to use for charging, as well as the maximum charging rate.

When the ESS is running as an energy source, it will only recharge from PV or excess genset power. If the ESS is running as an energy source, it will not recharge from mains.

### ESS charging source parameters

Parameter	Name	Range	Default	Details
8022	Mains Charging	0 to 100 % of battery nominal power	100 %, Not enabled	If enabled, the ESS can recharge from mains. The set point is the maximum charging rate. If the ESS is running as an energy source, it will not recharge from mains.
8031	DG Charge pct	0 to 100 % of the connected genset(s) nominal power	100 %	The set point is the maximum charging rate from gensets in percent. This is only active if 8033 is enabled and set to <i>Percent</i> .

Parameter	Name	Range	Default	Details
8032	DG Charge P	0 to 5000 kW	200 kW	This power must be available as spinning reserve while the ESS is recharging. This should be above the genset start limit. This is only active if 8033 is enabled and set to <i>Power</i> .
8033	DG Charge Mode	DG Charge in Percent DG Charge in Power	DG Charge in Percent, Not enabled	If enabled, the ESS can recharge from the gensets. This parameter determines whether parameter 8031 (Percent) or 8032 (Power) is used.
8041	PV Charging	0 to 100 % of the available surplus PV power	100 %, Not enabled	If enabled, the ESS can recharge from PV. The set point is the maximum charging rate.

### 7.3.3 Charging the ESS

The energy management system automatically manages the ESS charging when the conditions for charging are met.

#### Charging rules

Between SOC threshold 1 and the maximum (if neither of the thresholds has been crossed), the ASC uses the following rules:

1. If excess PV power is available, the ESS charges.
2. If the system requires power, the ESS reduces charging. If power is still required, the ESS stops charging and supplies the load.

#### Maximum rate

The ESS will charge at the maximum rate, unless you configure the maximum charge rate for the ESS. If there are charge restrictions from other sources, the ASC uses the lowest charge rate that is referenced.

Negative numbers indicate flow into the battery (charge the ESS), and positive numbers indicate flow out of the battery (discharge the ESS).

Parameter	Name	Range	Default	Details
7063	Minimum dispatch	-100 to 100 % of the ESS nominal power	-100 %	The maximum charge rate for the ESS.

### 7.3.4 Discharging from the ESS

The energy management system automatically manages the ESS discharging when the conditions for discharging are met.

#### Discharging rules

Between the SOC maximum and threshold 1 (if neither of the thresholds has been crossed), the ASC uses the following rules:

1. If the ESS is an energy source, the ESS discharges.
2. If the ESS is a power source and there is peak load demand, the ESS discharges.
3. If the system has excess power, the ASC reduces the power that the ESS supplies. If there is still excess power, the ESS can start charging.

#### Maximum rate

The ESS will discharge at the maximum rate, unless you configure the maximum discharge rate for the ESS. If there are discharge restrictions from other sources, the ASC uses the lowest discharge rate that is referenced.

Negative numbers indicate flow into the battery (charge the ESS), and positive numbers indicate flow out of the battery (discharge the ESS).

Parameter	Name	Range	Default	Details
7064	Maximum dispatch	-100 to 100 % of the ESS nominal power	100 %	The maximum discharging rate for the ESS.

### 7.3.5 Optimum dispatch

Parameter	Name	Range	Default	Details
7061	Dispatch	30 to 100 % of ESS nominal power	100 %	If enabled, the energy management system uses this as the optimum discharging rate (if all the other energy management conditions are met).  This parameter can be used to make the ESS supply fixed power. The optimum discharging rate has first priority. The energy management system can stop gensets to achieve the optimum discharging rate.
7062	Dispatch	OFF ON	OFF	Enable parameter 7061.

### 7.3.6 Genset load-dependent start and stop

The genset load-dependent start and stop (LDSS) parameters are configured in the AGC Genset controller. When using ASC Battery, configure two sets of load-dependent start and stop parameters in each AGC Genset controller.

If the ESS is available, the energy management system can be configured to tell the AGC Genset to use the first set of LDSS parameters. These parameters can therefore be set higher, since the ESS contributes to the spinning reserve. For example, the load-dependent start point can be 95 %, while the load-dependent stop is 75 %.

If the ESS is not available, the energy management system can be configured to tell the AGC Genset to use the second set of LDSS parameters. The ESS is not available if it is in a "must charge" state, or if it is out of service. The LDSS must be set lower, so that there is enough spinning reserve. For example, the load-dependent start point can be 85 %, while the load-dependent stop is 65 %.



#### More information

See **Genset functions, Load-dependent start and stop** in the **Option G5 Power management AGC-4 Mk II** for more information and examples.

## 7.4 Spinning reserve

Spinning reserve ensures that the power management system is always able to supply the required power. Spinning reserve is the power that is immediately available.

You can configure spinning reserve in an ASC Battery controller. This is a global parameter. That is, the power management system shares this value to all controllers to ensure that the spinning reserve is available.

#### Available power

The power management system uses **available power** in its genset start and stop calculations.

Available power = Genset nominal power - Load. Available power is thus power from gensets.

To be included in the available power, a genset must be:

- Controlled by an AGC in AUTO mode
- Running and connected to the busbar

#### Spinning reserve

The operator is however interested in the total power available in the system, including the generating capacity of batteries. This is the **spinning reserve**.

Spinning reserve = Genset available power + Battery generating capacity



To be included in the spinning reserve:

- The battery must be controlled by an ASC Battery controller in AUTO mode.
- The ESS must be ready.
- Discharging the battery must be allowed.

## Parameters

Parameter	Name	Range	Default	Details
8931	Spinning Res.	0 to 30000 kW	100 kW	This is a global power management system parameter, shared with all the other controllers. This ensures that if the ASC Battery controller breaks down, the rest of the system compensates for the lack of energy from the battery.
7070	DG P<1	-200 to 100 % 0.1 to 3200 s	-5 % 10 s	This alarm is activated if the genset power falls below the set point.
7080	DG P<2	-200 to 100 % 0.1 to 3200 s	-5 % 10 s	This alarm is activated if the genset power falls below the set point.
7090	Spinning res. 1	0 to 100 % 0.1 to 3200 s	30 % 10 s	Activate the alarm if the spinning reserve falls below this percentage of the value set in parameter 8931.
7100	Spinning res. 2	0 to 100 % 0.1 to 3200 s	10 % 10 s	Activate the alarm if the spinning reserve falls below this percentage of the value set in parameter 8931.

## Example: Off-grid genset and battery application

One battery and five gensets

Battery generating capacity = 0.4 MW

Nominal power for each genset = 1.5 MW

Spinning reserve required = 1.0 MW

Genset load-dependent start set point = 90 %

Genset load-dependent stop set point = 85 %

1. Site load = 3.5 MW, three gensets running.
  - Available power =  $3 \times 1.5 \text{ MW} - 3.5 \text{ MW} = 4.5 \text{ MW} - 3.5 \text{ MW} = 1 \text{ MW}$ .
  - Available spinning reserve =  $1 \text{ MW} + 0.4 \text{ MW} = 1.4 \text{ MW}$ .
  - The spinning reserve requirement is met.
2. A load of 0.5 MW is suddenly added.
  - Site load = 4.0 MW.
  - Genset load =  $4.0 \text{ MW} / 4.5 \text{ MW} = 89 \%$ . The genset load-dependent start requirement is not met.
  - Available spinning reserve =  $4.5 \text{ MW} - 4.0 \text{ MW} + 0.4 \text{ MW} = 0.9 \text{ MW}$ . The spinning reserve requirement is not met. The power management system therefore starts another genset.
  - Available spinning reserve =  $4 \times 1.5 \text{ MW} - 4.0 \text{ MW} + 0.4 \text{ MW} = 2.4 \text{ MW}$ . The spinning reserve requirement is met. No more gensets start.
3. The total site load falls to 3.6 MW.
  - Can a genset stop?
    - If one genset stopped, the load on the remaining three gensets would be  $3.6 \text{ MW} / 4.5 \text{ MW}$ , or 80 %. A load-dependent stop is therefore possible, subject to the spinning reserve requirement.
    - If one genset stopped, the available spinning reserve would be  $4.5 \text{ MW} - 3.6 \text{ MW} + 0.4 \text{ MW} = 1.3 \text{ MW}$ .
    - The spinning reserve requirement would therefore also be met if the genset stopped.
    - The genset can therefore stop.

## Example: Off-grid genset and battery system; half of battery capacity trips

Two 1 MW batteries, and ten gensets

Total battery generating capacity = 2 MW

Nominal power for each genset = 1.5 MW

Spinning reserve required = 3.5 MW

Genset load-dependent start set point = 90 %

Genset load-dependent stop set point = 70 %

1. Site load = 10 MW, eight gensets running.
  - Site load = 10 MW
  - Available spinning reserve =  $8 \times 1.5 \text{ MW} - 10 \text{ MW} + 2 \text{ MW} = 4 \text{ MW}$ .
  - The spinning reserve requirement is met.
2. One of the batteries trips, and can therefore no longer be included in the spinning reserve. The total battery generating capacity is now 1 MW.
  - Available spinning reserve =  $12 \text{ MW} - 10 \text{ MW} + 1 \text{ MW} = 3 \text{ MW}$
  - The spinning reserve requirement is not met, and so the power management system must start another genset.

## 7.5 Ramps

### 7.5.1 Load ramps

To avoid oscillations, load ramps (up and down) can be configured for both power and reactive power.

Parameter	Name	Range	Default	Details
2611	P ramp up	0.1 to 20 %/s	2 %/s	Limits the rate of power increase from the battery.
2612	Island ramp	Enabled, Not enabled	Not enabled	<b>Not enabled:</b> The battery will always ramp up to the full load. <b>Enabled:</b> If the battery is in an island PMS and not other power sources are connected, it will take the full load immediately.
2621	P ramp down	0.1 to 20 %/s	2 %/s	Limits the rate of power decrease from the battery.
2622	Ramp open point	1 to 20 %	5 %	The breaker cannot open after the ramp down until the load is below this point.
2641	Q ramp up	0.1 to 100 %/s	2 %/s	Limits the rate of reactive power increase from the battery.
2642	Q ramp lim. max	1 to 110 %	90 %	The controller ignores the ramp if the reactive power is above this limit.
2651	Q ramp down	0.1 to 100 %/s	2 %/s	Limits the rate of reactive power decrease from the battery.
2652	Q ramp lim. min	-20 to 50 %	-10 %	The controller ignores the ramp if the reactive power is below this limit.

The reactive power ramp rates are adjusted according to the nominal rating of the power converters ( $S=[\text{kVA}]$ ).

If the genset has reverse power, the ramps are ignored.

### 7.5.2 Ramp override

If the genset is running above a minimum load, and is not overloaded, the ASC uses a ramp when changing the ESS set point.

#### Genset overload

The ASC overrides the set point ramp if the generator is overloaded.

Parameter	Name	Range	Default	Details
8114	Overload Sp	0 to 110 % of genset nominal power	98 %	If the genset power is above this set point, the ASC Battery ignores the load ramp and supplies power immediately.

## Genset reverse power

The ASC overrides the set point ramp if the generator is running below a minimum load, or has reverse power. The minimum load is determined by parameter 8011 or 8012 (8013 determines which is used).

## 7.6 Flowcharts

### 7.6.1 Functions

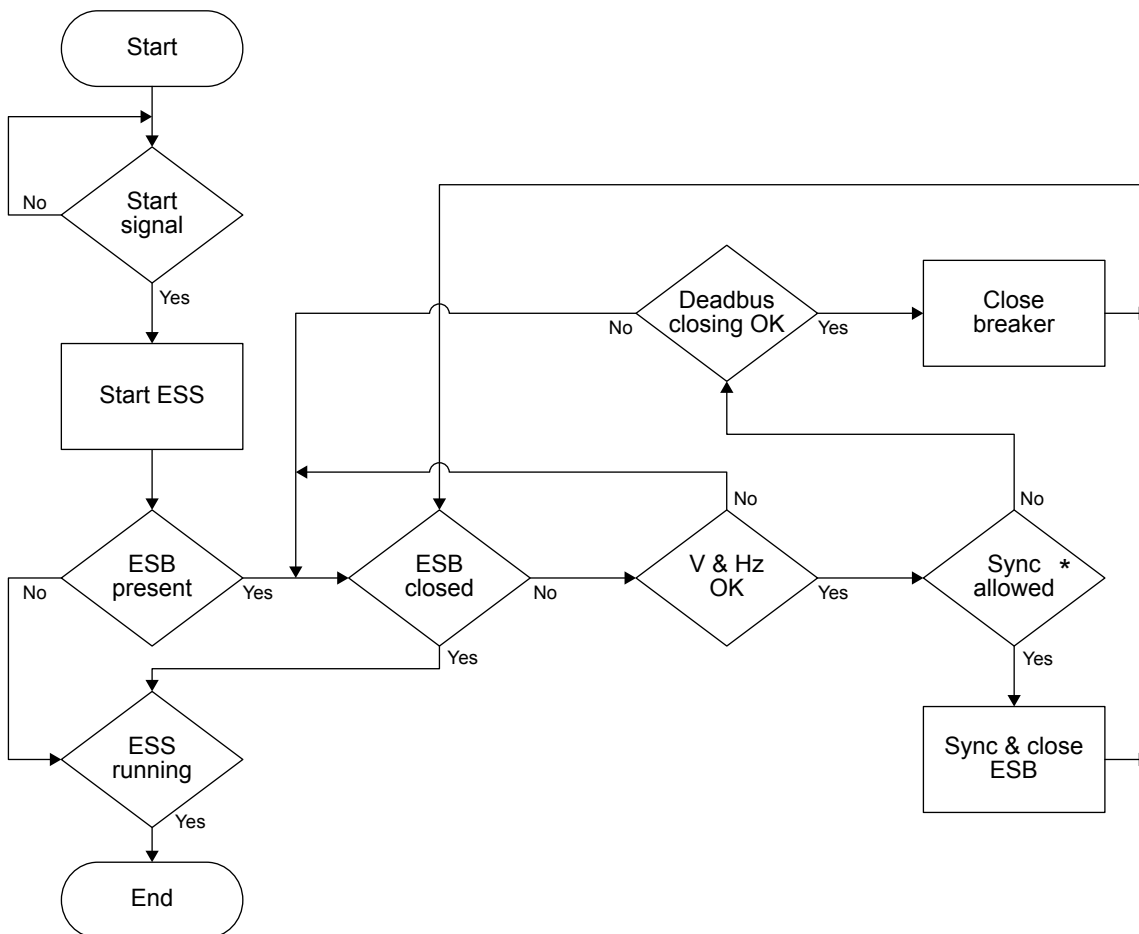
The following flowcharts show the most important function principles. The functions included are:

- Start sequence
- Stop sequence

Flowcharts for the mode descriptions are in the **AGC Designer's handbook**.

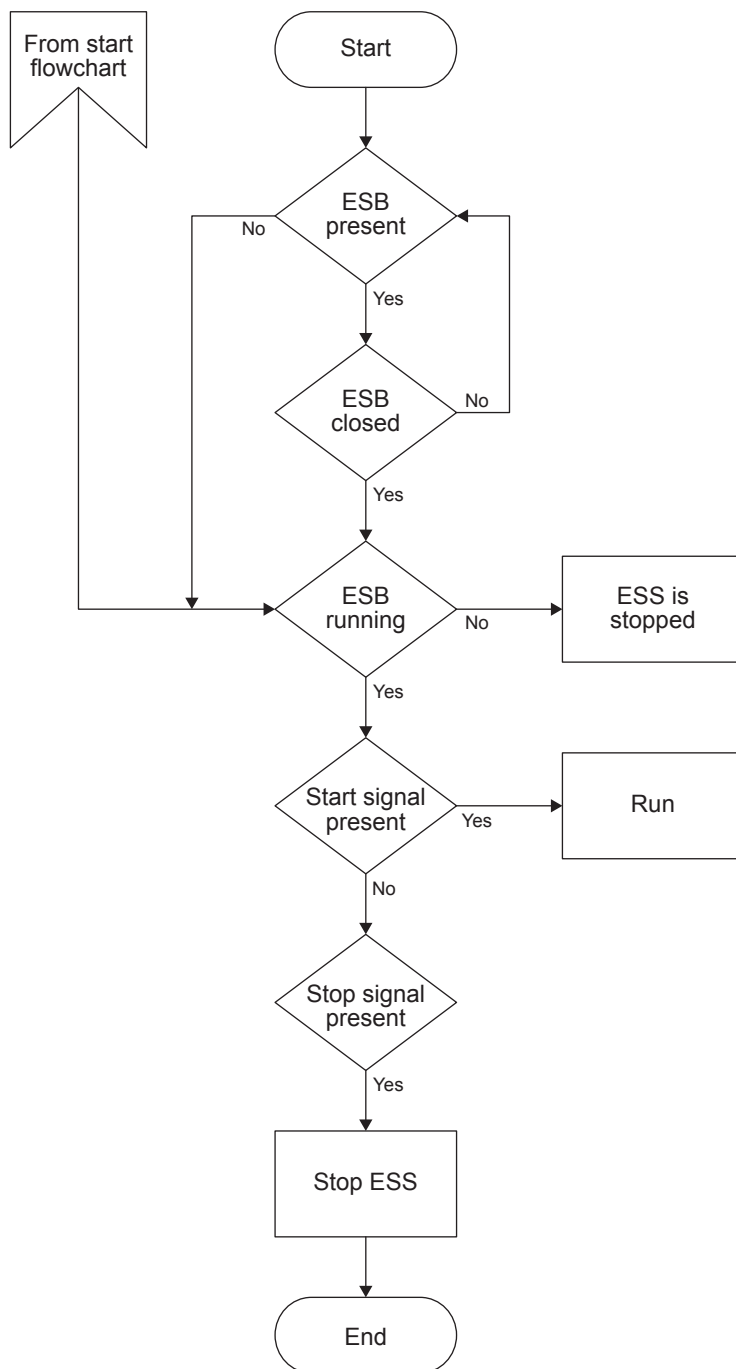
**NOTE** These simplified flowcharts are only for guidance.

### 7.6.2 Start sequence



**NOTE** \* Use *ESB close seq.* (parameter 2350) to enable automatic closing or wait for ESS OK.

### 7.6.3 Stop sequence



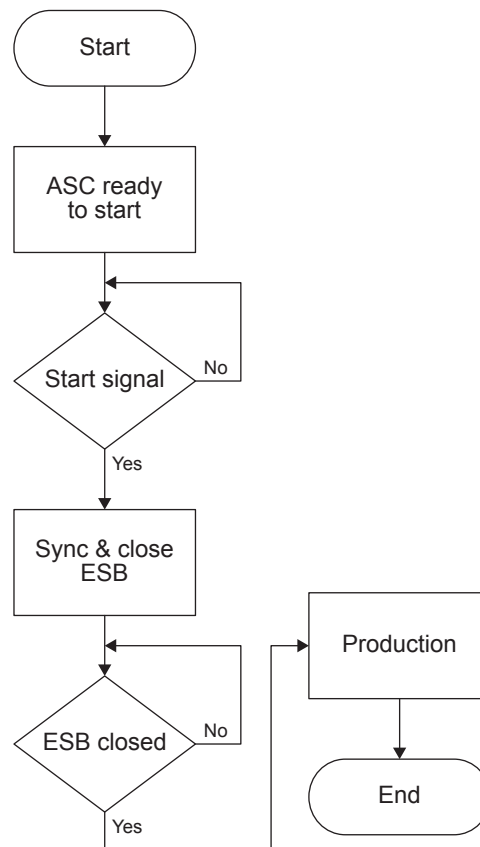
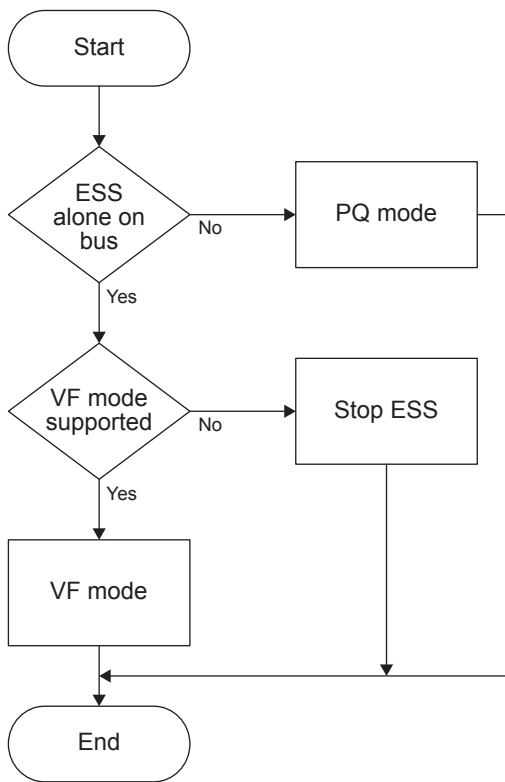
## 7.7 Modes of operation

### 7.7.1 Operation mode

The ASC can be operated in semi mode (local) or in automatic mode (remote). In automatic, the system will close the ES breaker (if present) and start ESS charging or discharging if the plant has a start signal.

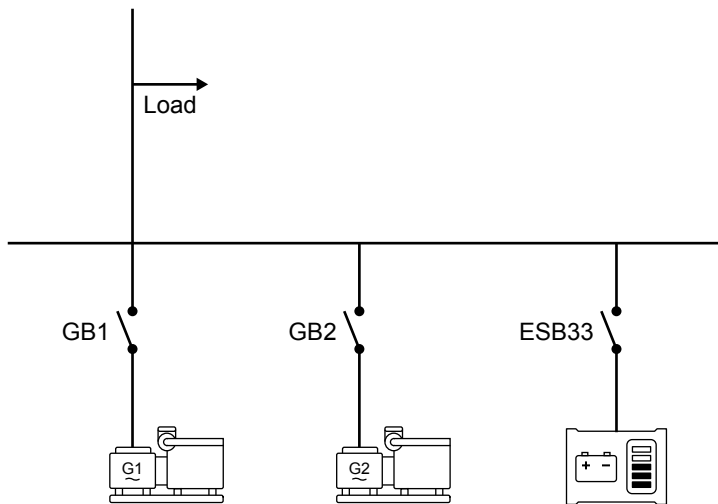
Rules for ESS operation:

- The ESS can only be alone on the busbar if VF mode (voltage and frequency mode) is supported by the PCS.
- The ESB can only be closed if the busbar voltage and frequency are inside the defined window.
- If the ESB is open, the ESS is stopped.



## 7.7.2 Island start

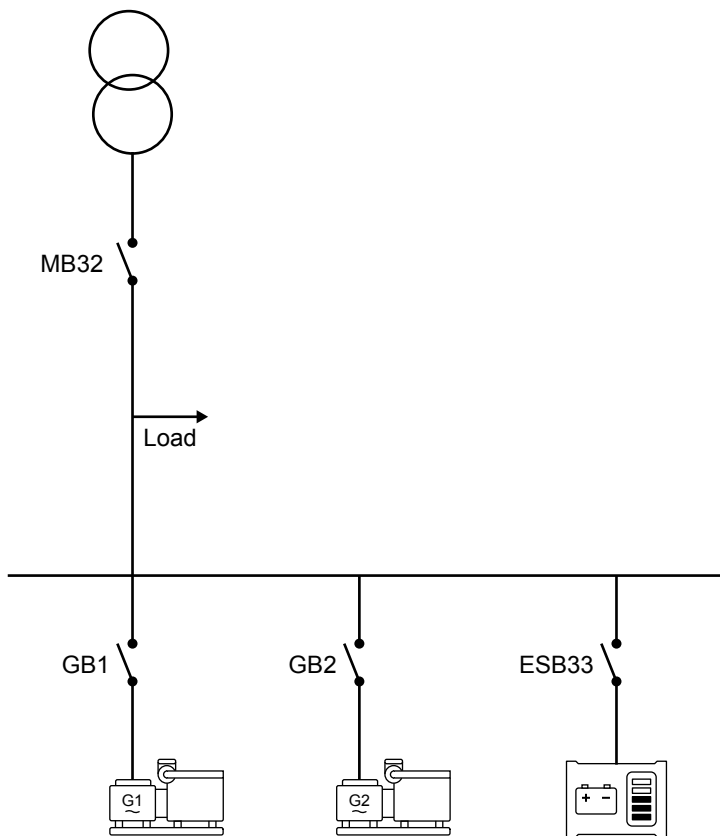
This is how the plant starts in island mode (with the controllers in AUTO and power management on).



1. Activate the start signal on the AGC DG.
2. The genset(s) start and connect to the busbar.
3. When the busbar is energised, the ASC starts and connects the power converter(s).
4. The power converters follow the ASC ramp up curves. If the power management configuration and operating conditions require ESS discharging, the power converters ramp up until the genset minimum load is reached.

## 7.7.3 Parallel mains start

This is how the plant starts when there is a mains connection (with the controllers in AUTO and power management on).



1. Activate the start signal on the AGC Mains.
2. When the mains breaker is closed and the busbar is energised, ESS supply can start.
3. The required number of gensets start (minimum zero, one or two in this example).
4. The plant runs according to the power management configuration and operating conditions.

## 7.8 Communication

### 7.8.1 Compatible battery energy storage systems



#### More information

See **DEIF Hybrid controller compatibility** for the list of compatible battery energy storage systems.

### 7.8.2 Consistency check

The ASC monitors the power delivered from the ESS. If the power matches the power that the ASC requested, the consistency check is OK.

If the power is not reached, and there is no good reason for this in the system, the ASC activates an alarm. The ASC then sends a 0 kW set point to the ESS (considering it out of service).

### 7.8.3 Communication failure

The ASC detects communication failure if the ESS does not respond to telegrams. The ASC does not use a heartbeat.

## 7.9 Fail class

All activated alarms must be configured with a fail class. The fail classes define the category of the alarms and the subsequent alarm action.

Two fail classes can be used. The following tables show the action of each fail class when the power converter is running or stopped.

## 7.9.1 Power converter running

Fail class/action	Alarm horn relay	Alarm display	Trip ES breaker	Stop power converter
Warning	X	X		
Shutdown	X	X	X	X

Example: An alarm with the fail class *Shutdown* is activated:

- The ASC activates the alarm horn relay.
- The ASC displays the alarm on the alarm info screen.
- The ASC opens the ES breaker immediately.
- The ASC stops the power converter immediately.
- The power converter cannot be started from the ASC (see next table).

## 7.9.2 Power converter stopped


Fail class/action	Alarm horn relay	Alarm display	Block power converter start	Block ESB sequence
Warning	X	X		
Shutdown	X	X	X	X

## 7.10 Other functions

### 7.10.1 Battery droop

When *DEIF Generic* or *SinExcel* is selected in parameter 7561, you can configure droop for the ASC battery controller. Adding droop to the battery regulation increases the system stability.


Parameter	Name	Range	Default	Details
2801	Droop config.	ASC parameters BESS comm. reading	ASC parameters	<b>BESS comm. reading:</b> This function is currently only supported for ATESS Growatt. Parameters 2803 and 2804 are ignored.
2803	Droop f slope	0 to 200 %P/Hz	40 %P/Hz	Change the battery power converter frequency set point in response to load deviations from the nominal load.
2804	Droop U slope	0 to 200 %Q/V	5 %Q/V	Change the battery power converter voltage set point in response to reactive load deviations from the nominal reactive load.



#### Power-frequency droop example

Settings: Nominal P = 1000 kW, Nominal f = 60 Hz, Droop f slope (2803) = 60 %P/Hz. Power reference = - 50 kW.

Frequency offset = Power reference / (Nominal power x Droop slope) + Nominal frequency  
Frequency offset = -50 kW / (1000 kW x 0.60 P/Hz) + 60 Hz = -0.08 Hz + 60 Hz = 59.92 Hz



#### Reactive power-voltage droop example

Settings: Nominal Q = 1000 kvar, Nominal U = 400 V, Droop U slope (2804) = 5 %Q/V. Reactive power reference = 100 kvar.

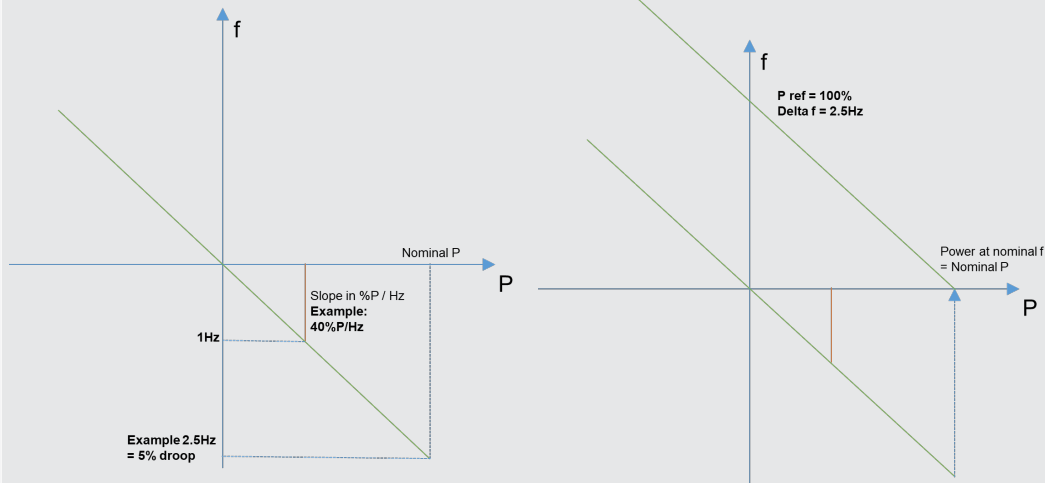
Voltage offset = Reactive power reference / (Nominal reactive power x Droop slope) + Nominal voltage

Voltage offset = 100 kvar / (1000 kvar x 0.05 Q/Hz) + 400 V = 2 V + 400 V = 402 V



### Droop curve example

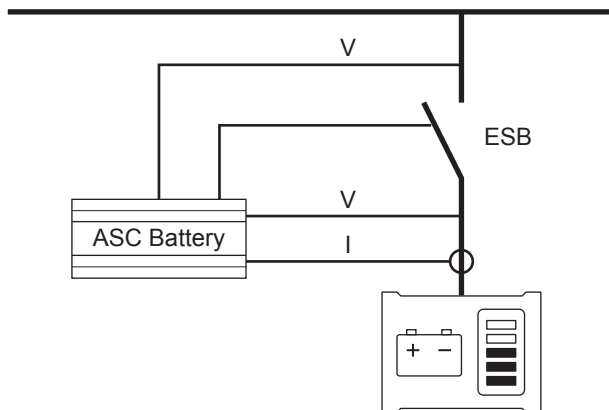
The left diagram shows the droop slope. The right diagram shows the frequency offset due to the droop.



## 7.10.2 AC measurements

The ASC Battery terminals can be connected to measure the AC power from the ESS. This is the default configuration.

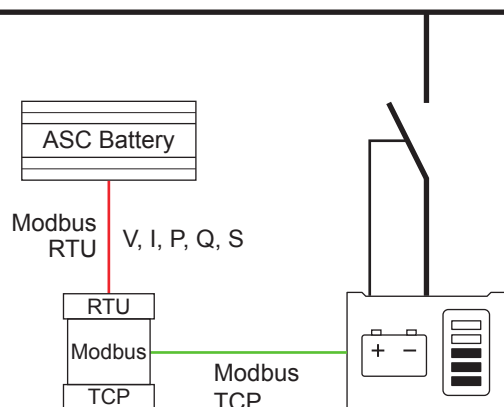
### ASC Battery does the AC measurements



Alternatively, the ASC Battery can receive the AC power measurements from the ESS. Select *ES communication* in parameter 7051.



## ASC Battery gets the AC measurements from the ESS



Parameter	Name	Range	Default	Details
7051	Power measures	ASC measurements ES communication DEIF open communication Power meter comm.	ASC measurements	DEIF open communication: Select this if the ASC receives the ESS power values over Modbus.

### 7.10.3 State of health

The ASC reads the state of health (SOH) from the ESS. The ASC activates an alarm if the SOH goes below the configured value.

Parameter	Name	Range	Default	Details
7130	SOH Minimum 01	0 to 100 %	20 %	SOH alarm 1
7140	SOH Minimum 02	0 to 100 %	15 %	SOH alarm 2

### 7.10.4 Other parameters

#### Remote or local stop and start

Parameter	Name	Range	Default	Details
8091	Start/stop	Remote Local	Remote	<b>Remote:</b> The ESS can be started/stopped by Modbus commands. The ASC ignores the display unit start/stop and breaker open/close buttons.  <b>Local:</b> The ESS can be start/stopped, and the ESB can be opened/closed by display unit buttons. The ASC ignores Modbus start/stop and open/close commands.

#### Set point control

Parameter	Name	Range	Default	Details
7501	Comm. bus control P	Enabled Not enabled	Not enabled	<b>Enabled:</b> Allows the <b>P reference</b> value to be changed over Modbus or Profibus.  <b>Not enabled:</b> The <b>P reference</b> value cannot be changed over Modbus or Profibus.
7502	Comm. bus ctrl cosphi	Enabled Not enabled	Not enabled	<b>Enabled:</b> Allows the <b>cosphi reference</b> value to be changed over Modbus or Profibus.

Parameter	Name	Range	Default	Details
				<b>Not enabled:</b> The <b>cosphi reference</b> value cannot be changed over Modbus or Profibus.
7503	Comm. bus control Q	Enabled Not enabled	Not enabled	<b>Enabled:</b> Allows the <b>Q reference</b> value to be changed over Modbus or Profibus.  <b>Not enabled:</b> The <b>Q reference</b> value cannot be changed over Modbus or Profibus.

### Communication configuration

Parameter	Name	Range	Default	Details
7511	Ctrl. comm. ID	1 to 247	3	ID number of external communication 1.
7512	Mon. comm. ID	1 to 247	3	Lowest communication ID of the power converter included in the ESS monitoring scheme.
7514	Ext. Comm. 1 Spd	9600 Baud 19200 Baud	9600 Baud	Communication speed selection for external communication 1.
7515	Ext. Comm. 1 Mod	RTU ASCII	RTU	External communication 1 type.
7520	Ext. Comm. 1 err.	1 to 100 s	10 s	External communication error alarm.

### ESS monitoring

Parameter	Name	Range	Default	Details
7566	ESS Monitoring	1 to 42	1	Set the number of battery systems that are monitored.
7570	ESS COMM error	0 to 100 s	3 s	This alarm activates when a communication error alarm is present on the ESS.
7580	ESS Warning	0 to 100 s	0 s	This alarm activates when a Warning alarm is present on the ESS.
7590	ESS Shutdown	0 to 100 s	0 s	This alarm activates when there is a shutdown alarm present on the ESS.
7600	ESS monitor err	-	-	This alarm activates when there is no communication from one or more of the monitored inverters.

### BMS monitoring

Parameter	Name	Range	Default	Details
7690	BMS monitor err	-	-	This alarm activates when there is no communication from the battery management system.

## 8. Common functions

### 8.1 PV, ESS and BMS communication protocols

#### ASC as Modbus master

The ASC can communicate with the inverters (or power converters) directly, or through a gateway device.

The ASC communication with the PV, BCU, BMS or PCS uses a Modbus RTU protocol. The ASC is the master and the inverter (or power converter) is the slave. Using this protocol, the ASC transmits the references to the inverters (or power converters) using Modbus RS-485 or by using the Ethernet gateway.

#### ASC as Modbus slave

The DEIF Open protocol uses Ethernet (Modbus TCP/IP) or Modbus RS-485. The PV controller (Fuel Save Controller/FSC) or the ESS controller is the master device. Using this protocol, the inverters (or power converters) can read the references from the ASC, which is the slave device.

Other equipment, for example, a SCADA system or a PLC, can also be the master and use the ASC Modbus slave to read operating data and adjust set points.

#### Communication protocol parameters

Parameter	Name	Range	Default	Details
7561	ASC Solar: PV protocol	See <a href="#">Compatible PV systems</a> .	Off	Additional protocols may be available. Contact DEIF for details.
7561	ASC Battery: ESS protocol	See <a href="#">Compatible battery energy storage systems</a> .	Off	Additional protocols may be available. Contact DEIF for details.
7562	Tx write type	Unicast Broadcast	Unicast	Only affects protocols where the ASC is the master.
7563	Tx maximum rate	0.1 to 10 s	0.5 s	Only affects protocols where the ASC is the master.
7564	Tx write fnc.	Single register 0x06 Multiple register 0x10	Multiple register 0x10	Only affects protocols where the ASC is the master.
7660	Weat. comm. ID	1 to 247	3	The ID given to the weather station to receive and transmit data.
7661	Weather prot.	See <a href="#">Compatible weather stations</a> .	OFF	Select the weather station protocol that matches your weather station. If no weather station is available, or the weather station is not in the list, select OFF.
7680	BMS comm. ID	1 to 247	3	The ID given to the BMS to receive and transmit data.
7681	BMS Protocol	See <a href="#">Compatible battery energy storage systems</a> .	OFF	Select the battery management protocol that matches your BMS. If no BMS is available, or the BMS is not in the list, select OFF.



#### More information

See **ASC-4 Modbus slave and Modbus master**, **ASC-4 Modbus slave tables**, **Application notes**, **DEIF hybrid controller compatibility** and **ASC-4 Modbus master tables** for more information.

#### 8.1.1 Tx write type

You can chose Unicast or Broadcast.

## Unicast

Unicast is used in point-to-point interfaces. This means in systems where the ASC communicates to one inverter/communication device only. All read/write commands from the ASC is performed to the ModbusID selected in menu 7511, and a response to the read/write request will be transmitted from the inverter/communication device.

Communication supervision is possible, and a communication alarm can be raised in case communication is compromised.

The operating status of the inverter can be taken into account by the ASC. For example, “stopping inverter” or “inverter ramping”.

P and Q references will be based on the rated size received/read from the inverter/device if the inverter protocol supports it. Otherwise, the ASC measurements need to be used.

Note that the ASC prioritises control communication. Depending on the number of telegrams to write and the inverter transmit speed, updating the data from the inverter may take a few seconds.

## Broadcast

Broadcast is used in interfaces with multiple inverters/devices where the ASC itself needs to control them all. In this case, the ASC does not address each inverter directly. Instead, it broadcasts the commands to all inverters. This is done to have a sufficiently fast control speed. The response is not mandatory as the ASC continuously transmits the commands.

Communication supervision is not possible, and a communication alarm cannot be activated if communication is compromised.

The operating status of the inverter cannot be taken into account by the ASC because the inverters do not feed back status information to the ASC.

Note that the more inverters there are, the slower the communication. The ASC prioritises control communication (that is, sending the set points to the inverters). Depending on the number of inverters, the number of telegrams to write and the inverters' transmit speed, updating the data from the inverters may take a several seconds. If the maximum number of inverters is used, the data update from the inverters may take minutes.

## Broadcast initialisation

Some protocols (SunSpec) may have an initialisation routine where the ASC outlines the implementation in the inverter. This routine will be performed on the inverter holding the ModbusID selected. Afterwards, the ASC will switch to Broadcast. When Broadcast is selected, the ASC will use Broadcast Modbus ID0 in all write commands despite the actual setting of the ModbusID.

During the initialisation routine, communication supervision is possible and a communication alarm can be raised in case communication is compromised.

P and Q references will be based on the rated sizes set in the ASC. ASC-rated settings menus have been expanded to include rated Q as well. The rated P and Q will need to be set to match the actual rated sizes of the total inverter installation.

## Tx maximum rate

Here it is possible to select how fast the ASC is allowed to transmit. The setting is added as some inverters cannot take in too much communication. For example, some inverters can accept telegrams every 100 ms, while others cannot run faster than 500 ms.

## Tx write fnc.

Here it is possible to select whether write commands are to be done using single register write (0x06) or multiple register write (0x10). Depending on protocol, using multiple register write (0x10) may be faster (less telegrams needed). However some inverters only support 0x06.

## Inverter comm identification

You can set the communication protocol that the inverter or converter uses in menu 7561.



### More information

See **Common functions**, **Communication protocols** for a list of supported communication protocols.

## ASC power [kW] measurements

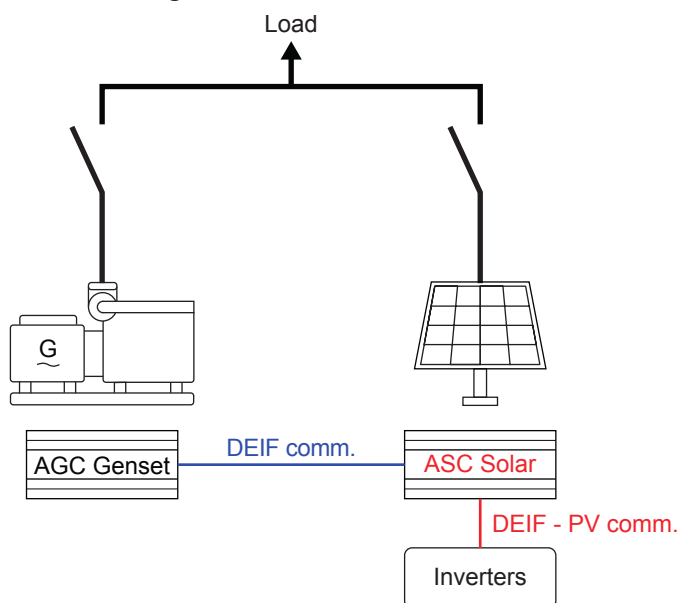
ASC power measurements can be received from measurements made by the controller, measurements sent to the controller from the PV or ES communication, or measurements sent through the DEIF internal communication. The measurement source is changed in menu 7051.

If the *ASC measurements* is selected, the CT and voltage measurements are being used when calculating the power.

It is possible to use the P, Q and S readings from the inverter or converter instead of the ASC's own measurements, but it depends on the communication method selected for *Tx write type*.

**NOTE** It is not possible to receive power measurement values from the PV or ES communication if *Tx write type* is Broadcast.

## Power management communication



The diagram shows the DEIF communication between the ASC Solar and the AGC. The blue line shows CAN bus power management communication. The communication between the ASC and the PV system is the Modbus or Ethernet communication.

## 8.2 Power management

### 8.2.1 Power management communication

The ASC controller communicates with the other DEIF controllers (other ASC controllers, as well as AGC and ALC controllers) over CAN bus.

#### CAN bus communication

Parameter	Name	Range	Default	Details
7531	PM CAN ID	25 to 40	33	The power management system CAN communication ID number for the ASC.

#### CAN bus communication errors

In each ASC, you can configure the controller mode for a CAN bus failure (*CAN fail mode*, 7532). You can also configure communication error alarms for *Missing all units* (7533), *Fatal CAN error* (7534), *Any DG missing* (7535) and *Any mains missing* (7536). The fatal CAN error alarm is activated when the number of controllers configured in *CAN miss amount* (8800) are missing.



#### More information

See **Setup, CAN bus** in **Option G5 Power management AGC-4 Mk II** for more information on power management CAN bus communication.

## 8.2.2 Power management mode

The ASC will follow the mode of the AGC mains; island, fixed power, mains power export, peak shaving or load take over (grid-tied or off-grid). If no mains controller (AGC mains) is installed in the application, the plant is forced into island mode (off-grid).

## 8.2.3 Genset set points (kW)

In the power management mode, the plant will force the gensets that are online (connected to the busbar) to operate at a minimum load. The purpose of this is to eliminate the risk of engine problems, for example wet-stacking, fouling or other issues when idling at low loads.

## 8.2.4 Island operation

During island operation the connected genset load can be between -50 and 100 % of engine nominal power. The *Min DG load 01/02* parameters on the ASC are shared parameters that ensure all engines connected to the busbar are loaded to the same level. Since the gensets are in frequency control mode, the inverters (or power converters) regulate the power. If the gensets are loaded more than the parameter set point, then the inverters (or power converters) are regulated up to take over load from the gensets and vice versa.

### Minimum generator load parameters

Parameter	Name	Range	Default	Details
8011	Min DG load 01	-50 to 100 %	30 %	Sets the minimum load level for all gensets connected to the busbar.
8012	Min DG load 02	-50 to 100 %	30 %	Sets the minimum load level for all gensets connected to the busbar.
8013	Min DG load set	Min. DG load set 1 Min. DG load set 2	Min. DG load set 1	Selects the active minimum genset load setting.

## 8.2.5 Parallel to grid operation

Gensets that operate in parallel to the PV plant are always loaded to at least their *Minimum Load* setting to prevent engine fouling. This is true even if the PV plant can supply more power to the grid than the set point allows.

The power management system uses PV production as much as possible to supply the load demand, and starts and stops gensets as required while taking minimum genset load into account.

## 8.2.6 Inverter/power converter set points

The inverters (or power converters) will get a set point from the ASC controller. The ASC can transmit or broadcast the set point to the inverters (for example, SunSpec). Alternatively, the inverters can read the set point from the ASC (DEIF Open).

The set point is calculated so that the inverters always produce as much as possible. The PV penetration will cover the load demand apart from the genset minimum load (island mode).

In grid-tied modes (for example, peak shaving or fixed power), the plant can be set up to stop all engines. This is done by adjusting the minimum number of gensets to run (multi-start) to "0" (the default is "1") for the AGC Genset controllers.



### More information

See the **AGC Parameter list** for more information about the genset multi-start parameters.

## 8.2.7 Set points in multi-ASC applications

If more than one ASC is present, they will share the load equally if they are running or ready to start. This means that the ASCs ensure that the production is balanced out on the running inverters and/or power converters.

## 8.2.8 Reactive set points (kvar)

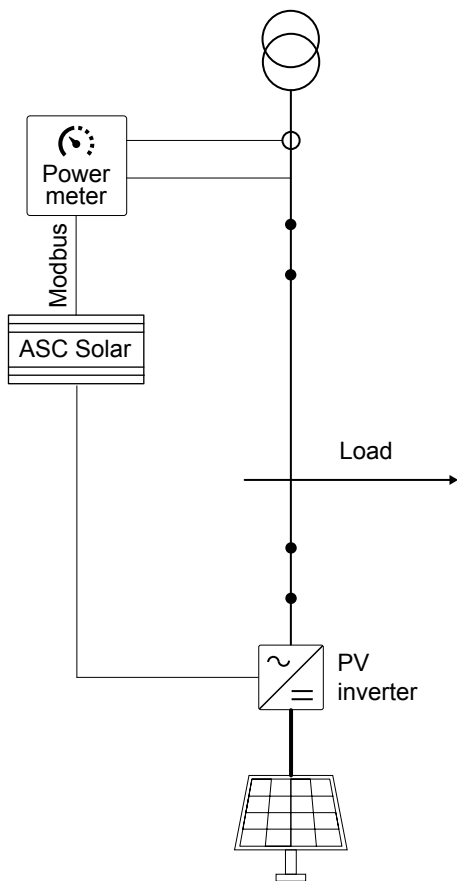
You can use a variety of reactive power regulation methods to regulate the reactive power from the inverters/power converters.

There are parameters for grid-tied and off-grid modes:

Parameter	Name	Default	Grid-tied	Off-grid	Details
7021	Cosphi ref	0.9	X		Use this parameter to configure the fixed power cos phi set point. When the PV/ESS is running in parallel to the utility with fixed cos phi reference, it follows this set point.
7022	Cosphi ref	Inductive	X		This parameter makes it possible to select inductive or capacitive reference from the cos phi dispatch.
7023	Q-ref	500 kvar	X		For a fixed Q [kvar], the inverters/power converters use the set point in this parameter. The inverters/power converters each supply an equal share of the set point. For example, if the set point is 105 kvar and the application contains 15 inverters, then each inverter will supply 7 kvar.
7024	Q type grid-tie	Cosphi superior	X		See the section below.
7031	DG cosphi lim I	0.8		X	The limit of the genset cos phi on the inductive side. For example, if set to 0.95, the genset will only deliver reactive load up to a maximum of 0.95 inductive. If the actual load has characteristic of 0.9, the inverters/power converters will carry the remainder from 0.95 to 0.9.
7032	DG cosphi lim C	1.0		X	The limit of the genset cos phi on the capacitive side. If set to for example 1.00, the genset will not be able to operate with the capacitive power factor (under-excited). If the menu 7031 is set to 1.00 and 7032 is set to 1.00, the genset will not carry any Q at all. The inverters/power converters will supply all Q (under the assumption they support it).
7033	Q type off-grid	Off		X	If equal var sharing (in percent) is requested between the gensets and the inverters/power converters, equal kvar sharing can be enabled in this parameter. If var sharing is switched off, the settings in parameters 7031 or 7032 will be used.
7041	P/Q limit type	OFF	X	X	See the section below.
7042	P/Q cap limit %	95 %	X	X	See the section below.

### 7024, Method of var regulation

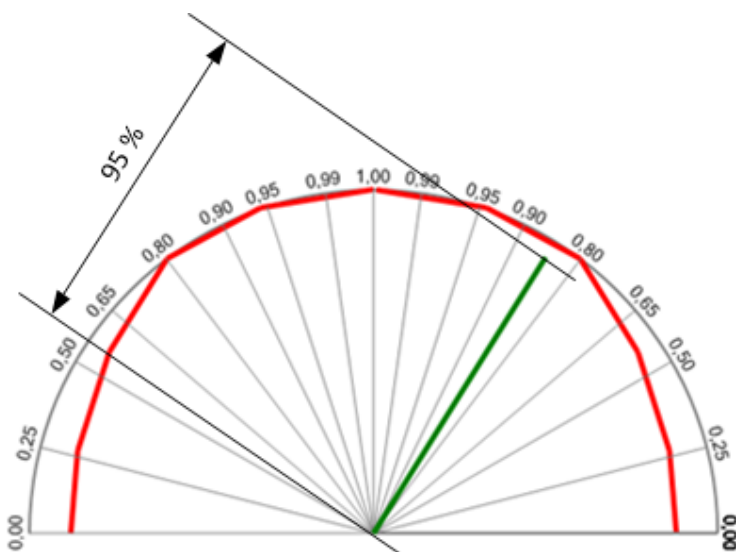
- **Off:** No Q control when the MB is closed or when fixed power mode is selected.
- **Cosphi fixed:** The inverters/power converters maintain a fixed cos phi (set in parameter 7021).
- **Cosphi imp/exp:** The inverters/power converters are regulated against a cos phi set point in parameter 7021.
  - **Measured at the point of connection:** A power meter or measurement transducers are needed to measure the reactive power imported to or exported from the plant. The inverters/power converters are regulated accordingly.



- **Cosphi superior:** This is used if the application is a power management application and the cos phi set point is controlled at the AGC mains controller. If one or several ASC controllers are used, it is often more convenient to adjust the cos phi set point from a central point. That is, the AGC mains adjusts the set point, and then transmits the set point to the ASC(s). All ASCs with this setting will follow the AGC mains. If one or several ASCs do not use this setting, they may, for example, use a fixed cos phi set point.
- **Q fixed:** The ASC uses the setting in parameter 7023.
- **Q imp/exp:** This requires a power meter/transducer (see **Cosphi imp/exp**) and the Q ref will maintain measure at the point of connection.

## 7042, limit operating chart

This defines how far out on the operating chart the inverter/power converter is allowed to go. If set to 100 %, it is possible that the full area is used. If, for example, it is set to 95 %, the load level will not reach the limit of the capability curve.



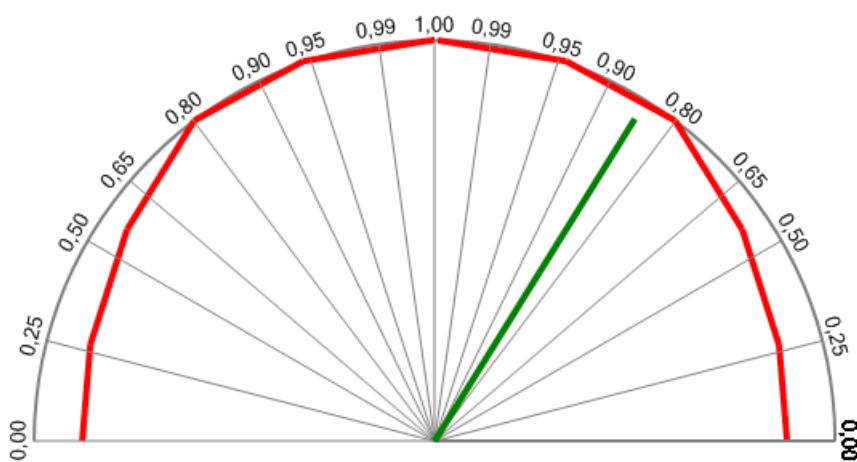


## 7041, use capability curve

This parameter defines how the Q or P can be limited using the capability curve of the inverter/power converter.

Three selections are available:

OFF	The ASC does not limit the reactive power set point to the inverter/power converter. This means that the inverter/power converter will respond unless it limits itself. Some inverters/power converters have internal limits meaning that if the ASC issues a set point on the far side of the limit, the inverter/power converter ignores the set point.
Capability curve (Q)	The ASC limits the Q produced by the inverter/power converter. So if the var sharing would request a reactive load exceeding the limits, then the ASC ensures that the adjusted limitation is not exceeded by reducing the reactive power.
Capability curve (P)	The ASC limits the P produced by the inverter/power converter. So if the kW sharing would request an active load exceeding the limits, the ASC ensures that the adjusted limitation is not exceeded by reducing the active power.



The kvar set points depend on the plant mode. In island mode, the PVs/ESSs and the gensets share equally and therefore run at the same cos phi. In mains parallel, the cos phi set point follows the set point as configured in the ASC or it can receive set points from the mains controller.

Parameters 2641 (Q ramp up) and 2651 (Q ramp down) configure the kvar ramps.

Note that the inverters/power converters can be regulated according to an adjusted capability curve (explained in the Q-max derate section).

## 8.3 Breaker types

It is optional to use a PV/ESS breaker. Select the breaker type in the application configuration. The breaker (if present) can be configured to be one of three types:

### Continuous NE

This type of signal is most often used combined with a contactor. When using this type of signal, the ASC will only use the close breaker relays. The relay will be closed for closing of the contactor and will be opened for opening of the contactor. The open relay can be used for other purposes. Continuous NE is a normally energised signal.

### Pulse

This type of signal is most often used combined with circuit breaker. With the setting pulse, the ASC will use the close command and the open command relay. The close breaker relay will close for a short time for closing of the circuit breaker. The open breaker relay will close for a short time for opening of the breaker.

## Ext/ATS no control

The ASC can only read the status of the breaker through digital input signals. Breaker control is performed by an external source.

## 8.4 Alarm inhibit

To limit when the alarms are active, each alarm has configurable inhibit settings. The inhibits are only available in the USW.

Each alarm has a drop-down window where you can select which conditions have to be present to inhibit the alarm. You can select more than one inhibit. The alarm is inhibited as long as at least one of the selected inhibits is active.

### ASC Solar inhibits

Inhibit	Description
Inhibit 1	M-Logic outputs: The conditions are programmed in M-Logic.
Inhibit 2	
Inhibit 3	
PVB ON	The PV breaker is closed.
PVB OFF	The PV breaker is open.
Run status	The PV voltage and frequency is okay, and the timer in parameter 6160 has expired.
Not run status	The PV is off, or the timer in parameter 6160 has not expired.
PV voltage > 30 %	The PV voltage is above 30 % of the nominal voltage.
PV voltage < 30 %	The PV voltage is below 30 % of the nominal voltage.
MB ON	The mains breaker is closed (stand-alone application).
MB OFF	The mains breaker is open (stand-alone application).
Parallel	Both the PVB and MB are closed.
Not parallel	Either the PVB or MB can be closed, but not both.
Redundant controller	The controller is the redundant controller (option T1).

### ASC Battery inhibits

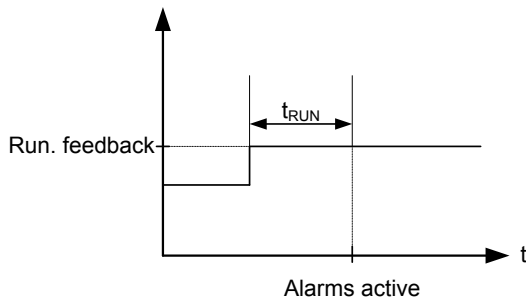
Inhibit	Description
Inhibit 1	M-Logic outputs: The conditions are programmed in M-Logic.
Inhibit 2	
Inhibit 3	
ESB ON	The ESS breaker is closed.
ESB OFF	The ESS breaker is open.
Run status	The ESS voltage and frequency is okay, and the timer in parameter 6160 has expired.
Not run status	The ESS is off, or the timer in parameter 6160 has not expired.
ESS voltage > 30 %	The ESS voltage is above 30 % of the nominal voltage.
ESS voltage < 30 %	The ESS voltage is below 30 % of the nominal voltage.
MB ON	The mains breaker is closed (stand-alone application).
MB OFF	The mains breaker is open (stand-alone application).
Parallel	Both the ESB and MB are closed.
Not parallel	Either the ESB or MB can be closed, but not both.
Redundant controller	The controller is the redundant controller (option T1).

**NOTE** Function inputs such as remote start or access lock are never inhibited. Only alarm inputs can be inhibited.

## 8.5 Run status (6160)

Alarms can be configured to activate when the running feedback is active and a time delay has expired.

The diagram shows that after the running feedback is activated, the run status delay expires. When the delay expires, alarms with *Run status* are activated.



**NOTE** The timer is ignored if digital running feedback is used.

## 8.6 Access lock

The purpose of access lock is to prevent operator configuration of the controller parameters and change the running modes. The input to be used for the access lock function is defined in the utility software (USW).

Access lock is typically activated from a key switch installed behind the door of the switchboard cabinet. As soon as access lock is activated, changes from the display cannot be made.

Access lock only locks the display and does not lock any AOP or digital input. AOP can be locked by using M-Logic. It is still possible to read all parameters, timers and the state of inputs in the service menu (9120).

It is possible to read alarms, but not any alarms when access lock is activated. Nothing can be changed from the display.

This function is ideal for a rental generator, or a generator placed in a critical power segment. The operator does not have the possibility to change anything. If there is an AOP-2, the operator can still change up to 8 different predefined things.

**NOTE** The stop push-button is not active in semi-auto mode when the access lock is activated. For safety reasons it is recommended to install an emergency stop switch.

**NOTE** AOP buttons are not locked when access lock is activated.

## 8.7 Command timers

Command timers allow the controller, for example, to start and stop the genset automatically at specific times each weekday or certain weekdays. If auto mode is activated, this function is available in island operation, load takeover, mains power export and fixed power operation. Up to four command timers can be used for start and stop for instance. The command timers are available in M-Logic and can be used for other purposes than starting and stopping the genset automatically. Each command timer can be set for the following time periods:

- Individual days (MO, TU, WE, TH, FR, SA, SU)
- MO, TU, WE, TH
- MO, TU, WE, TH, FR
- MO, TU, WE, TH, FR, SA, SU
- SA, SU

**NOTE** To start in AUTO mode, the *Auto start/stop* command can be programmed in M-Logic or in the input settings.

**NOTE** The time-dependent commands are flags that are raised when the command timer is in the active period.

## 8.8 Running output

**6160 Run status** can be configured to give a digital output when the PV/ESS is running.

The screenshot shows the 'Parameter "Run status" (Channel 6160)' window. It features a 'Timer' slider set to 5 seconds, with a range from 0 to 300. Below the timer are dropdown menus for 'Output A' (Terminal 5) and 'Output B' (Terminal 8), and a 'Password level' dropdown (customer). On the left, there are checkboxes for 'Enable', 'High Alarm' (checked), 'Inverse proportional', and 'Auto acknowledge', along with an 'Inhibits...' dropdown. The right side has a 'Commissioning' section with 'Actual value : 0' and 'Actual timer value' (0 sec to 5 sec). At the bottom are buttons for 'Write', 'OK', and 'Cancel'.

Select the correct relay numbers in output A and output B and enable the function. Change the relay function to limit in the I/O menu. Then the relay activates, but no alarm will appear.

The screenshot shows the 'Parameter "Relay 05" (Channel 5000)' window. It features a 'Set point' dropdown set to 'Limit relay'. Below it is a 'Timer' slider set to 5 seconds, with a range from 0 to 999.9. There are also dropdowns for 'Password level' (customer) and 'Inhibits...'. On the left, there are checkboxes for 'Enable', 'High Alarm' (checked), 'Inverse proportional', and 'Auto acknowledge'. The right side has a 'Commissioning' section with 'Actual value : 0' and 'Actual timer value' (0 sec to 5 sec). At the bottom are buttons for 'Write', 'OK', and 'Cancel'.

**NOTE** If the relay function is not changed to *Limit relay*, an alarm appears for every run status.

## 8.9 Not in auto

This function can be used for indication or to raise an alarm in case the system is not in auto. The functions is set up in menu 6540.

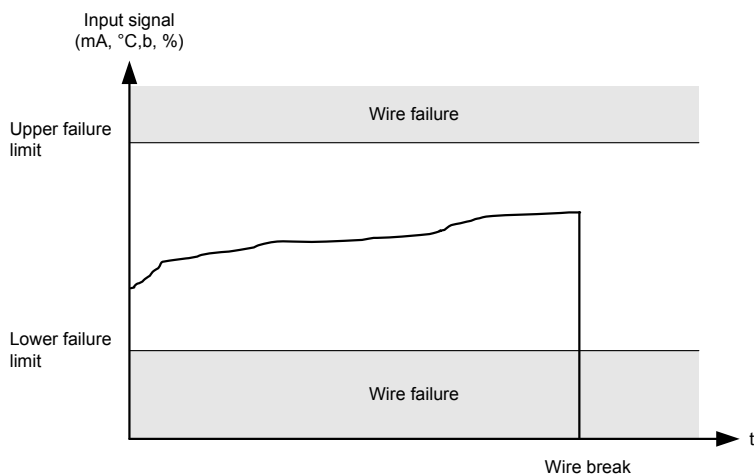
## 8.10 Wire fail detection

If it is necessary to supervise the sensors/wires connected to the multi-inputs and analogue inputs, then it is possible to enable the wire break function for each input. If the measured value on the input is outside the normal dynamic area of the input, it will be detected as if the wire has made a short circuit or a break. An alarm with a configurable fail class will be activated.

Input	Wire failure area	Normal range	Wire failure area
4-20 mA	< 3mA	4-20 mA	> 21 mA
0-40 V DC	$\leq 0$ V DC	-	N/A
RMI Oil, type 1	< 1.0 ohm	-	> 195.0 ohm
RMI Oil, type 2	< 1.0 ohm	-	> 195.0 ohm
RMI Temp, type 1	< 4.0 ohm	-	> 488.0 ohm
RMI Temp, type 2	< 4.0 ohm	-	> 488.0 ohm
RMI Temp, type 3	< 0.6 ohm	-	> 97.0 ohm
RMI Fuel, type 1	< 0.6 ohm	-	> 97.0 ohm
RMI Fuel, type 2	< 1.0 ohm	-	> 195.0 ohm
RMI configurable	< lowest resistance	-	> highest resistance
P100	< 82.3 ohm	-	> 194.1 ohm
P1000	< 823 ohm	-	> 1941 ohm
Level switch	Only active if the switch is open		

### Principle

The illustration below shows that when the wire of the input breaks, the measured value will drop to zero. Then the alarm will occur.



## 8.11 Digital input functions

The ASC has a number of digital inputs. You can add hardware options to increase the number of digital inputs.

Hardware	Digital inputs	Notes
Power supply PCB	5	2 not configurable if PVB/ESB is present
Option M4	7	1 not configurable
Option M12 I/O extension	13	

## Not configurable digital input functions

Function	Mode	Terminal	Input type	Details
PVB/ESB position OFF	Auto, Semi	26	Constant	The PVB/ESB is open.  The ASC uses this feedback to confirm that the breaker is open. The feedback is also used to detect a position failure (and activate an alarm).
PVB/ESB position ON	Auto, Semi	27	Constant	The PVB/ESB is closed.  The ASC uses this feedback to confirm that the breaker is closed. The feedback is also used to detect a position failure (and activate an alarm).
Emergency stop	Auto, Semi	118	Constant	The ASC immediately opens the PVB/ESB and stops the PV/ESS. Requires option M4.

## Configurable digital input functions

Function	Mode	Input type	Details
Access lock	Auto, Semi	Constant	Deactivates the display push-buttons. You can view measurements, alarms and the log.
Remote start	Semi	Pulse	Initiates the start sequence of the PV/ESS when semi or manual mode is selected.
Remote stop	Semi	Pulse	Initiates the stop sequence of the PV/ESS when semi or manual mode is selected.
Semi auto mode	Auto	Pulse	Changes the mode to semi-auto.
Auto mode	Semi	Pulse	Changes the mode to auto.
Remote PVB/ESB ON	Semi	Pulse	Initiates the PVB/ESB ON sequence (to close the breaker).
Remote PVB/ESB OFF	Semi	Pulse	Initiates the PVB/ESB OFF sequence (to open the breaker).
Remote Alarm Ack	Auto, Semi	Constant	Acknowledges all active alarms. The alarm LED on the display is still red, but it stops flashing.
Auto start/stop	Auto	Constant	The ASC starts the PV/ESS when this input is activated. The ASC stops the PV/ESS if the input is deactivated. The input can be used when the ASC is in island operation, fixed power, load takeover or mains power export, and the AUTO running mode is selected.
GB 1 to 16 on busbar	Auto, Semi	Constant	These inputs are activated when the generator breaker closes and the genset is connected to the busbar. The ASC needs this information for a stand-alone application.
Ext. Power control	Auto, Semi	Constant	When the input is activated, the ASC uses the 0 to 10 V DC signal as an external P set point.
Ext. Reactive Power control	Auto, Semi	Constant	When the input is activated, the ASC uses the 0 to 10 V DC signal as an external Q set point.
Ext. cosphi control	Auto, Semi	Constant	When the input is activated, the ASC uses the 0 to 10 V DC signal as an external cos phi set point.
RRCR input 1 to 4	Auto, Semi	Constant	The RRCR inputs provide the ASC with regulation set points. Use the <i>RRCR Input Reference</i> window in the USW to configure how the set points correspond to the RRCR input patterns.

**NOTE** The input functions are set up in the USW. See the USW help for more information.

## 8.12 Multi-inputs

The ASC unit has three multi-inputs which can be configured to be used as the following input types:

1. 4 to 20 mA
2. 0 to 40 V DC
3. Pt100
4. Pt1000
5. RMI oil
6. RMI water
7. RMI fuel
8. Digital

**NOTE** The function of the multi-inputs can only be configured in the PC utility software.

Two alarm levels are available for each input, the menu numbers of the alarm settings for each multi-input is controlled by the configured input type as seen in the following table.

Input type	Multi-input 102	Multi-input 105	Multi-input 108
4 to 20 mA	4120/4130	4250/4260	4380/4390
0 to 40 V DC	4140/4150	4270/4280	4400/4410
Pt100/Pt1000	4160/4170	4290/4300	4420/4430
RMI oil*	4180/4190	4310/4320	4440/4450
RMI water*	4200/4210	4330/4340	4460/4470
RMI fuel*	4220/4230	4350/4360	4480/4490
Digital**	3400	3410	3420

**NOTE** \* These RMI functions are not relevant to ASC-4. You can use them to configure customised resistance measurement inputs. If you need more information, see the **AGC-4 Mk II Designer's handbook**.

**NOTE** \*\* Only one alarm level is available for the digital input type.

### 8.12.1 4 to 20 mA

If one of the multi-inputs has been configured as 4 to 20 mA, the unit and range of the measured value corresponding to 4 to 20 mA can be changed in the PC utility software in order to get the correct reading in the display.

### 8.12.2 Scaling of 4 to 20 mA inputs

Scaling the analogue inputs ensures that the inputs are read with a resolution that fits the connected sensor. Follow the steps below when changing the scaling of the analogue inputs.

**NOTE** The setup of the multi-inputs and alarm parameters must be done in this order. If not, the alarm levels will be wrong.

1. Set up the multi-input for 4 to 20 mA. This is done in menu 10980-11000 for multi-input 102-108 and in menu 11120-11190 for option M15 or M16. Write to the controller, and reload the parameters.
2. Now the scaling parameters are available in menu 11010-11110.
3. Select the AUTO SCALE enable check box when setting up the inputs. As a result, the reading remains the same, but decimals are added. Deactivating AUTO SCALE makes the reading smaller by a factor of 10 for each decimal added.
4. You can then configure the alarm parameters for the multi-inputs.
5. A parameter file (usw file) should always be saved without AUTO SCALE enabled.

None	Prot	Sync	Reg	Dig	Ain	Out	Gen	Maina	Comm	Pin	Jump	USW	VDO 102	VDO 105	VDO
Drag a column header here to group by that column															
Category	Channel	A_Text	Address	Value											
Ain	4000	4-20mA 91.1	256	10											
Ain	4010	4-20mA 91.2	257	10											
Ain	4020	V, fal ana 91	264	N/A											
Ain	4030	4-20mA 93.1	250	10											
Ain	4040	4-20mA 93.2	259	10											
Ain	4050	V, fal ana 93	265	N/A											
Ain	4060	4-20mA 95.1	262	10											
Ain	4070	4-20mA 95.2	261	10											
Ain	4080	V, fal ana 95	266	N/A											
Ain	4090	4-20mA 97.1	262	10											
Ain	4100	4-20mA 97.2	263	10											
Ain	4110	V, fal ana 97	267	N/A											

### Setup with no decimals

0-5 [units] pressure transducer (4 to 20 mA)

Decimals = 0

Without use of decimals, the set point can only be adjusted in steps of one bar, which gives a very rough range of setting.

Analog 127	4mA
Analog 129	4mA
Analog 131	4mA
SETUP <u>V</u> 3	V2 V1 P01

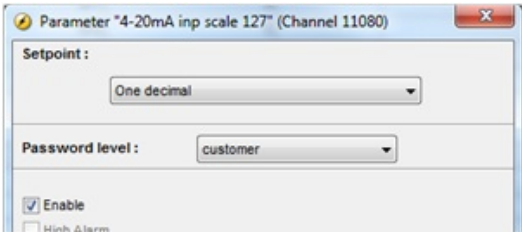
The display will show 0 to 5 [units] in the measuring range 4 to 20 mA.

### Setup with one decimal

0-5 [units] transducer (4 to 20 mA)

Decimals = 1

Auto scale = enable



Analog 127	4.0mA
Analog 129	4mA
Analog 131	4mA
SETUP <u>V</u> 3	V2 V1 P01

Decimals = 1, AUTO SCALE = enabled

Analog 127	0.4mA
Analog 129	4mA
Analog 131	4mA
SETUP <u>V</u> 3	V2 V1 P01

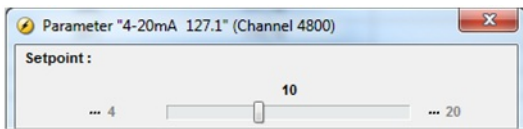
Decimals = 1, AUTO SCALE = disabled

**NOTE** If the number of decimals is changed without enabling the set point, 4 to 20 mA will be presented as 0.4 to 2.0 mA (0.0 to 0.5 [units]). In other words, *AUTO SCALE* decides where the decimal point is placed.

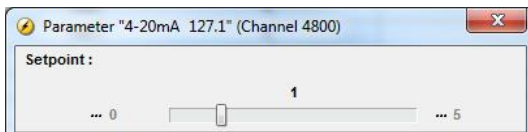
### Setting up the measuring range of the sensor

The measuring range of the multi-input is set up inside the actual alarm:



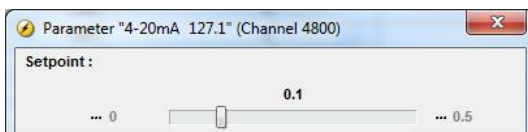


The three dots to the left of the figures is a button. Scale the input as required, for example 0 to 5 [units]:

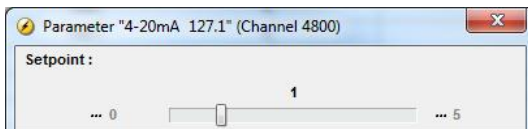


The display will then show 0 at 4 mA.

In order to get the alarm input to work again after changing the "decimal setting", it is necessary to make a readjustment of the alarm:



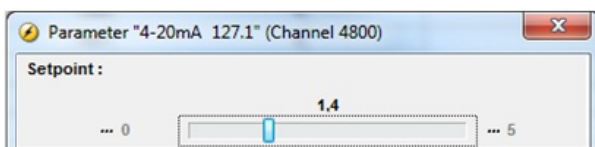
Change it to match the new selection of decimals.



Therefore, when selecting decimals, the selection of AUTO SCALE depends on whether the alarm inputs are already set up. If they are set up, it is a good idea to select AUTO SCALE. If they are not set up, it is voluntary if AUTO SCALE is selected.

## Reload parameters

It is necessary to upload the parameters from the device to the computer after changing the scale (no decimal/one decimal/two decimal) settings. This is in order to refresh the parameter list so the alarm settings present the correct value:



In the example shown above, the value can be adjusted with one decimal. If the parameters were not refreshed, it would still only be possible to adjust the set point without decimals.

## Save the parameter file

A parameter file (usw file) should always be saved without the AUTO SCALE enabled.

After having set up the 4 to 20 mA inputs (HW as well as alarms), the parameter file should be uploaded from the device to the PC and then saved. In this way, the AUTO SCALE is then deactivated (automatically cleared by the device), and the settings will not be modified again if the parameters are reloaded to the device.

**NOTE** If the file is saved with the AUTO SCALE enabled, then the minimum and maximum values of the alarm will be affected (multiplied by 10 or 100) at the next use of the parameter file (under certain conditions).

### 8.12.3 0 to 40 V DC

The 0 to 40 V DC input has primarily been designed to handle the battery asymmetry test.

### 8.12.4 Pt100/1000

This input type can be used for heat sensor, for example cooling water temp. The unit of the measured value can be changed from Celsius to Fahrenheit in the PC utility software in order to get the desired reading in the display.

### 8.12.5 Digital

If the multi-inputs are configured as *Digital*, they become available as a configurable input.

## 8.13 Input function selection

Digital input alarms can be configured with a possibility to select when the alarms are to be activated. The possible selections of the input function are normally open or normally closed.

The drawing below illustrates a digital input used as an alarm input.

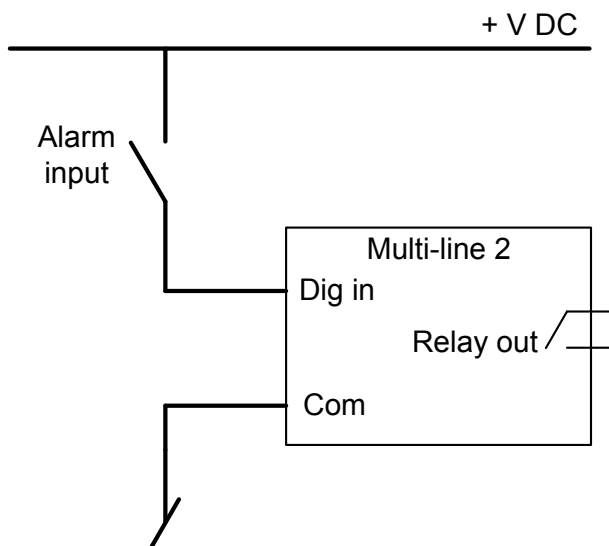
1. Digital input alarm configured to NC, normally closed

**This will initiate an alarm when the signal on the digital input disappears.**

2. Digital input alarm configured to NO, normally open

**This will initiate an alarm when the signal on the digital input appears.**

**NOTE** The relay output function can be selected to be ND (Normally Deenergised), NE (Normally Energised), Limit or Horn.



## 8.14 Language selection

The unit has the possibility to display different languages. It is delivered with one master language which is English. This is the default language, and it cannot be changed. In addition to the master language, 4 different languages can be configured. This is done via the PC utility software. Four languages can be obtained in the ASC. However, 11 languages can be contained in the USW project file.

The languages are selected in the system setup **menu 6080**. The language can be changed when connected to the PC utility software. It is not possible to make language configuration from the display, but the already configured languages can be selected.

## 8.15 Display unit status texts

The status texts are shown in the top line of the display unit. The status texts are based on the ASC operating conditions, and are generally self-explanatory. The most important display unit status texts are listed below.

Status text	Description
ACCESS LOCK	The access lock input is activated, and the operator presses one of the blocked keys.
AMF ACTIVE	ASC running in auto mode during a mains failure.
AMF AUTO	ASC in auto mode and ready to respond to a mains failure.
AMF SEMI	ASC in semi-automatic mode and waiting for operator input.
BLOCKED FOR START	Inverter/power converter stopped and active alarm(s) on the PV/ESS.
BROADCAST ABORTED	The application broadcast was terminated.
BROADCAST COMPLETED	Successful broadcast of an application.
BROADCASTING APPL. #	The ASC is broadcasting an application through the CAN line to the other ASCs and AGCs in the power management system.
Curt. ###% act: #	ASC Solar: The PV production is curtailed.
DELOADING BTB ##	The power management system is adjusting the power set points in the system to download BTB ##.
DELOADING MB ##	The power management system is adjusting the power set points in the system to download MB ##.
DELOADING TB ##	The power management system is adjusting the power set points in the system to download TB ##.
ESS NOT READY	ASC Battery: The ESS is not ready to start.
FIXED POWER ACTIVE	ASC running in auto mode and supplying fixed power.
FIXED POWER AUTO	ASC in auto mode and ready to supply fixed power.
FIXED POWER SEMI	ASC in semi-automatic mode and waiting for operator input.
ISLAND ACTIVE	ASC running in auto mode and supplying power while not connected to a mains supply.
ISLAND AUTO	ASC in auto mode and ready to supply island power.
ISLAND SEMI	ASC in semi-automatic mode and waiting for operator input.
LOAD TAKEOVER AUTO	ASC in auto mode and ready to take over load.
LOAD TAKEOVER SEMI	ASC in semi-automatic mode and waiting for operator input.
LTO ACTIVE	ASC running in auto mode and taking over the load.
MAINS P EXPORT AUTO	ASC in auto mode and ready to export power to the mains.
MAINS P EXPORT SEMI	ASC in semi-automatic mode and waiting for operator input.
MB EXTERN. TRIPPED	Some external equipment (not the ASC) tripped the MB. An external trip is logged in the event log.
MPE ACTIVE	ASC running in auto mode and exporting power to the mains.
PEAK SHAVING ACTIVE	ASC running in auto mode and doing peak shaving.
PEAK SHAVING AUTO	ASC in auto mode and ready to do peak shaving.
PEAK SHAVING SEMI	ASC in semi-automatic mode and waiting for operator input.
PREPARING ETHERNET	Preparing Ethernet connection.
PROGRAMMING LANGUAGE	The language file is downloaded from the USW.
PROGRAMMING M-LOGIC	Downloading M-Logic to the ASC.

Status text	Description
PVB EXTERN. TRIPPED	ASC Solar: Some external equipment (not the ASC) tripped the PVB. An external trip is logged in the event log.
PV NOT READY	ASC Solar: The PV is not ready to start.
PV PREPARE #####s	ASC Solar: The PV is preparing to start in ##### seconds.
PV STARTING UP	ASC Solar: The PV is starting up.
RAMP TO #####kW	The power is ramping in steps. The next step that will be reached after the timer has expired is displayed.
READY AMF AUTO	Inverter/power converter stopped in Auto.
READY FIXED P AUTO	Inverter/power converter stopped in Auto.
READY ISLAND AUTO	Inverter/power converter stopped in Auto.
READY LTO AUTO	Inverter/power converter stopped in Auto.
READY MPE AUTO	Inverter/power converter stopped in Auto.
READY PEAK SHAV AUTO	Inverter/power converter stopped in Auto.
RECEIVE COMPLETED	The application was received successfully.
RECEIVE ERROR	The application was not received correctly.
RECEIVING APPL. #	The ASC is receiving an application.
SUNSPEC GOT ID: ###	The IDs of the detected Sunspec Modbus model(s) are shown.
SUNSPEC IDENTIFYING	The ASC is trying to detect the Sunspec Modbus slave.
SUNSPEC INITIALIZED	There is ASC communication to the Sunspec Modbus slave(s).
SUNSPEC N/A RETRY: ##	The Modbus slave is not a Sunspec Modbus slave. The ASC will try again in ## seconds.
SUNSPEC TIMED OUT	There is no Sunspec Modbus slave.
TOO SLOW 00<-----	Frequency too low during synchronising.
-----> 00 TOO FAST	Frequency too high during synchronising.

## 8.16 Internal battery

### 8.16.1 Memory backup

When changing the controller's internal battery, all controller options and settings are lost. The memory backup feature allows the user to back up the controller options and settings before the internal battery runs out. After replacing the battery, the controller options and settings can be restored.

DEIF recommends that a backup is made when the commissioning is tested and done, as well as after any firmware update. The following settings are stored in the backup:

Type	Stored
Identifiers	X
Counters	X
Views configuration	X
Inputs configuration	X
Outputs configuration	X
Translations	
M-Logic configuration	X

Type	Stored
AOP-1 configuration	X
AOP-2 configuration	X
Application configuration	X
Parameters	X
Modbus configuration	X
Permissions	X
Logs	

The backup is found in parameter **9230 Memory backup** with the jump menu. In this parameter, you are able to back up or restore.

**NOTE** If new firmware is flashed to the controller, the backup is erased. If the controller battery fails and there is no backup, the controller options are lost, and you will need to contact DEIF support to restore the options.

## NOTICE

**The controller reboots after a restore.**

Make sure that the system will not be disturbed.



### More information

See **Internal battery change** in **ML-2 Application notes Backup tool 4189340851** for information on changing the controller internal battery. Note that the back up and restore functions in jump menu 9230 replaced the backup tool software.

## 8.16.2 Internal battery alarm

If the internal battery is dismantled during operation, a failure will appear on the display.

## 8.17 Service menu

The purpose of the service menu is to give information about the operating conditions. Enter the service menu using the **JUMP** push-button (9120 Service menu).

Use the service menu for easy troubleshooting using the event log. The display examples are for a ASC-4 Solar controller.

### Entry window

The entry window shows the selections in the service menu.

PV	400	400	400V
9120 Service menu			
Timers			
TIME	IN	OUT	MISC

Available selections:

### Alarm

Shows the alarm timer and the remaining time. The indicated remaining time is minimum remaining time. The timer will count downwards when the set point has been exceeded.

BB	400	400	400V
1000 -P>			
Remaining time		10.0s	
<u>UP</u>	DOWN		

### IN (digital input)

Shows the status of the digital inputs.

BB	400	400	400V
Digital input 54			
Input =		0	
<u>UP</u>	DOWN		

### OUT (digital output)

Shows the status of the digital outputs.

BB	400	400	400V
Relay 5			
Output A		0	
<u>UP</u>	DOWN		

### MISC (miscellaneous)

Shows miscellaneous messages.

BB	400	400	400V
M-Logic enabled			
Various =		0	
<u>UP</u>	DOWN		

## 8.18 Event log

### Logs

The logging of data is divided in three different groups:

- Event log containing 500 loggings.
- Alarm log containing 500 loggings.

The logs can be viewed in the display or in the PC utility software. When the individual logs are full, each new event will overwrite the oldest event following the "first in - first out" principle.

### Display

In the display, it looks like this when the "LOG" push-button is pressed:

BB	400	400	400V
LOG Setup			
Event log			
<u>Event</u>	Alarm	Batt.	

Now it is possible to select one of the three logs.

If the "Event" is selected, the log could look like this:

BB	400	400	400V
PV breaker OFF			
21-01-08		18:54:28.8	
INFO	<u>FIRST</u>	LAST	

The specific alarm or event is shown in the second line. In the example above, the fuel level alarm has occurred. The third line shows the time stamp.

If the cursor is moved to "INFO", if a value is available, the value can be read when pressing "SEL":

BB	400	400	400V
Mains breaker ON			
MENU NOT AVAILABLE			
<u>INFO</u>	FIRST	LAST	

The first event in the list will be displayed if the cursor is placed below "FIRST" and "SEL" is pressed.

The last event in the list will be displayed if the cursor is placed below "LAST" and "SEL" is pressed.

The keyUP and keyDOWN push-buttons are used for navigating in the list.

## 8.19 Counters

The ASC includes a number of counters. Some of these can be adjusted, for example, if the ASC is installed on an existing genset or a new circuit breaker is installed. The ASC counters can be adjusted in the USW.

### 8.19.1 USW counters

You can view and adjust a number of counters using the USW. Click the **Σ** icon to open the counters window.

## ASC Solar counters example

Counters

OperationsRunning hoursEnergyReEnergyCurtailmentGensetsMainsPulse

Mains breaker

0

PV breaker

0

## ASC Battery counters example

Counters

OperationsRunning hoursEnergyReEnergyGensetsMainsPulseBattery

Export total

0

kWh

Export year

0

kWh

Export month

0

kWh

Export week

0

kWh

Export day

0

kWh

Import total

0

kWh

Import year

0

kWh

Import month

0

kWh

Import week

0

kWh

Import day

0

kWh



## 8.19.2 Pulse input counters

Two configurable digital inputs can be used as counter inputs. For example, the two counters could be used for fuel consumption or heat flow. The two digital inputs can ONLY be configured for pulse inputs using M-Logic. An example is shown below.

The screenshot shows the M-Logic configuration window for 'Pulse counter 1'. It features a logic rule editor with three events: Event A (NOT, Dig. Input No23: Inputs), Event B (NOT, Not used), and Event C (NOT, Not used). The operators are all set to OR. The rule is enabled. The output is set to Pulse counter 1: Common, and the delay is set to 0 seconds.

### Pulse input counter parameters

Parameter	Name	Range	Default	Details
6851	Pulse counter 1	0 to 1000	1	<p>Sets how many units or pulses are required to increase the pulse counter by one.</p> <p>If 6852 is set to <i>Unit/pulse</i>, then this parameter checks the amount of units in one pulse.</p> <p>If 6852 is set to <i>Pulse/unit</i>, then this parameter checks the amount of pulses in one unit.</p>
6852	Pulse counter 1	Unit/pulse Pulse/unit	Unit/pulse	Sets the type of scaling performed for <i>Pulse counter 1</i> .
6853	Pulse counter 1	No decimals One decimal Two decimals Three decimal	No decimals	Adjusts the number of decimals seen in the display unit.
6861	Pulse counter 2	0 to 1000	1	<p>Sets how many units or pulses are required to increase the pulse counter by one.</p> <p>If 6862 is set to <i>Unit/pulse</i>, then this parameter checks the amount of units in one pulse.</p> <p>If 6862 is set to <i>Pulse/unit</i>, then this parameter checks the amount of pulses in one unit.</p>
6862	Pulse counter 2	Unit/pulse Pulse/unit	Unit/pulse	Sets the type of scaling performed for <i>Pulse counter 2</i> .
6863	Pulse counter 2	No decimals One decimal Two decimals Three decimal	No decimals	Adjusts the number of decimals seen in the display unit.

## 8.19.3 kWh/kvarh counters

The controller has two transistor outputs, each representing a value for the power production. The outputs are pulse outputs, and the pulse length for each of the activations is 1 second.

Term. number	Output
20	kWh
21	kvarh
22	Common terminal

The number of pulses depends on the actual adjusted setting of the nominal power:

Generator power	Value	Number of pulses (kWh)	Number of pulses (kvarh)
P <sub>NOM</sub>	<100 kW	1 pulse/kWh	1 pulse/kvarh
P <sub>NOM</sub>	100 to 1000 kW	1 pulse/10 kWh	1 pulse/10 kvarh
P <sub>NOM</sub>	>1000 kW	1 pulse/100 kWh	1 pulse/100 kvarh

**NOTE** The kWh measurement is shown in the display as well, but the kvarh measurement is only available through the transistor output.

**NOTE** Be careful - the maximum burden for the transistor outputs is 10 mA.

## 8.20 Parameter ID

Parameter 11200 can be used to identify which parameter file is used in the controller.

The screenshot shows a 'Setpoint' dialog box for 'Parameter Id'. It has a 'Password level' dropdown set to 'customer'. Below this are four unchecked checkboxes: 'Enable', 'High Alarm', 'Inverse proportional', and 'Auto acknowledge'. There is also an 'Inhibits...' dropdown menu. At the bottom are 'Write', 'OK', and 'Cancel' buttons.

The screenshot shows a 'Parameter text for "Parameter ..."' dialog box. It contains a text input field with 'Parameter Id' entered. Below the field are 'OK' and 'Cancel' buttons.

## 8.21 M-Logic

M-Logic is a simple tool based on logic events. One or more input conditions are defined, and at the activation of those inputs, the defined output will occur. A variety of inputs can be selected, such as digital inputs, alarm conditions and running conditions. A variety of outputs can also be selected, such as relay outputs and change of running modes.

M-Logic is included in the controller by default. It does not require any options. However, selecting additional options (for example, option M12, which offers additional digital inputs and outputs) can increase the functionality.

M-Logic is not a PLC, but can function as a PLC if only very simple commands are needed.

**NOTE** M-Logic is part of the PC utility software. It can only be configured using the PC utility software (and not via the display).

**NOTE** See the *Help* function in the PC utility software for a full description of M-Logic.

### 8.21.1 M-Logic events

You can see the events on the M-Logic page in the USW.

Event group	Description
Alarms	All ASC alarms and inputs are available as events.
Limits	These M-Logic events are activated when certain limits are reached. Limits can be used in alarm configurations to stop the alarm announcements in the display.
Events	The states in the ASC are available as events (for example, breaker open/close, the mode, the parameter selection).
Cmd Timers	Command timers. Use parameters to define the start and stop. These functions can then be used to activate commands.
CAN Input	16 CAN input active are available as events.
DG power meter inputs	16 power meters with 4 inputs each.
Mains power meter inputs	ASC Solar: 16 power meters with 4 inputs each. ASC Battery: 1 power meter with 4 inputs.
PV power meter inputs	ASC Solar: 16 power meters with 4 inputs each.
Redundancy	See Option T1.
Display	The primary display selection.
Logic	TRUE and FALSE.
Inputs	The ASC digital inputs.
Modes	Semi-auto mode and auto mode.
Relays	The ASC relays.
Virtual events	32 virtual events.
Fail class	Warning and shutdown.
Power management	The states for all the AGC controllers in the energy management system.

## 8.21.2 M-Logic outputs

You can see the outputs on the M-Logic page in the USW.

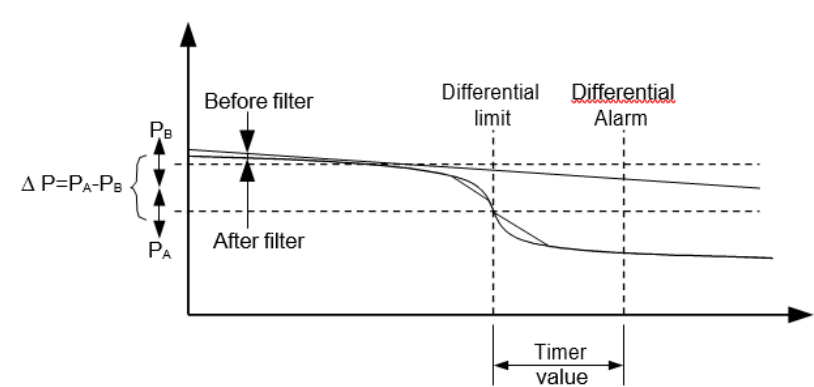
Output group	Description
Redundancy	See Option T1.
Command	A variety of functions, including changing mode, breaker open and close, start, stop, and change parameters.
Virtual events	Activate up to 32 virtual events.
Relays	Activate the controller relays.
DG Ena/Dis	Enable and disable gensets.
Inhibits	Activate inhibits.
CAN Cmd	Activate CAN commands.
Display	Set primary display, and activate display views.
GB feedbacks	Activate GB feedbacks for the 16 gensets.
MB feedbacks	Activate MB feedback.
Battery	<p>This category is only available on ASC Battery.</p> <ul style="list-style-type: none"> <li>• Set and reset power and energy functions</li> <li>• Set AC or DC coupling</li> <li>• Select state of charge settings</li> <li>• Set mode (power/energy source)</li> <li>• Request ESS to sync or open MB</li> </ul>

Output group	Description
	<ul style="list-style-type: none"> <li>Enable/Disable spinning reserve</li> </ul>

## 8.22 Differential measurement

With the differential measurement function, it is possible to compare two analogue inputs and trigger on the difference between the two values.

If the differential function is for example air filter check, the timer will be activated if the set point between PA (analogue A) and PB (analogue B) is exceeded. If the differential value drops below the set point value before the timer runs out, then the timer will be stopped and reset.



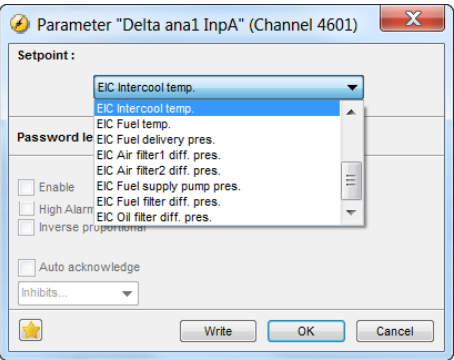
Six different differential measurements between two analogue input values can be configured.

Differential measurements between two sensors can be configured in menus 4600-4606 and 4670-4676. As an example, the figure below shows the two parameters for input selection for differential measurement 1.

Ain	4601	Delta ana1 InpA	1482	4	
Ain	4602	Delta ana1 InpB	1483	4	

Inputs are selected from the input list as shown below, available inputs are:

- Multi-inputs
- Analogue input (M15.X)



The relevant alarm set point is chosen in parameters 4610-4660 and 4680-4730. Each alarm can be configured in two alarm levels for each differential measurement between analogue input A and input B.

## 9. Remote monitoring

### 9.1 Monitoring solutions

There are different possibilities for achieving a remote monitoring solution. If it is intended to use an existing system, it is possible by using the Ethernet TCP/IP connection (option N) of the DEIF ASC. Then all data contained in the Modbus protocol can be polled from the device. The ASC will act as a slave device in the system, and it can be used in for instance HMI or SCADA systems.

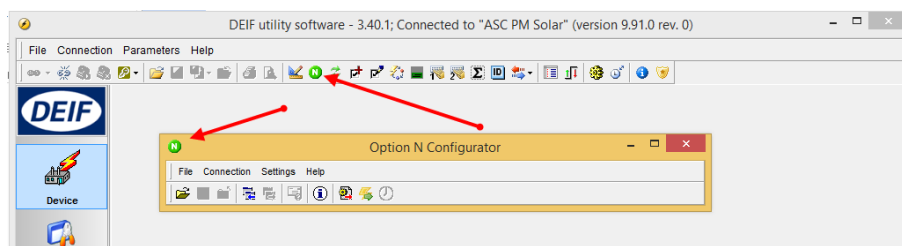
Another solution is to be installing a gateway giving access to a cloud-based database. This will give a front portal that can be accessed. This will show live data and log data to a server depending on the solution. DEIF offers a ready-made solution for this purpose.

Another way to use gateway device as mentioned is to have it work as an actual remote gateway. In this way, the DEIF PC utility software can be accessed with all the control and monitoring functions needed (control can be switched off/made user level-dependent).

### 9.2 DEIF Modbus connection

The Ethernet connection is used for the remote or local monitoring. This is because the Modbus RTU RS-485 is used for the control of the inverters.

In order to set up IP, SM and GW, use the Ethernet configuraton tool in the DEIF PC utility software.



### 9.3 Slave device, using Ethernet TCP/IP

Using the controller as an Ethernet TCP/IP slave device you can read all necessary statuses, measurements and calculations of the ASC and readings from the inverters. Option N must be installed on the controller to use the controller as a Modbus TCP/IP slave device.



#### More information

See the **ASC-4 Modbus slave tables** and the **ASC-4 Modbus slave and Modbus master** description of options for ASC-4 Modbus slave addresses.



#### More information

See the **AGC-4 Mk II Modbus tables** and **Option H2 and H9 Modbus communication AGC-4 Mk II** for AGC-4 Mk II Modbus addresses.



#### More information

See the **AGC-4 Modbus tables** and **Option H2 and H9 Modbus communication AGC-4** for AGC-4 Modbus addresses.

### 9.4 DEIF remote monitoring

The DEIF remote monitoring system is a hybrid monitoring system where values, alarms and logs will be seen from either the DEIF ASC and the inverters (maximum 42) or just the DEIF ASC. This means that it is a monitoring system that gives a combination of genset values, inverter values and associated plant sensor values. The latter could be weather sensors or POA and BOM sensors.

## 9.5 Genset values

Typically, some values will be available from the gensets (depending on the selected solution (integrated or add-on)).

- Power kw
- Reactive power kvar
- Oil pressure
- Coolant temperature
- Fuel level
- Are any (shutdown) alarms present

If the add-on solution is used, please note that the ASC only recognises the power (P and Q) and breaker status. Values from other sensors must be hardwired into the ASC in order to be shown.

If the integrated solution is used, please note that the ASC recognises several values besides the power of the gensets. So more possibilities exist when using this solution (where DEIF AGCs are installed on the gensets).

## 9.6 Inverter values

The ASC-4 controller includes a Modbus master that can access various values from the supported inverters. The available values depend on the inverter. For compatible inverters, see **DEIF hybrid controller compatibility**. The **ASC-4 Modbus master tables** show which values are supported for each PV protocol.

Available data from the inverters can be read from the ASC Modbus slave using the TCP/IP port. For details, see Modbus addresses 47000 to 47069 in *Input register (04)* in the **ASC-4 Modbus slave tables**.