DESIGNER'S HANDBOOK

ASC-4 Solar

Automatic Sustainable Controller

4189341330A

4. Single-controller applications

5. Energy management systems

6. Solar controller functions

1. Introduction

1.1 About

The ASC-4 Solar controller can be used as a single controller to add PV power to an existing site, or with other DEIF controllers in a power/energy management system. The ASC-4 Solar controller controls and protects a photovoltaic (PV) system, with up to 32 inverters per controller.

In a power/energy management system (PMS), the controller is designed for seamless integration of PV power with other power sources. Multiple ASC-4 Solar controllers can be used in each PMS. The PMS makes sure that spinning reserve requirements are met, and responds quickly to load and weather changes. To save fuel, the PMS maximises PV penetration, while making sure that the gensets meet their minimum load requirements.

The controller has built-in AC measurements. There are two sets of voltage measurements (three phases, and (optional) the neutral phase), and one set of current measurements (three phases).

Operators can easily control the system from the display unit. Alternatively, use the communication options to connect to an HMI/SCADA system.

1.1.1 Key features

	Single solar controller	Power management systems
Applications	Brownfield	Greenfield
Solar integration in hybrid systems (including microgrids)	•	•
Communicates with PV systems over Modbus • Monitor and troubleshoot the Modbus communication from the ASC-4 display unit • SunSpec support • Non-SunSpec support (see compatibility list)	•	•
Control of PV breaker (optional)	•	•
Using ASC-4 Solar with gensets		
Connect to gensets for PV-diesel	Up to 16 gensets	Up to 32 gensets (with AGC-4 Mk II/AGC 150)
Power meter interfacing	•	Not required
Minimum genset load constraint	•	•
Load-dependent genset start/stop	By digital output (useful for rental)	By PMS
Easy to use		
Simple graphical configuration with the free PC tool	•	•
Highly customisable with user-friendly M-Logic tool	•	•
Effective commissioning with DEIF emulation (use and verify the functions of the real system for design, production and testing)	•	•

	Single solar controller	Power management systems
Optimal operation		
Define and change the priorities of connected power sources	-	●
Uptime guaranteed through spinning reserve	-	●
Maximised sustainable power production	*	●

NOTE * The single solar controller aims for maximum sustainable power production. However, power management systems can better maximise sustainable power production.

Scalable and flexible

You can easily add controllers to an application, rearrange applications, and move controllers from single controller applications to PMS (or the other way around).

Ideal for self-consumption applications

While in grid parallel mode, the ASC-4 Solar is capable of feeding surplus PV energy to the grid and generate profit in accordance with grid operator feed-in tariffs. Alternatively, the ASC-4 Solar can regulate the PV production to match the self-consumption, thereby preventing any feed-in of PV power to the grid if prohibited by grid operator regulations.

Genset load management

In any operation mode, the ASC-4 Solar automatically maximises the sustainable power penetration, depending on the total load demand, without compromising the minimum genset load requirement.

This secures a minimum genset load, to reduce the risk of reverse power, glazing (cylinder liner polishing), and impure combustion and exhaust problems.

Spinning reserve

The ASC-4 Solar offers spinning reserve support as a percentage of the produced power, as part of an existing superior system (for instance an existing PLC system) or using short-term weather forecasting.

Weather (optional)

- Forecast system interfacing
- Meteorological data representation

Hardware

DEIF-developed platform, manufactured in Denmark. Flexible configuration.

1.1.2 Options

Required for solar applications

Option	Type	Function
H2.2	Hardware	Modbus communication to inverters. Note that H2.2 is standard for ASC-4 Solar.

Required for power meter communication

Option	Type	Function
H2.8	Hardware	Modbus communication to power meter(s).

Required for power management

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

Required for TCP/IP communication

Option	Type	Function
N	Hardware	Modbus TCP/IP.

More information
See the **Data sheet** for an overview of all the available options.

1.1.3 Terms and abbreviations

Term	Abbreviation	Explanation
Automatic Sustainable Controller	ASC-4 Battery ASC 150 Storage	DEIF's controller to integrate an energy storage system in an application with other power sources.
	ASC-4 Solar	DEIF's controller to integrate photovoltaic 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. The BOM affects the PV panel efficiency and output.
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).
Curtailment		The power from the PV system is reduced, so that it produces less power than expected.
Energy management	EM	The ASC and AGC-4 Mk II/AGC-4 controllers work together to follow the energy management rules. They work together to run at the configured set point. In this way, the PV, ESS, mains connection(s), and/or genset(s) run optimally.
Energy management system	EMS	The ASC controllers work with each other, as well as with AGC Genset and Mains controllers. The ASC Battery controllers charge and discharge according to the energy management rules. The AGC Genset controllers start, stop and run at the load required by energy management. The AGC Mains controllers connect and disconnect the mains as required. Together, the controllers form an energy management system. This can also be called an integrated system.
Frequency response	FR	Some inverters (the primary regulator) respond immediately to a frequency change.
Global horizontal irradiation	GHI	The irradiation from the sky, as measured on the horizontal.
Grid		National or local electricity grid. Also known as mains.
Grid-tied		The PV system is connected to grid/mains power.
Inverter		Equipment that changes direct current to alternating current.
Load-dependent start or stop	LDSS	Controller settings that use the system load to determine when to start and stop gensets.

Term	Abbreviation	Explanation
Mains breaker	MB	The breaker between the PV 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. AGC 150 controllers can also be used in these energy management systems.
Off-grid		The PV 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 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, a mains connection, another busbar section, or a genset.
Spinning reserve		Partially loaded and synchronised power sources that can quickly respond to load changes.
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.

1.2 About the Designer's handbook

1.2.1 General purpose

This Designer's handbook describes the controller and its applications. It includes function descriptions, the display unit and menu structure, and parameters.

CAUTION

Lack of knowledge can be dangerous

Read this document before starting to work with the controller and the equipment that it controls. 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 4.24.

1.3 Warnings and safety

1.3.1 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.

1.3.2 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.

1.3.3 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.

1.3.4 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.

1.3.5 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.

1.3.6 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.

1.4 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.

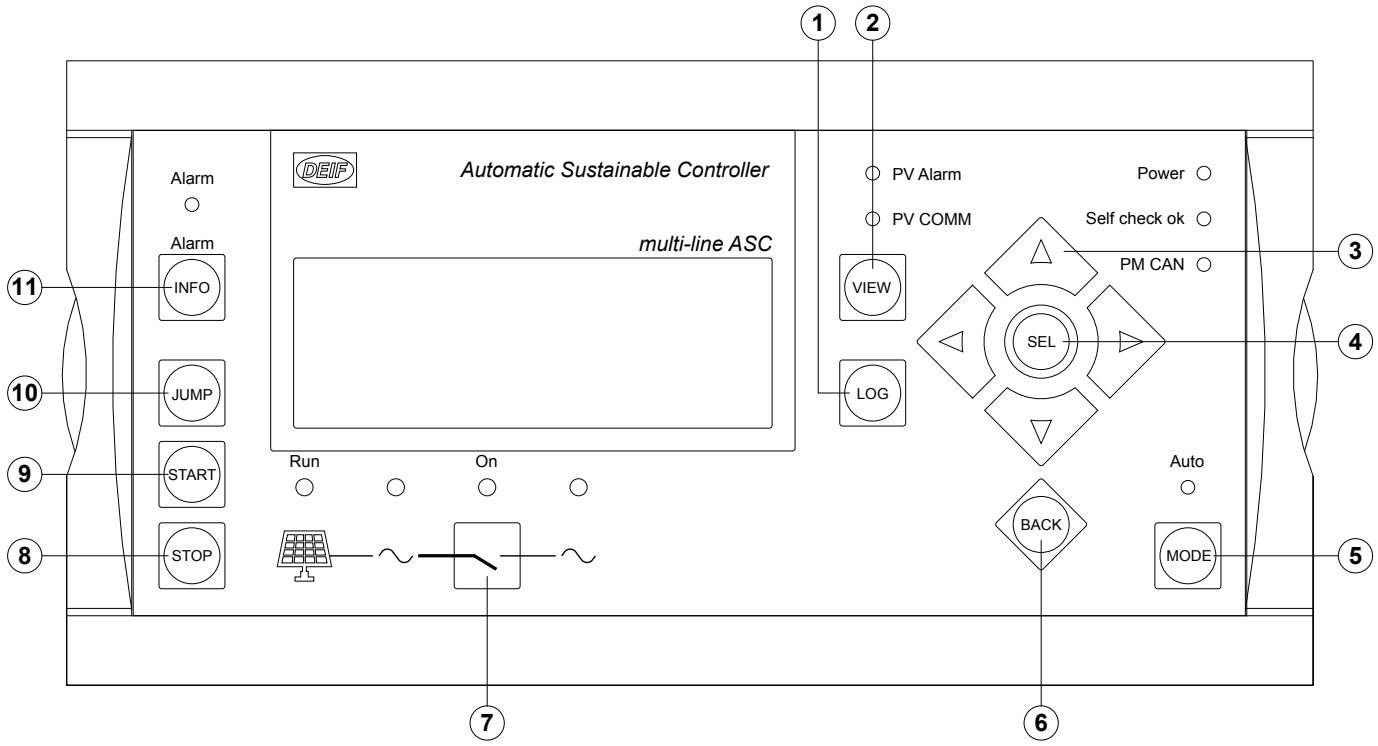
2. Display unit and menu structure

2.1 Display unit (DU-2)

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

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

2.1.1 Button functions

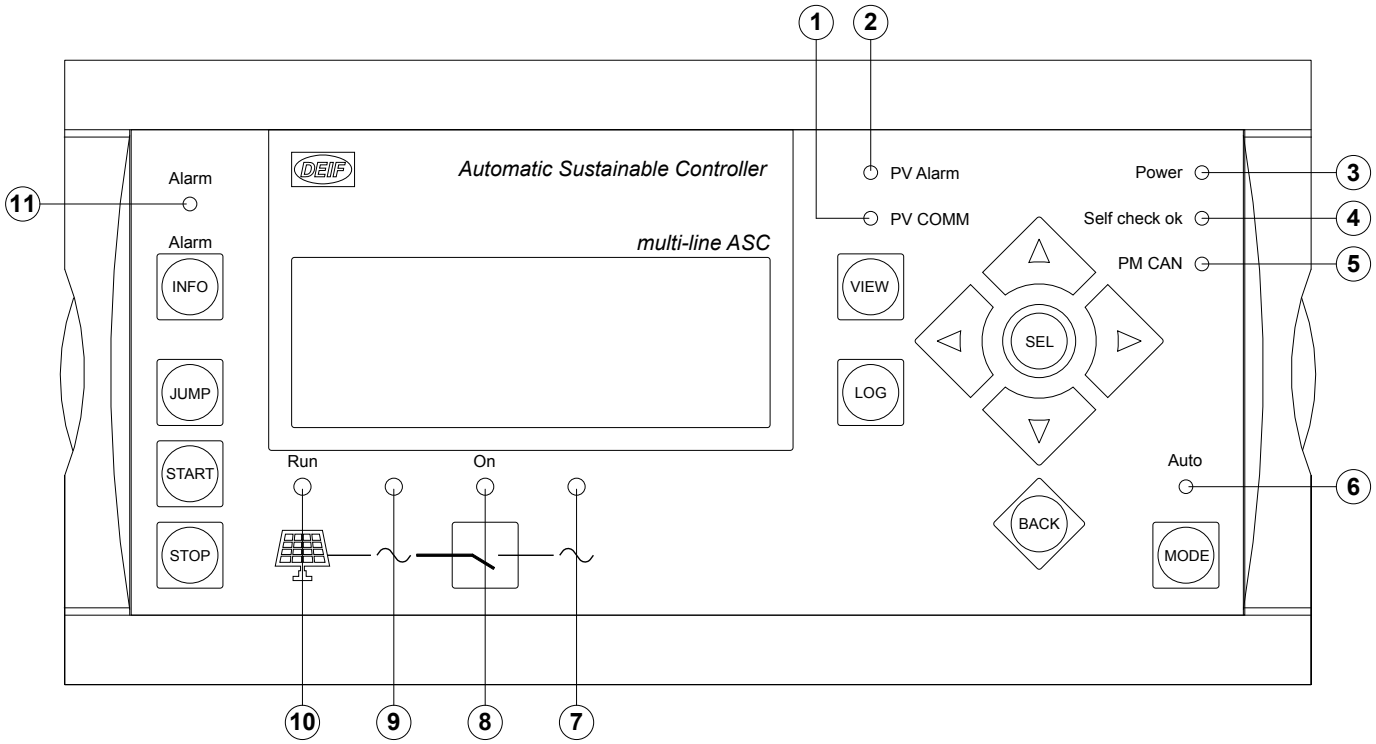


Button	Name	Notes
1	LOG	Displays the LOG SETUP window where you can choose between the Event and Alarm logs. The logs are not deleted when the auxiliary supply is switched off.
2	VIEW	Shifts the first display line in the setup menus. No function in the View screen (V1-V2-V3). When more than one display is connected, push for two seconds to change the display to the master display.
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	Go one step backwards in the menu (to previous display or to the entry window).
7	PVB On/Off	Breaker is open: Push to start the close breaker sequence (if SEMI mode is selected). Breaker is closed: Push to start the open breaker sequence (if SEMI mode is selected).
8	STOP	Stops the PV plant (if SEMI mode is selected).
9	START	Starts the PV plant (if SEMI mode is selected).
10	JUMP	Enter a menu number to select and display any setting without having to navigate through the menus.

Button	Name	Notes
		See **Display unit and menu structure > Menu structure** for more information.
11	INFO	Changes the lower three display lines to show the alarm list. To acknowledge all alarms, push the button for two seconds.

2.1.2 LED functions

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



LED	Name	Notes
1	PV COMM	Red (flashing): Communication with the inverter is faulty. Off: There is no communication with the inverter.
2	PV Alarm	Red (flashing): Alarms are present on the inverter. Go to the inverter to see which alarms are present. Off: There are no inverter alarms.
3	Power	Green: The power supply is on.
4	Self check OK	Green: The ASC is OK (microprocessor supervision).
5	PM CAN	Green: The power management CAN bus is working without faults. Yellow: Power management is not selected. Red: There is a fault on the power management CAN bus.
6	Controller mode	Green: AUTO mode is selected. 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 breaker is closed. Yellow (flashing): PV breaker load time has not expired. Off: PV breaker is open.
9	Source busbar status	Green: PV voltage and frequency is OK.

LED	Name	Notes
		Off: There is no PV voltage.
10	Source status	Green: PV inverter is running. Off: PV inverter 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.

2.2 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 pushes one of the blocked keys.
BLOCKED FOR START	Inverter stopped and active alarm(s) on the PV.
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.
CLOSE DELAY: ###.#s	The breaker can close after the delay.
Curt. ###% act:#	The PV production is curtailed.
DELOADING BTB ##	The power management system is adjusting the power set points in the system to deload BTB ##.
DELOADING MB ##	The power management system is adjusting the power set points in the system to deload MB ##.
DELOADING TB ##	The power management system is adjusting the power set points in the system to deload TB ##.
DEVICE TYPE UNKNOWN	The controller does not recognise a device.
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.
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	Some external equipment (not the ASC) tripped the PVB. An external trip is logged in the event log.
PV NOT READY	The PV is not ready to start.
PV PREPARE ####s	The PV is preparing to start in #### seconds.
PV STARTING UP	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 FIXED P AUTO	Inverter stopped in Auto.
READY ISLAND AUTO	Inverter stopped in Auto.
READY MPE AUTO	Inverter stopped in Auto.
READY PEAK SHAV AUTO	Inverter 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.
REDUNDANT CONTROLLER	The display unit is connected to the redundant controller.
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 server.
SUNSPEC INITIALIZED	There is ASC communication to the Sunspec Modbus server(s).
SUNSPEC N/A RETRY: ##	The Modbus server is not a Sunspec Modbus server. The ASC will try again in ## seconds.
SUNSPEC TIMED OUT	There is no Sunspec Modbus server.
TOO SLOW 00<----------	Frequency too low during synchronising.
----------> 00 TOO FAST	Frequency too high during synchronising.

2.3 Menu structure

The display has two menu systems. You can view these without a password.

View menu system

There are 20 view pages. Use the arrow buttons to change to the next/previous page. Use the utility software to select the values shown on the view pages.

Setup menu system

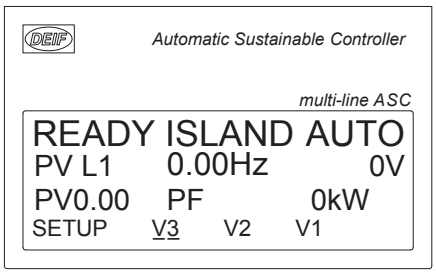
You can use this to see the parameters.

You can use the setup system to change parameters, but you must enter the password.

2.3.1 Start page

When the controller is powered up, the start page is shown. To reach the start page, you can always push the BACK button (up to three times).

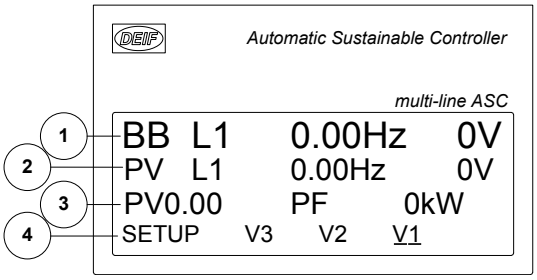
NOTE If an alarm is present, the alarm information page is shown at power up.



2.3.2 View menu

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

View 1 (V1)



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

- **SETUP**: This gives access to these sub-menus:
  - Protection setup
  - Control setup
  - I/O setup
  - System setup
- **V3** (View 3) – The page displays the operational status and selected measurements.
- **V2** (View 2) – Access to up to 20 configurable windows, displaying selected measurements.
- **V1** (View 1) – Access to up to 20 configurable windows, displaying selected measurements.

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

2.3.3 Event log and alarm log

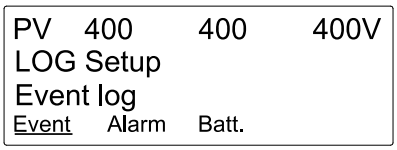
The controller has these logs:

- Event log, which contains 500 entries.
- Alarm log, which contains 500 entries.

The logs can be seen in the display or PC utility software. When a log is full, each new event overwrites the oldest event (FIFO).

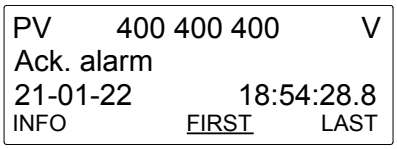
Display

This page is shown when the **LOG** button is pushed:



Event

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



The alarm or event is shown in the second line. In the example above, an alarm was acknowledged. The third line shows the time stamp.

The first event in the list is displayed when **FIRST** is selected. The last event in the list is displayed when **LAST** is selected. Use the **Up** and **Down** buttons to see the other events.

INFO

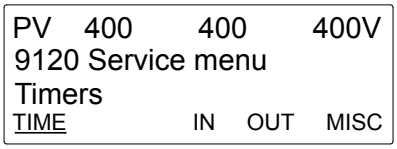
When INFO is selected, a value is shown if it is available.

2.3.4 Service menu

The service menu shows information about the operating conditions. Use the **JUMP** button (9120) to enter the service menu.

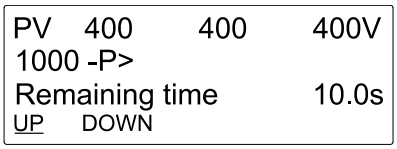
Service menu start page

The start page shows the selections in the service menu.



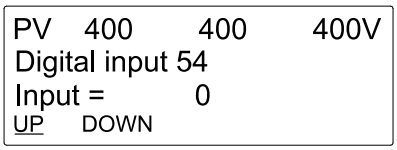
TIME (alarm timer)

Shows the alarm timer and the remaining time for one alarm. The timer counts down when the set point is exceeded. Select **UP** or **DOWN**, or use the **Up** and **Down** buttons to see the other alarms.



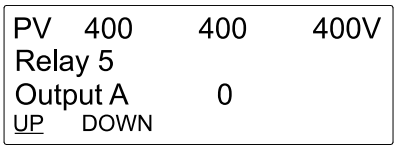
IN (digital input)

Shows the status of one digital input. Use **Up** and **Down** to see the other digital inputs.



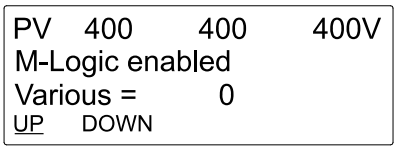
OUT (digital output)

Shows the status of one digital output. Use **Up** and **Down** to see the other digital outputs.



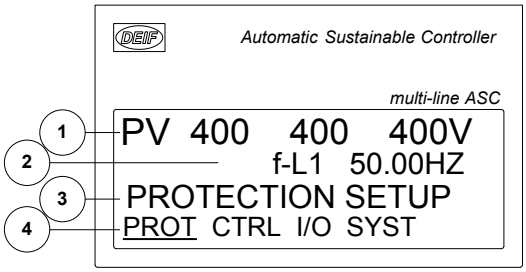
MISC (miscellaneous)

Shows miscellaneous messages.



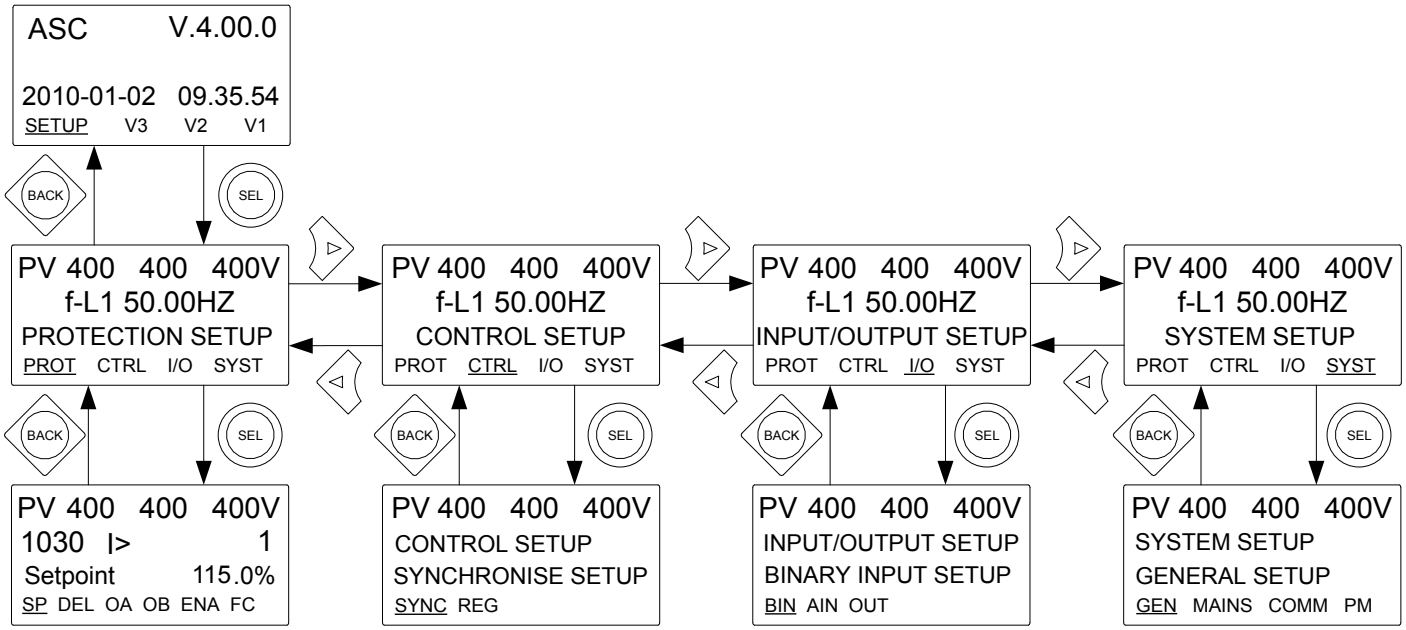
2.3.5 Setup menu

The setup menu system is used for parameter setup of the controller. 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 start page, by selecting SETUP in the fourth display line.

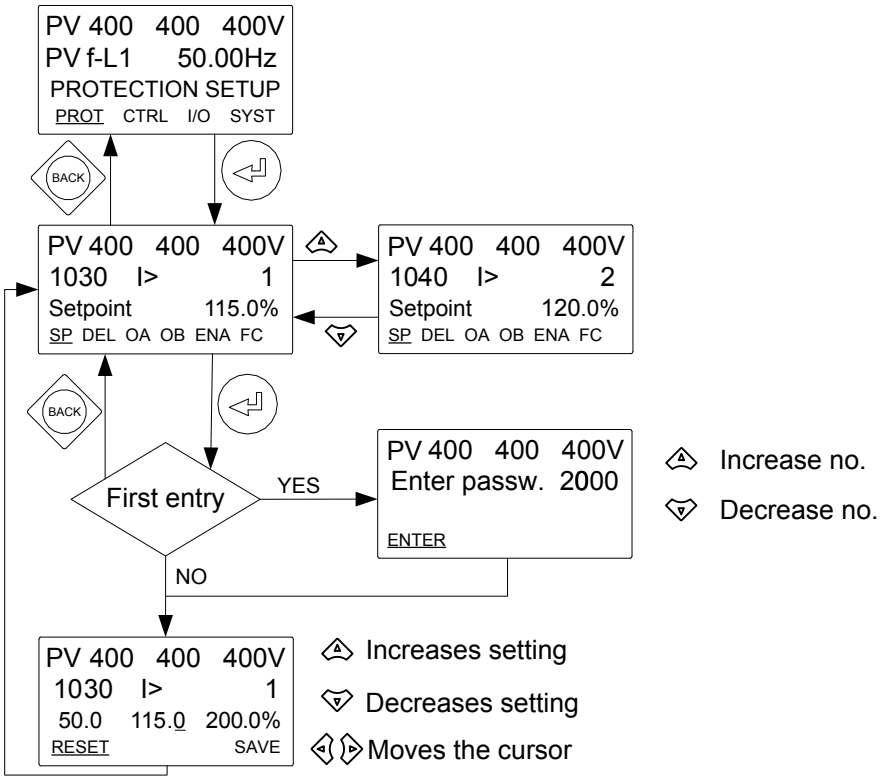


Line	Daily use	Setup menu	Alarm/event list
1	Source and busbar values.		
2	Display various values.	Info on the selected parameter number.	The latest alarm/event.
3	Info on the line 4 cursor selection.	The setting for the selected function. If changes are made, the max. and min. values for the setting.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

Setup structure



Changing the over-current set point example



2.4 Mode overview

ASC can run in **Auto** or **Semi-auto** mode. The mode is selected by pushing 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 sequences manually.

Semi-auto

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

2.5 Password

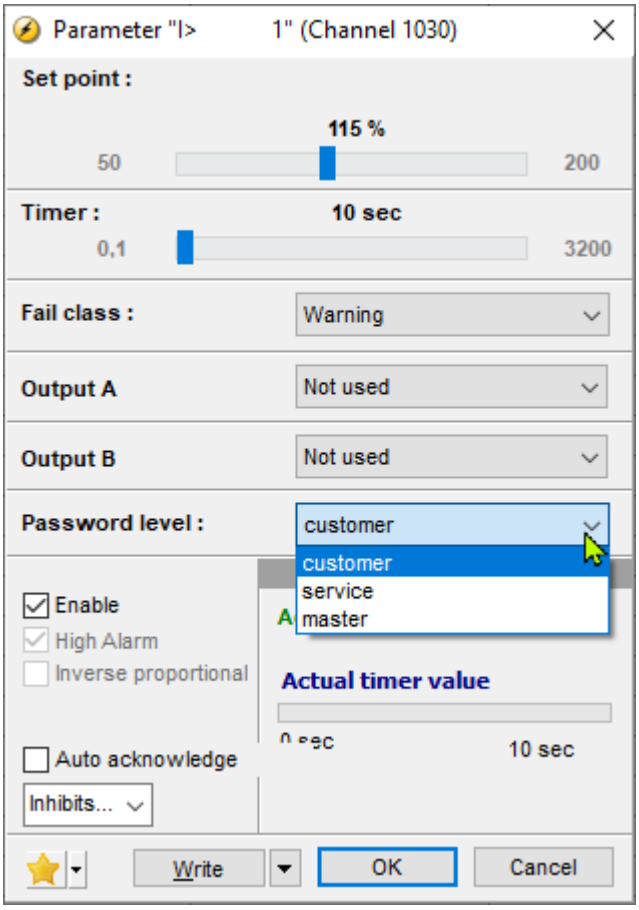
2.5.1 Password management

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

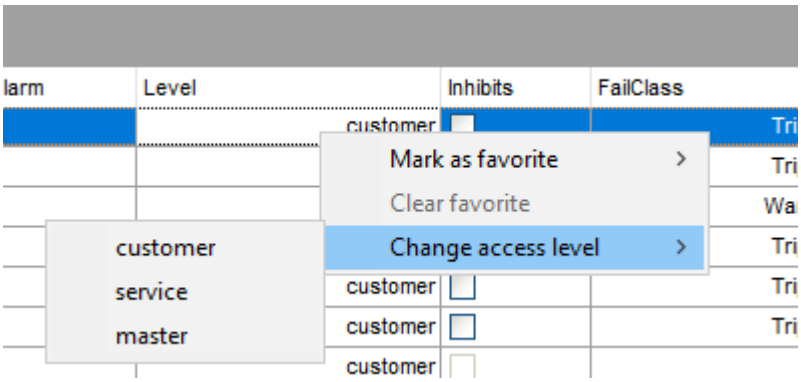
Password level	Factory setting	Access		
		Customer	Service	Master
Customer	2000	•		
Service	2001	•	•	
Master	2002	•	•	•

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.



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.



2.5.2 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.

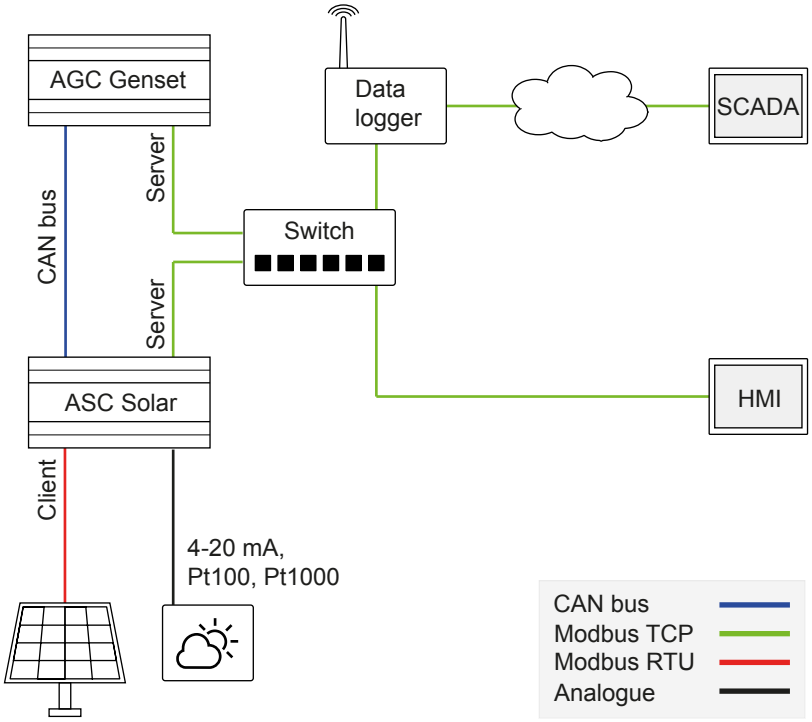
The customer password can be changed in jump menu 9116, the service password in 9117, and the master password in 9118. The factory passwords must be changed if the operator is not allowed to change the parameters. It is not possible to change the password for a higher level than the password entered.

3. Communication

3.1 ASC Solar communication

The ASC can communicate as a Modbus client and/or Modbus server.

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.

3.2 PV communication protocols

ASC as Modbus client

The ASC can communicate with the inverters directly, or through a gateway device.

The ASC communication with the PV system uses a Modbus RTU protocol. The ASC is the Modbus client and the inverter is the Modbus server. Using this protocol, the ASC transmits the references to the inverters using Modbus RS-485 or by using the Ethernet gateway.

More information
See **Modbus client monitoring** in the **ASC-4 Modbus Client User manual** for troubleshooting information.

ASC as Modbus server

The DEIF Open protocol uses Ethernet (Modbus TCP/IP) or Modbus RS-485. A PLC or a Fuel Save Controller (FSC) is the Modbus client device. Using this protocol, the PLC or FSC can read the references from the ASC, which is the Modbus server device.

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

Communication protocol parameters

Parameter	Name	Range	Default	Details
7561	PV protocol	See **DEIF hybrid controller compatibility**.	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 Modbus client.
7563	Tx min interval	0.1 to 10 s	0.5 s	Only affects protocols where the ASC is the Modbus client.
7564	Tx write fnc.	Single register 0x06 Multiple register 0x10	Multiple register 0x10	Only affects protocols where the ASC is the Modbus client.
7660	Weat. comm. ID	1 to 247	3	The ID given to the weather station to receive and transmit data.
7661	Weather prot.	See **DEIF hybrid controller compatibility**.	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.

More information
See **ASC-4 Modbus server tables**, **Application notes, DEIF hybrid controller compatibility** and **ASC-4 Solar Modbus client tables** for more information.

3.2.1 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. The inverters must not reply to the broadcast messages. This is done to have a sufficiently fast control speed.

For broadcast, communication supervision is only possible if PV monitoring is enabled (parameter 7566). For communication supervision, if the communication is compromised, the ASC activates a communication alarm.

If PV monitoring is not enabled (parameter 7566), the operating status of the inverters cannot be taken into account by the ASC (because the inverters do not feed back status information to the ASC). However, if PV monitoring is enabled, the ASC takes the operating status of the inverters into account.

When PV monitoring is used with broadcast, 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.

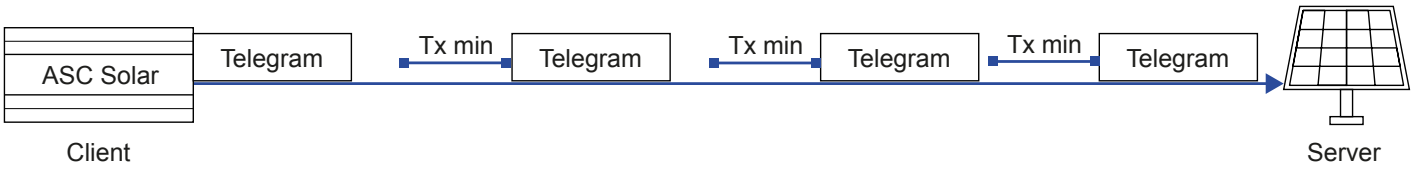
Broadcast initialisation

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 selected Modbus control ID (parameter 7511). 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 Modbus control ID (parameter 7511).

During the initialisation routine, communication supervision is possible and the ASC can activate a communication alarm if communication is compromised.

Tx min interval

Select the minimum interval between transmission from the ASC in parameter 7563. Some inverters cannot receive information fast enough. For example, some inverters can accept telegrams every 100 ms, while others need 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.

3.2.2 Communication failure

The ASC detects communication failure if the PV plant does not respond to telegrams. The ASC does not require a heartbeat.

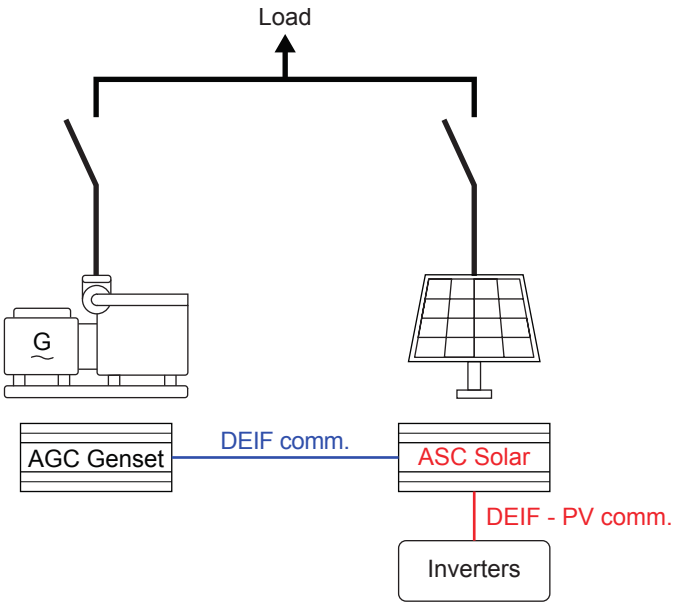
3.2.3 ASC power measurements

You can change the source of the ASC power measurements in *Power measures* (parameter 7051). You can select one of the following:

- **ASC measurements**: The ASC CT and voltage measurements are used to calculate the power.
- **PV communication**: Use the P, Q and S readings from the inverter for the power measurement (instead of the ASC's own measurements). Select *PV communication* in parameter 7051. Note: If *Tx write type* is *Broadcast*, to get the readings from the inverter, you must select *Enable* in *PV monitoring* (parameter 7566).

  NOTE For power readings from the inverter, the ASC AC voltage measurements are still required.
- **DEIF open communication**: Measurements from DEIF internal communication.
- **Power meter comm**: A PV power meter.

3.2.4 Power management communication



The blue line on the diagram shows the CAN bus power management communication between the ASC Solar and the AGC.

The communication between the ASC and the PV system is Modbus RTU or TCP/IP communication.

3.3 Controller IP address

If the controller includes option N, you can use TCP/IP communication to connect to the controller. This requires an Ethernet cable, or a connection to the network that includes the controller.

Default controller network address

- IP: 192.168.2.21
- Gateway: 192.168.2.1
- Subnet mask: 255.255.255.0

Finding the controller IP address on the display

Use jump menu 9002 to see the controller IP address.

Configuring the IP address using utility software and a USB connection

You can use a USB connection and the utility software to change the controller IP address. Plug the USB cable into PC with the utility software and the controller service port.

Point-to-point Ethernet connection to the controller

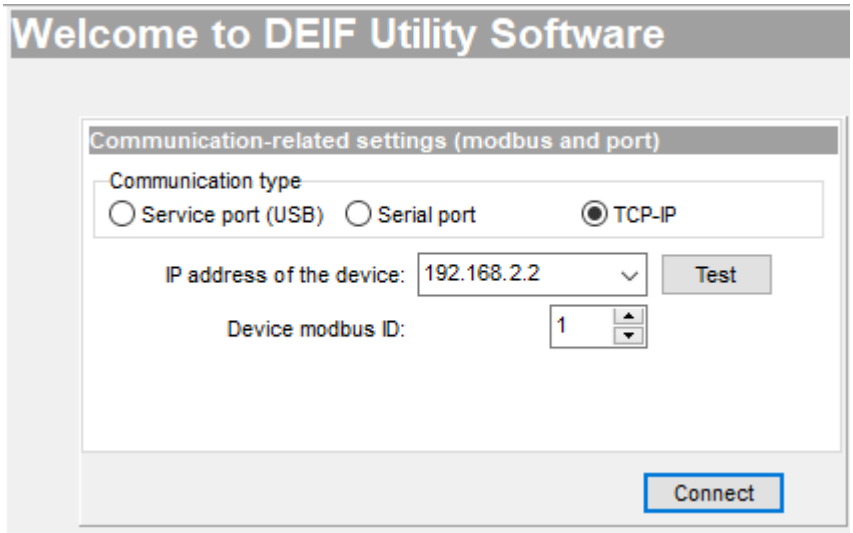
If you do not want to use a USB connection to change the IP address, you can use a point-to-point Ethernet connection. The PC must have a static IP address. For the default controller network address, the PC static IP address must be 192.168.2.xxx, where xxx is a free IP-address in the network (note: xxx cannot be 2 (the controller IP address) or 1 (the gateway)).

If you change the controller address (for example, from 192.168.**2**.yyy to 192.168.**47**.yyy) the connection is lost. A new static IP for the PC is needed. In this case, 192.168.47.zzz, where zzz is a free IP-address in the network. The PC address, IP address, and gateway must be in the same subnet.

When the PC has the correct static IP address:

1. Use an Ethernet cable to connect the PC to the controller.
2. Start the utility software.

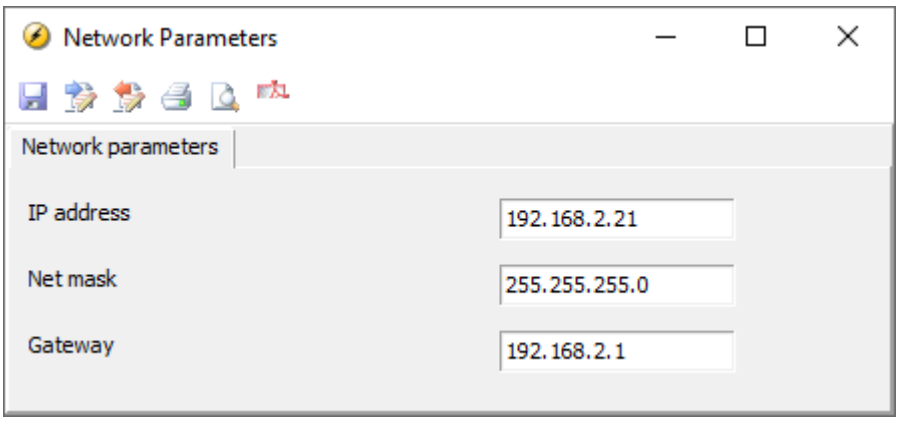
3. Select *TCP-IP*, and enter the controller IP address.



4. You can use the *Test* button to check if the connection is successful.
5. Select *Connect* to connect to the controller using TCP-IP.

Configuring the controller IP address using the utility software

To change the controller network parameters from the utility software, select the *Option N configuration* button. The *Network Parameters* window opens:



When the controller network parameters have been changed, select the *Write to device* button.

The controller receives the new network parameters and reboots the network hardware.

To connect to the controller again, use the new controller IP address (and a correct PC static IP address).

Using a switch

For a system with multiple controllers, all controllers can be connected to a switch. Create a unique IP address for each controller in the network before connecting the controllers to a switch.

The PC can then be connected to the switch, and the Ethernet cable can be in the same port of the switch at all times. You can enter the controller IP address in the utility software.

The TCP-IP connection is faster than other connections. It also allows the user to shift between controllers in the application supervision window in the utility software.

3.4 Remote monitoring

3.4.1 Monitoring solutions

A range of remote monitoring solutions is possible.

For an existing system, you can use the Ethernet TCP/IP connection (option N) of the ASC. All data in the Modbus protocol can then be polled from the device. The ASC acts as a Modbus server device in the system. For example, this solution can be used in HMI or SCADA systems.

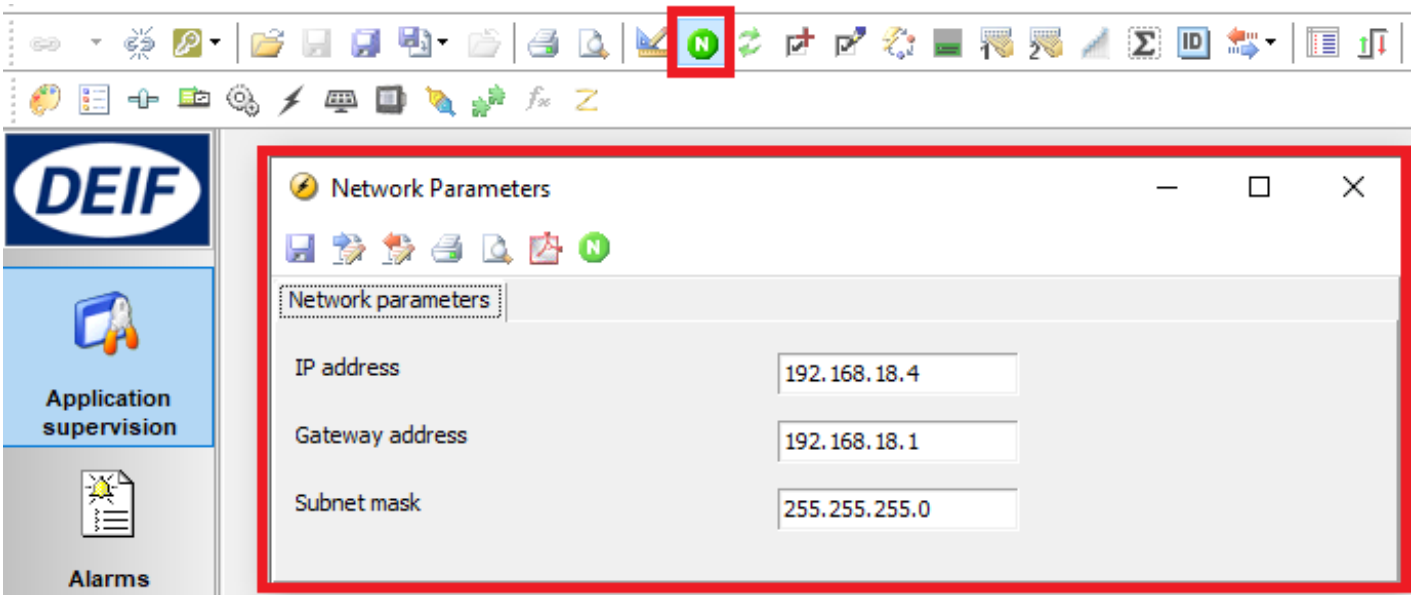
Another solution is to install a gateway, giving access to a cloud-based database. This gives an accessible front portal. Live data and log data are sent to a server (depending on the solution). DEIF offers a ready-made solution for this.

Alternatively, the gateway can work as an actual remote gateway. In this solution, the DEIF PC utility software can be accessed with all the control and monitoring functions needed (control can be switched off, or made user level-dependent).

3.4.2 DEIF Modbus server connection

The Ethernet connection is used for remote or local monitoring.

To see or set up the controller's IP, SM and GW, use the Ethernet configuration tool in the DEIF PC utility software.



3.4.3 Modbus server device, using Ethernet TCP/IP

Using the controller as an Ethernet TCP/IP Modbus server, 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 server.

More information
See the **ASC-4 Modbus server tables** and the **ASC-4 Modbus server User manual** for the ASC-4 Modbus server addresses.

3.4.4 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.

3.4.5 Genset values

For an add-on solution (that is, single controller applications), the ASC only knows the power (P and Q) and breaker status. To show values from other sensors, these must be hardwired to the ASC.

For integrated solutions (that is, power management, where the gensets have DEIF AGCs), the ASC knows the power of the gensets and several other values. Typically, these values are available from the gensets:

- Power kW
- Reactive power kvar
- Oil pressure
- Coolant temperature
- Fuel level
- Any (shutdown) alarms

3.4.6 Inverter values

The ASC-4 controller includes a Modbus client 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 client tables** show which values are supported for each PV protocol.

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

4. Single-controller applications

4.1 Single controller

The ASC can operate as a single controller, that is, without power management communication to other DEIF controllers. Single controllers are particularly useful for brownfield applications (the ASC is installed in an existing plant). Single controllers can also be used in greenfield applications.

In a single-controller application, the ASC Solar controller operates as the only DEIF controller in the system. The ASC is the link to the inverter.

To control the PV power set point (optional), the single controller must get the power measurements and breaker positions for the power sources in the rest of the application. You can use transducers, or the ASC can read Modbus values from power meters, external genset controllers, or a PLC.

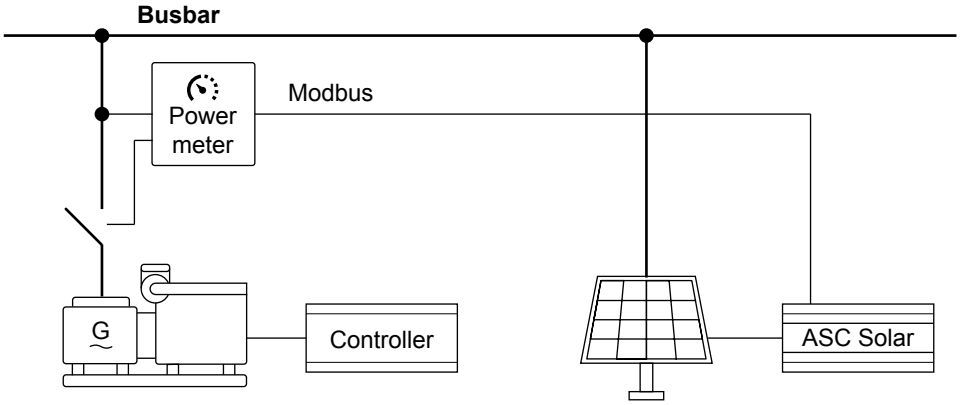
The ASC can be used in single controller applications that are off-grid, grid-tied, or a combination. There is a maximum of 16 grid connections, and there can be up to 16 gensets. If there is more than 1 grid connection, the ASC interacts with the grid connections as if there was only 1 grid connection.

4.2 Modes of operation

Off-grid applications

In a single controller off-grid application, the ASC can only use island operation.

Single controller off-grid PV application

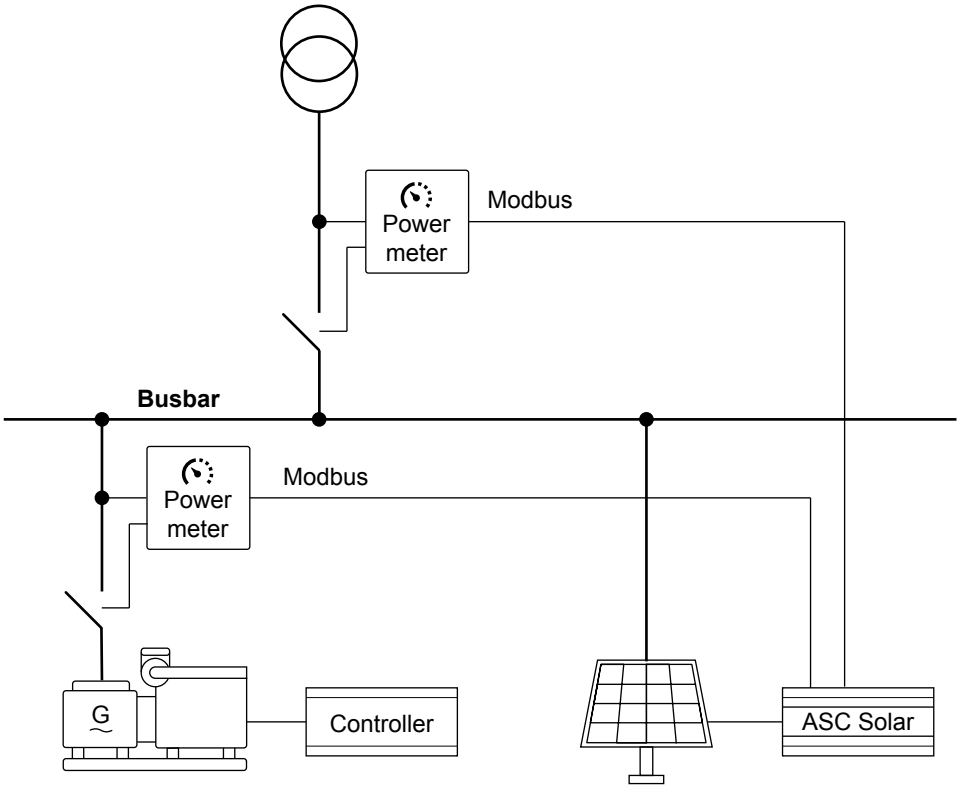


Grid-tied applications

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

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

Single-controller grid-tied PV application



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

Combination applications

In a single-controller combination application, the ASC can have the following modes of operation:

- Mains breaker open (that is, off-grid):
  - Island operation
- Mains breaker closed (that is, grid-tied):
  - MPE (Mains Power Export)
  - Peak shaving
  - Fixed power

4.3 Power measurements and connection status

For a single controller application, the ASC needs the power (active and reactive) from all the other power sources in the system. The ASC also needs the connection status of the other power sources.

There is a range of ways to get this information.

	Active power (P)	Reactive power (Q)	Connection status
Power meter*	●	●	●
External genset controller*	●	●	●
DEIF open communication	●	●	●
Transducer*	●	●	-
Digital input	-	-	●

NOTE * Check the compatibility list to make sure that the power meter/external genset controller/transducer supports all these measurements.

Power meters and genset controllers

The ASC supports a wide range of power meters, as well as communication with genset controllers from other manufacturers.

More information
See the **DEIF hybrid controller compatibility** documents for a list of compatible power meters and genset controllers.

The ASC must have option H2.8 for Modbus communication with the power meters or genset controllers.

Some power meters and genset controllers include the connection status.

Measurement transducers

The genset power (active and reactive) can be measured with transducers, and received by ASC analogue inputs or multi inputs.

Connection status

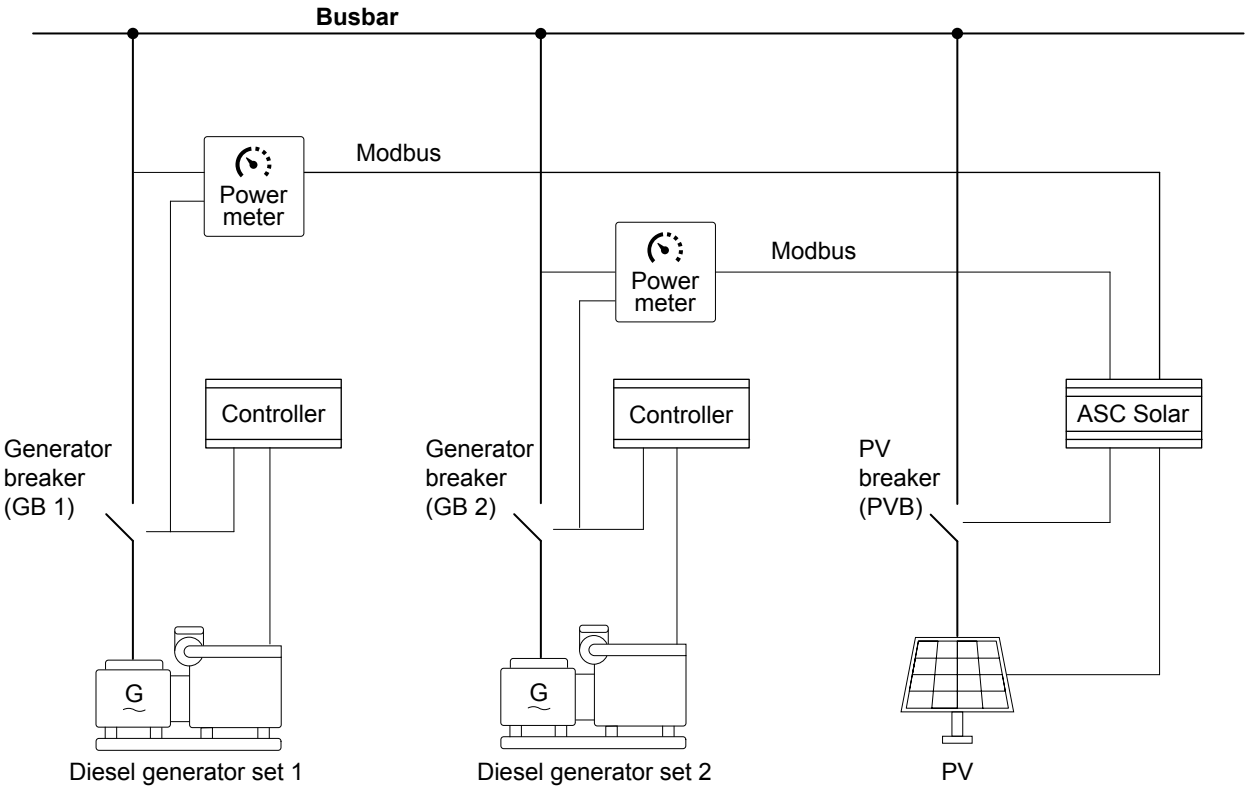
Transducers always also need a digital input for connection status. If the power meter/genset controller does not include the connection status, you must configure a digital input.

4.4 Genset applications

4.4.1 Gensets and single solar controller (off-grid)

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. For external genset controllers and some power meters, each meter can send all this information. Alternatively, the ASC can 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

4.4.2 Genset power measurement

For a single controller application, the genset power (active and reactive) and breaker positions must be measured. You can use the following parameters to select the power and breaker measurements. The application can include up to sixteen (16) gensets.

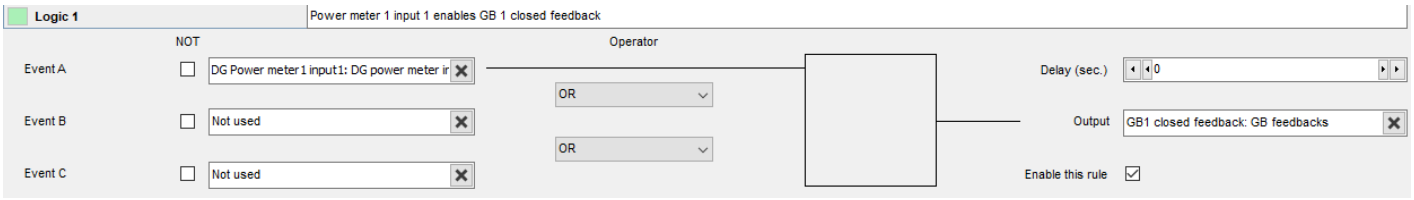
Parameters

Parameter	Name	Range	Default	Description
7331 to 7481	DG[1 to 16] nom. power	0 to 30000 kW	0 kW	Configure the nominal power for each genset.
7333 to 7483	DG[1 to 16] P input	Analogue input [91/93/95/97] Multi input [102/105/108] DEIF open communication Power meter comm. [01 to 16]	Multi input 105	Select the source of each genset power measurement.
7335 to 7485	DG[1 to 16] Q input		Multi input 108	

Gensets connected

The ASC also needs to know which gensets are connected. For some power meter protocols, this is included. See the **DEIF hybrid controller compatibility** document.

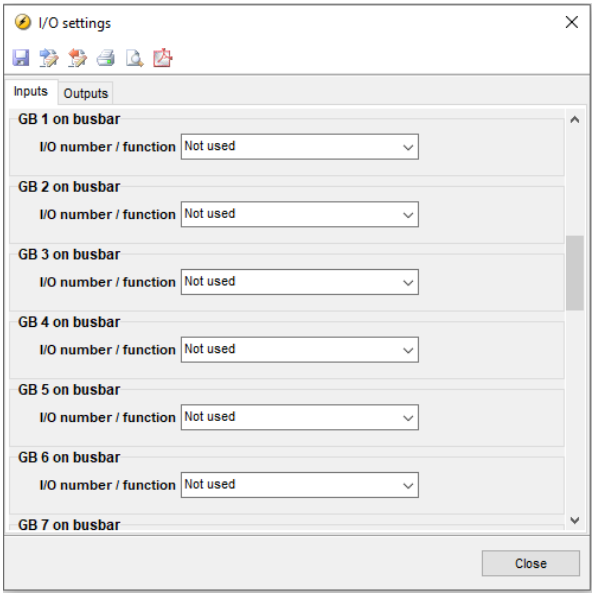
Genset breaker status from the power meter protocol



If the genset breaker status is included in the power meter protocol, configure M-Logic to connect the output from the power meter to enable the corresponding genset.

For the *DEIF Genset Control* protocol, input 1 is always for GB closed. Input 3 is always for GB open.

Genset breaker status from digital inputs



If the genset breaker status is not included in the power meter protocol, configure a digital input for each breaker.

4.4.3 DEIF open communication

An external system (for example, a PLC) can use the ASC Modbus server to send the ASC the power measurements and connection status.

Example for two gensets

The application consists of two gensets (controlled by a PLC) and a PV system (controlled by a single ASC controller).

1. In the utility software, select *DEIF open communication* in parameters 7333 and 7343 (Genset 1 P and Q), and 7335 and 7345 (Genset 2 P and Q).
2. Configure the PLC to connect to the ASC Modbus server.
3. Configure the PLC to use the following:
   - *Genset 1 Active power*: PLC address 440151 (Modbus address 40150, function code 03)
   - *Genset 2 Active power*: PLC address 440152 (Modbus address 40151, function code 03)
   - *Genset 1 Reactive power*: PLC address 440166 (Modbus address 40165, function code 03)
   - *Genset 2 Reactive power*: PLC address 440167 (Modbus address 40166, function code 03)
   - *Genset breaker 1 Closed*: PLC address 440185, bit 1 (Modbus address 40184, bit 1, function code 03)
   - *Genset breaker 2 Closed*: PLC address 440185, bit 2 (Modbus address 40184, bit 2, function code 03)

4.4.4 Measurement transducers

The genset power (active and reactive) can be measured with transducers, and received by ASC analogue inputs, multi inputs, or a CIO 308.

Example: Setting up multi input 102 for genset power

A 4 to 20 mA transducer is used to measure the genset 1 active power.

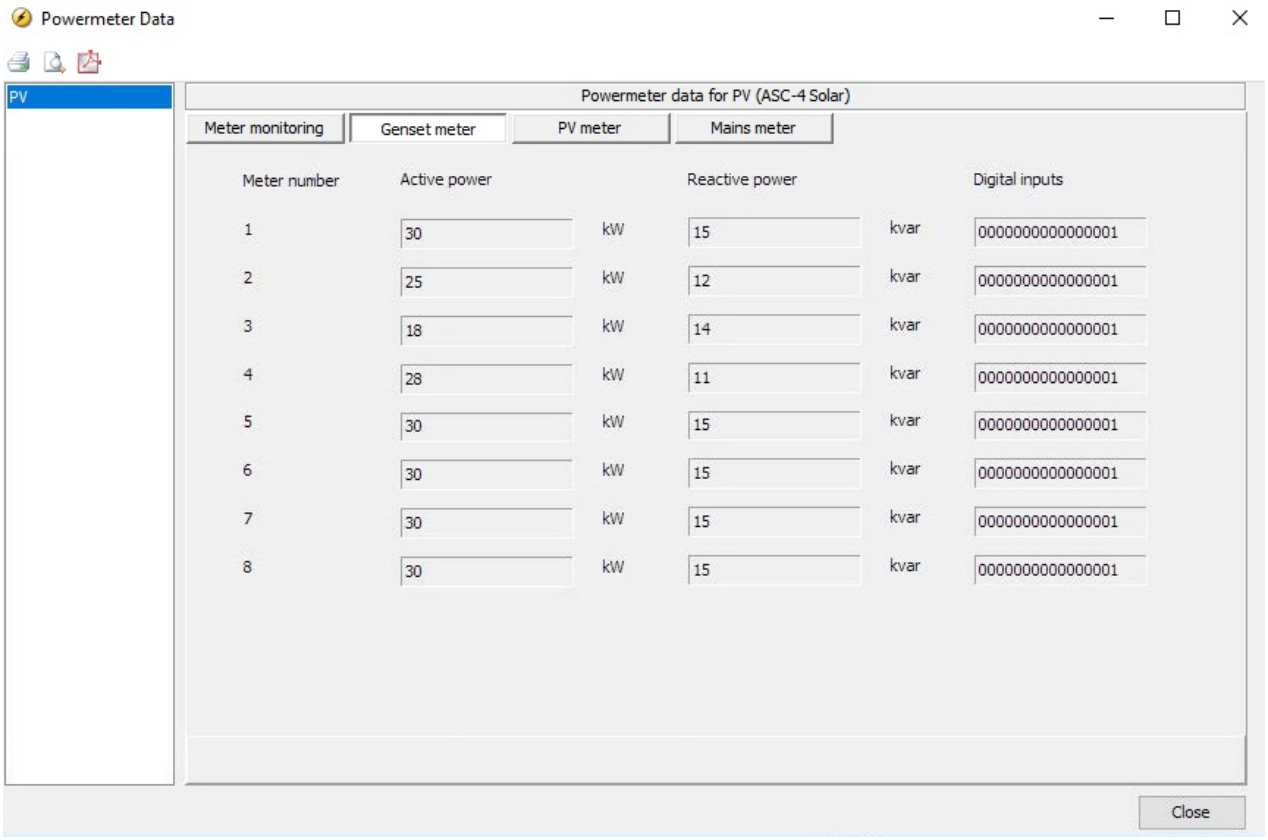
In *DG1 P input* (parameter 7333), select *Multi input 102*.
In *Multi inp. conf. 102* (parameter 10980), select *4-20mA*.
In *DG1 nom. power* (parameter 7331), select the genset nominal power.
Configure the transducer so that the power is 0 kW at 4 mA and at the nominal power at 20 mA.

Connection status

Transducers always also need a digital input for connection status.

4.4.5 Power meter monitoring

In the utility software, under *Application supervision*, select *Power meter data*  to open the *Power meter data* window.



Digital inputs shows the breaker status.

For the *DEIF Genset Control* protocol, for genset breakers:

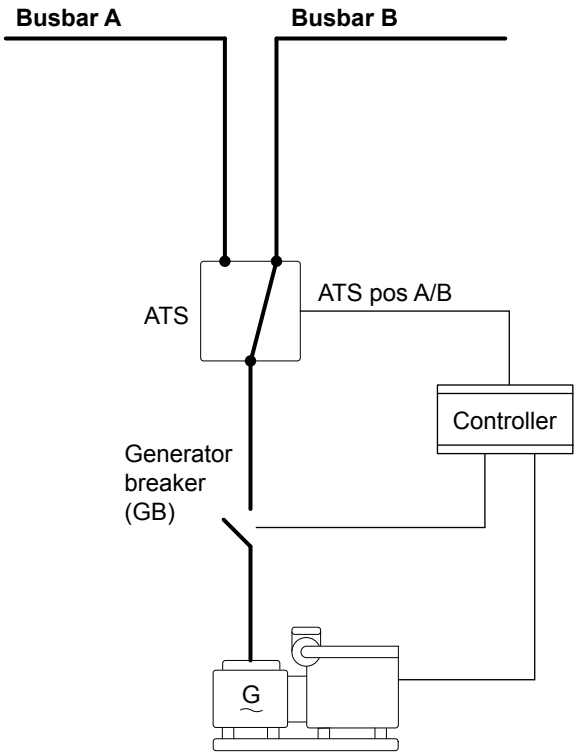
- **...0001**: The breaker is closed.
- **...0100**: The breaker is open.

For mains breakers:

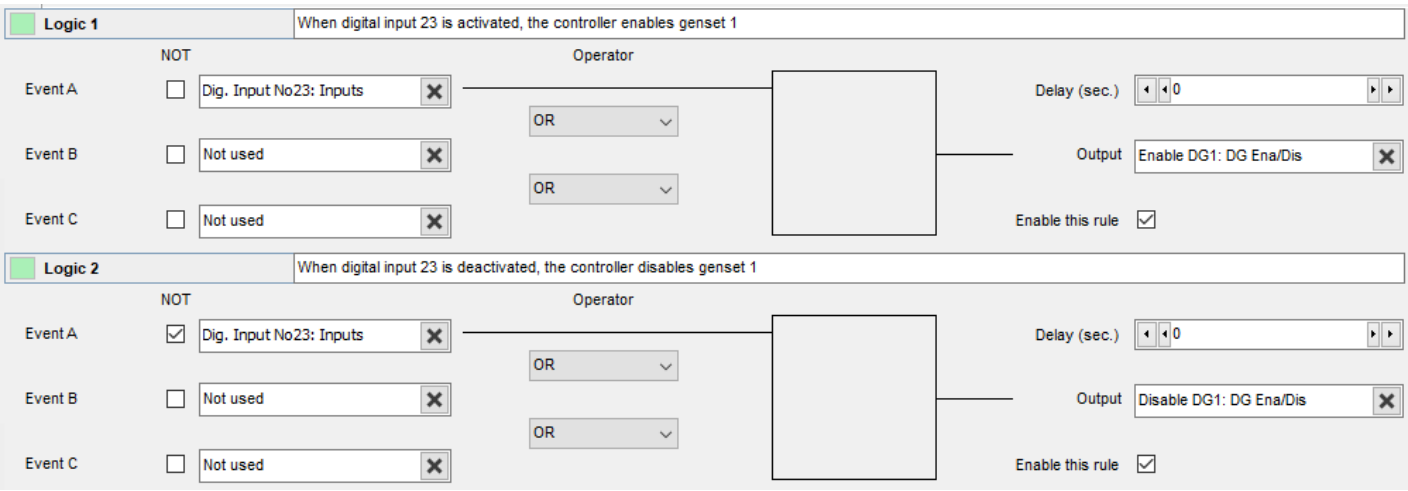
- **...0010**: The breaker is closed.
- **...1000**: The breaker is open.

4.4.6 Split busbar

In a single-controller application, you can use M-Logic to enable and disable each genset in the application. This is useful when a genset can connect to two busbars.



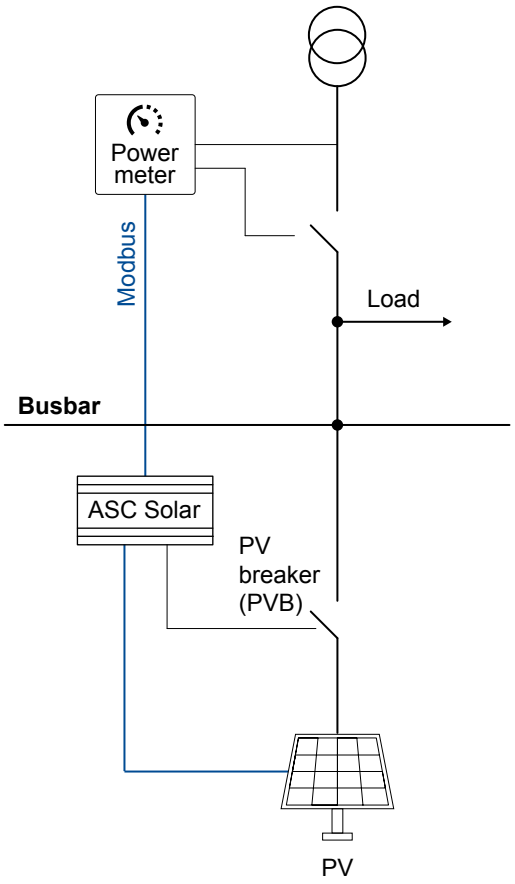
This M-Logic uses a digital input to enable and disable a genset. Set it up so that the genset is enabled when it is connected to the busbar with the PV. For the diagram above, the output from the ATS is connected to digital input 23.



4.5 Mains applications

4.5.1 Mains and single solar controller (grid-tied)

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).



Setting in ASC

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

4.5.2 Mains power measurement

For a single controller application, the mains power (active and reactive) (imported or exported) and breaker position must be monitored. There are a number of ways for the ASC to get the mains power measurements.

Parameters

Parameter	Name	Range	Default	Description
7491	Mains P input	Analogue input [91/93/95/97] Multi input [102/105/108] DEIF open communication Power meter comm. 01	Multi input 102	Select the source of the mains power measurement
7493	Mains Q input			

4.5.3 Mains power measurement from power meter communication

For a single controller application, the mains power (active and reactive) and breaker position must be monitored. The application can include up to one mains connection. There are a number of ways for the ASC to get the mains power measurements.

Mains power measurement from power meter communication is described here.

Power measurement

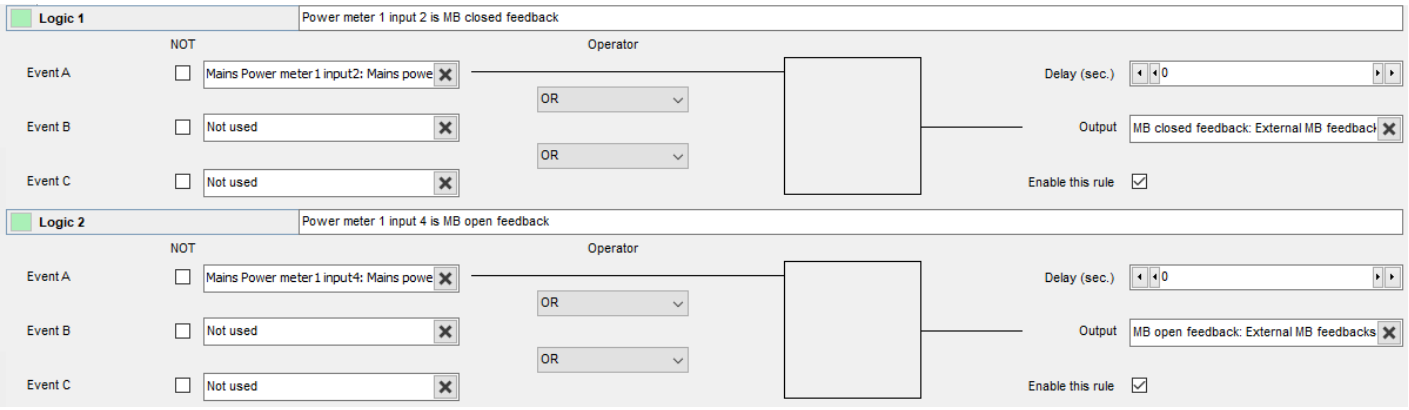
In the utility software:

- Select the power meter protocol in *Mains met. prot* (parameter 7725).
- Select the number of nodes in *Mains nbr. node* (parameter 7726).
- Select the Modbus ID in *Mains meter ID* (parameter 7703).

Mains connection

The ASC also needs to know whether the mains is connected. For some power meter protocols, this is included. See the **DEIF hybrid controller compatibility** document.

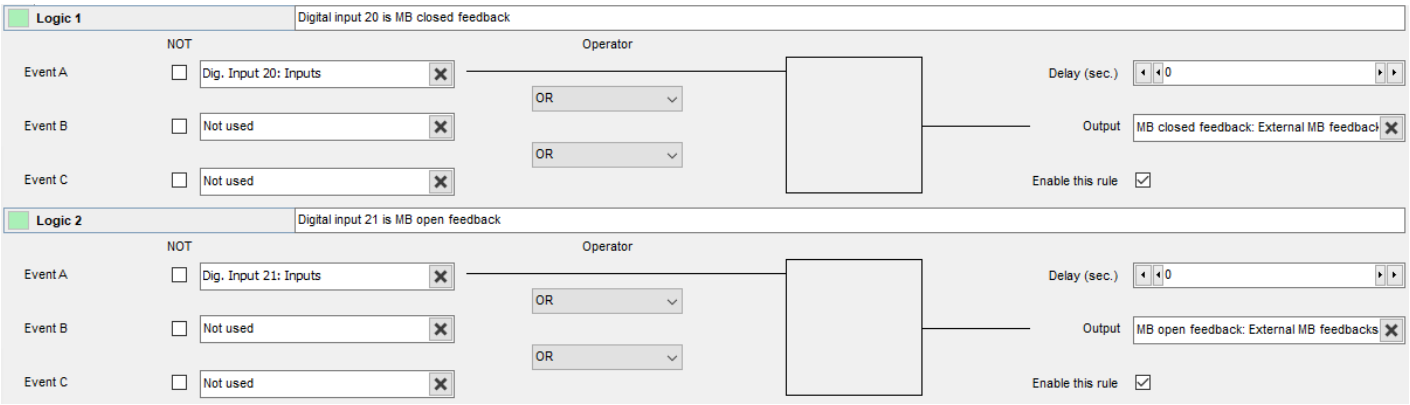
Mains breaker status from the power meter protocol



If the mains breaker status is included in the power meter protocol, configure M-Logic to connect the output from the power meter to mains breaker feedbacks.

Power meter input 2 is always for MB closed. Power meter input 4 is always for MB open.

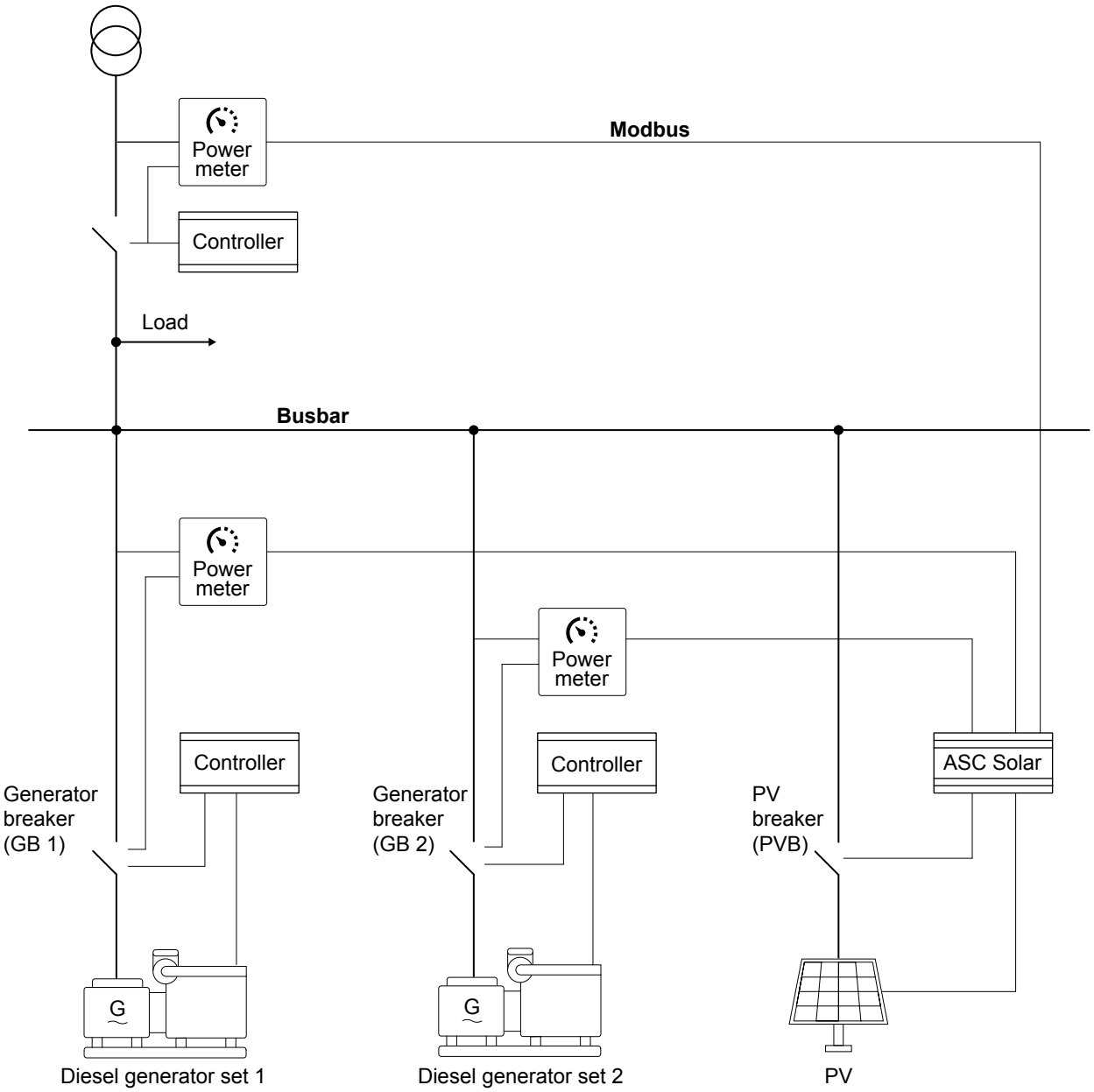
Mains breaker status from digital inputs



If the mains breaker status is not included in the power meter protocol, configure a digital input for each breaker feedback.

4.6 Combination (off-grid + grid-tied)

This application is used when a single-controller application is used in both grid-tied and 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

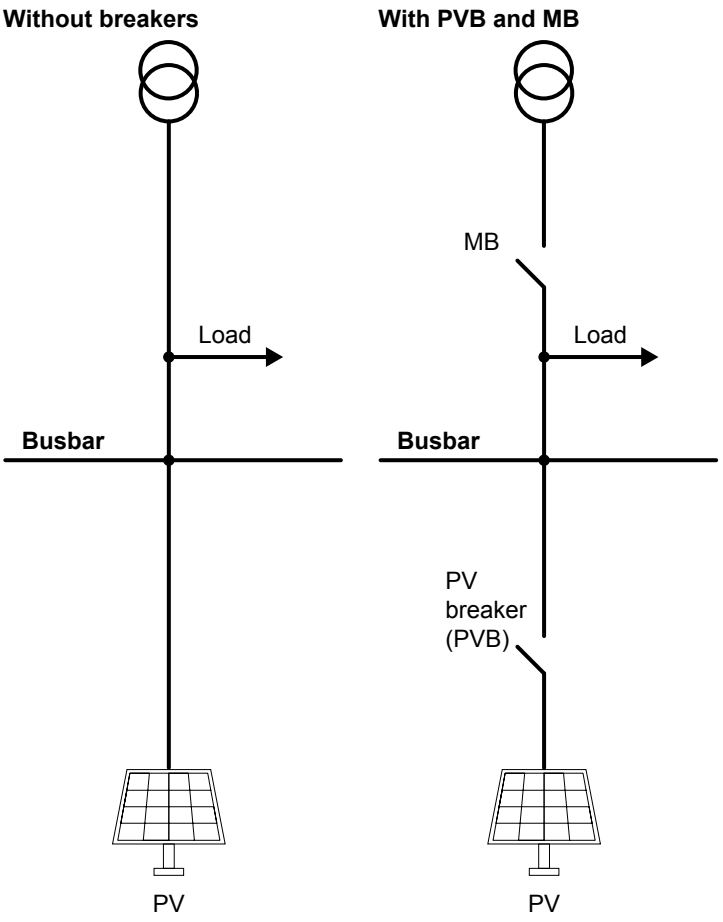
Parameter	Name	Range
6071	Operating mode	Island operation Fixed power Peak shaving Mains power export

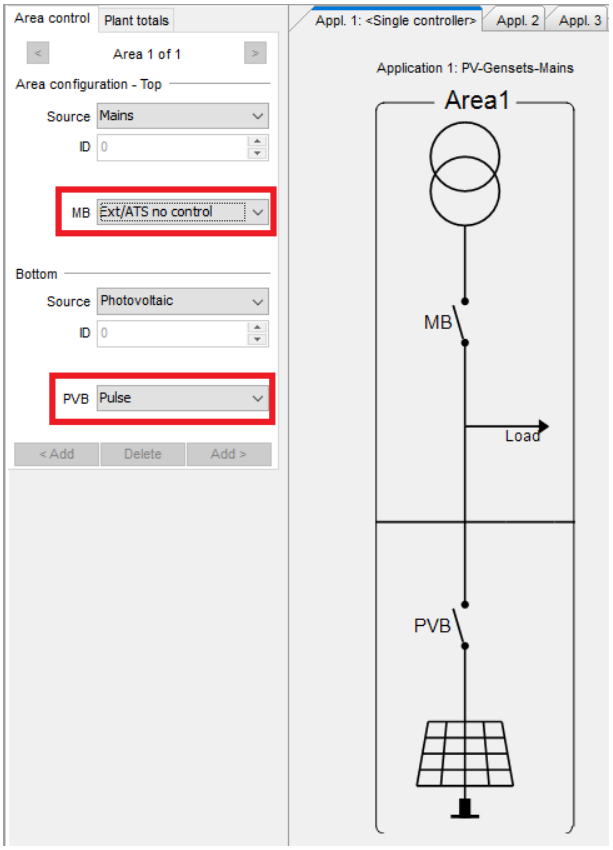
4.7 Breaker control

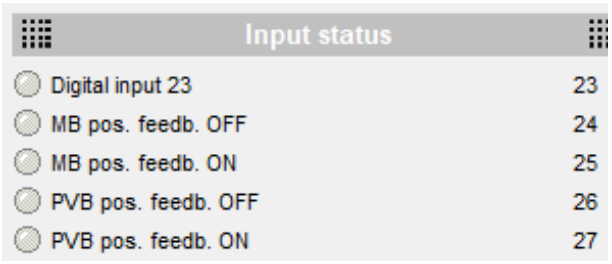
In a single controller application, the ASC Solar controller can control a PV breaker (optional). The ASC can protect generator(s) from reverse power by tripping the PVB.

If a mains and/or genset breakers are present, the ASC cannot control these breakers. The ASC only receives these breaker feedbacks (open/closed).

Use the *Application configuration* page in the utility software to add/remove the PVB and/or mains breaker to match the application. The controller automatically assigns digital inputs for the breaker feedbacks.







5. Energy management systems

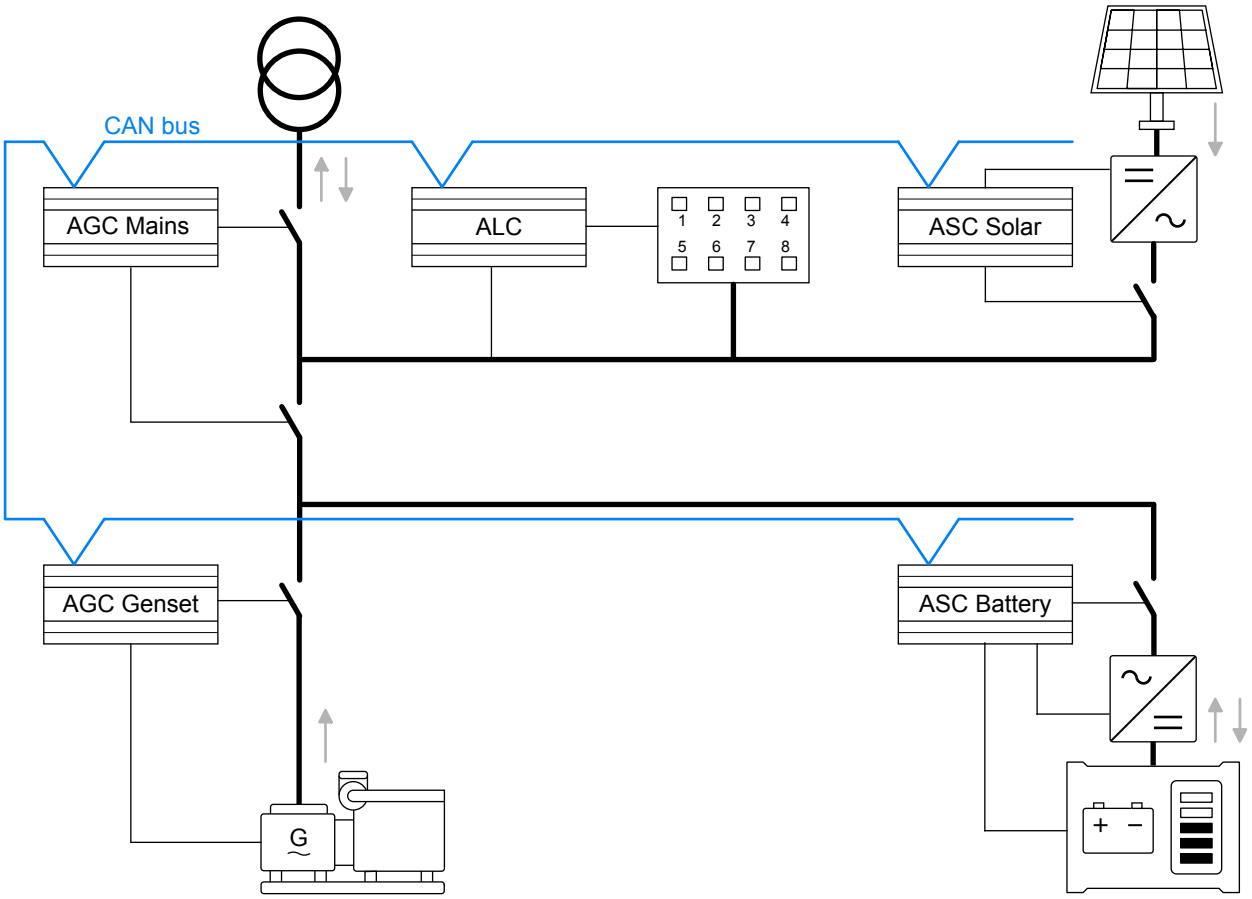
5.1 Overview

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.

Example of energy management system



Controller functions

Controller	Controls	Functions
ASC Solar	PV	• P and Q control • Control photovoltaic (PV) breaker • Inverter communication
ASC Battery	ESS	• P and Q control • Energy storage system charging and discharging • Control energy storage system (ESS) breaker • Energy storage system communication
AGC Genset	Genset	• Governor control

Controller	Controls	Functions
		• AVR control • Control genset breaker • ECU communication
AGC Mains	Mains connection	• Power import or export • Control breakers • Synchronise the plant to the mains
ALC	Load groups	• Connect and disconnect load groups • Manage heavy consumer requests

5.2 Power management applications

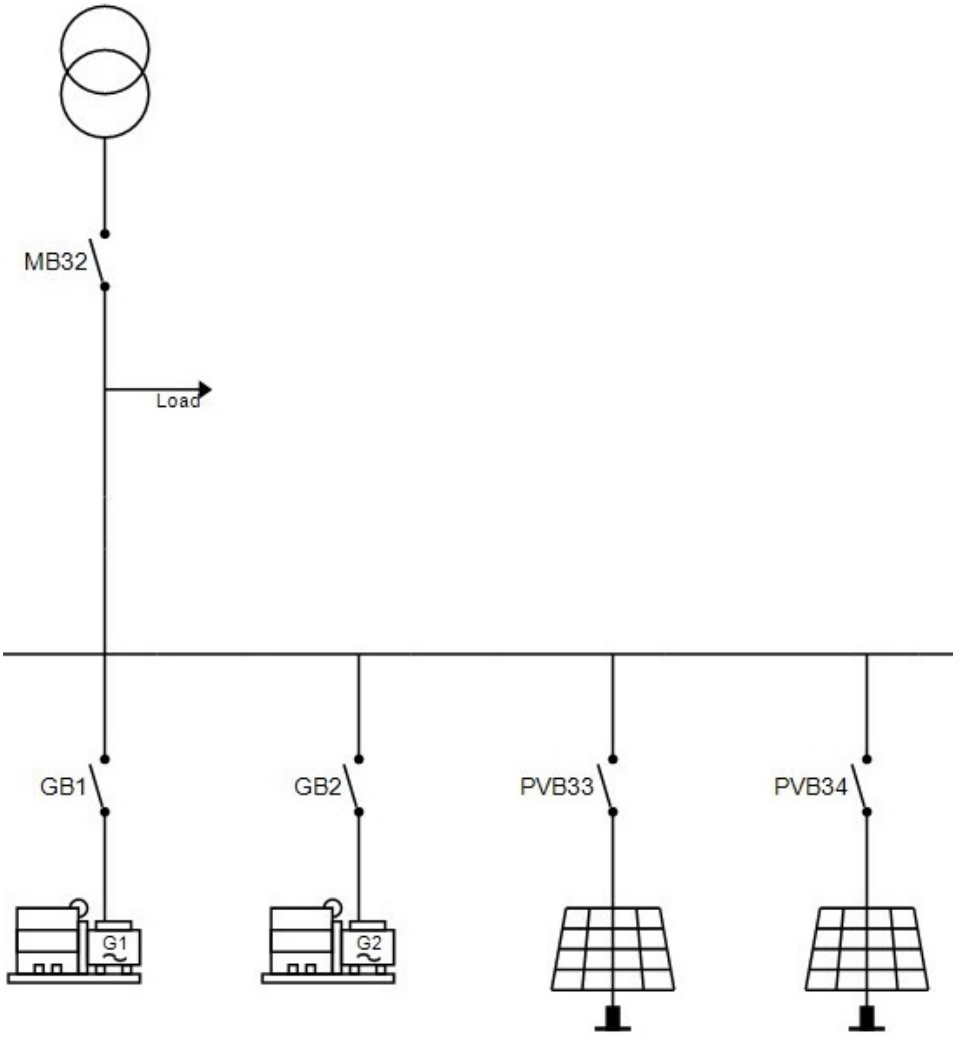
The ASC can be included in power management (also known as energy management). This allows PV, mains, gensets, and/or ESS to work together in an integrated system. Power management includes:

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. Each PV module represents either an inverter, or a string of inverters. There can be up to 16 ASC Solar controllers.

Breaker control



The ASC can control a PV breaker. For PV, this can be useful if there is a breaker in front of the string of inverters. The breaker can close when the busbar is live and Hz/voltage is normal. If the busbar is outside its limits, the ASC can open the PV breaker but not close it.

One ASC can control one PV 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 AUTO mode, the ASC closes the breaker when the busbar is live (and then the inverter starts). The ASC does not require a manual start signal if AUTO is selected.

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

5.3 Power management operation

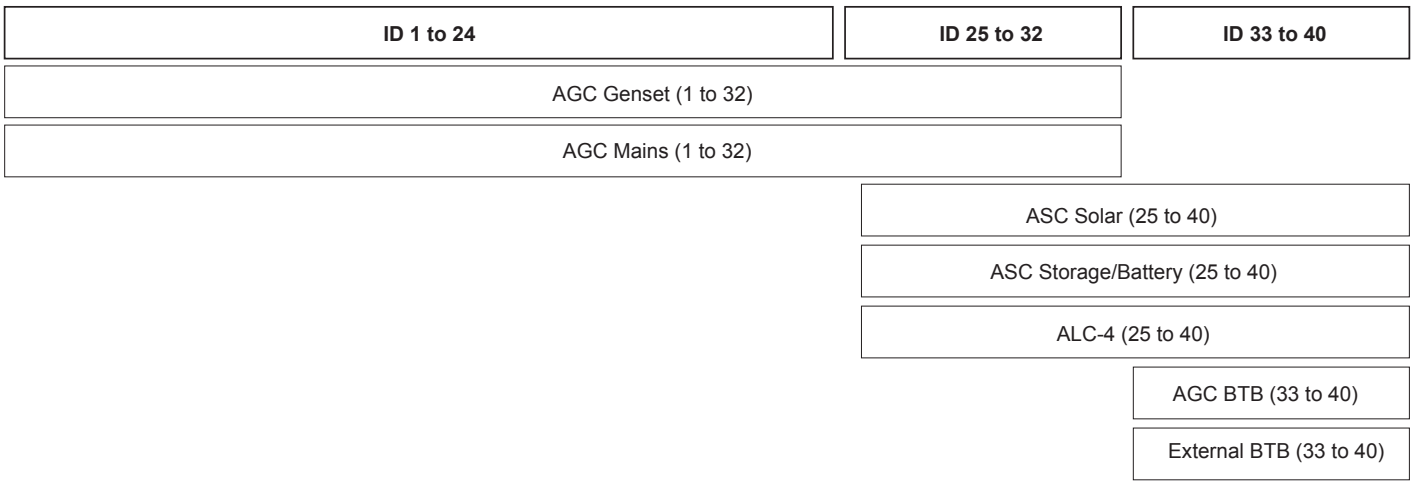
The ASC follows the operation of the AGC mains: Island, fixed power, mains power export, peak shaving, or load take-over (grid-tied or off-grid). If there is no mains controller (AGC mains) in the application, the plant uses island operation (off-grid).

5.4 System limitations

When the ASC is used for power management, the number of controllers is limited.

	Maximum number
AGC Genset	32
AGC Mains	32
ASC Solar	16
ASC Storage/Battery	16
ALC-4	16
AGC BTB/Externally-controlled BTB	8

Controller ID allocation and sharing



Example

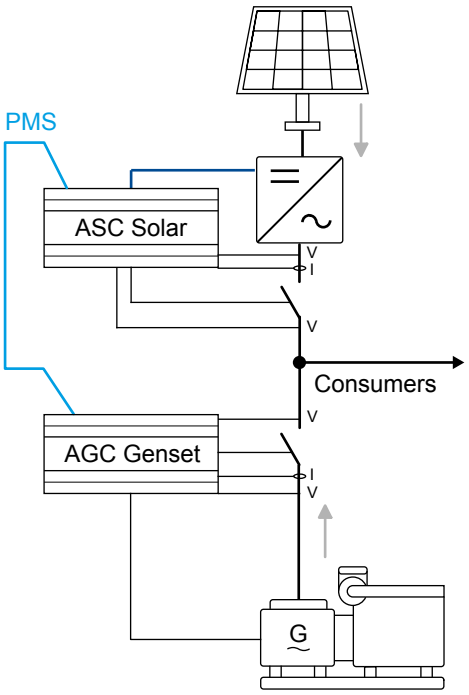
If you have a system with one mains feeder, then you have (32 - 1) = 31 IDs left for the gensets. If you have two mains feeders, you have (32 - 2) = 30 IDs left for the gensets.

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

5.5 Off-grid applications

These applications use CAN bus power management communication between the DEIF controllers. It is therefore not necessary to install additional hard wiring between the ASC and the other power sources.

5.5.1 Off-grid with genset(s) and solar



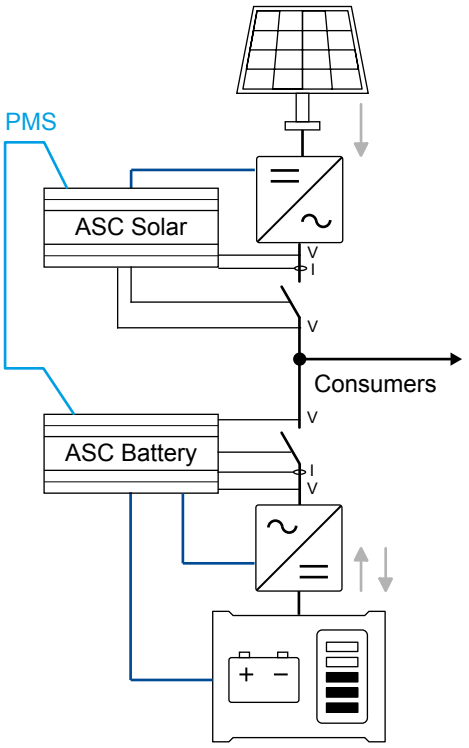
AGC Genset configuration

Parameter	Name	Setting
6071	Operating mode	Power management

ASC Solar configuration

Parameter	Name	Setting
6071	Operating mode	Power management

5.5.2 Off-grid with solar and battery



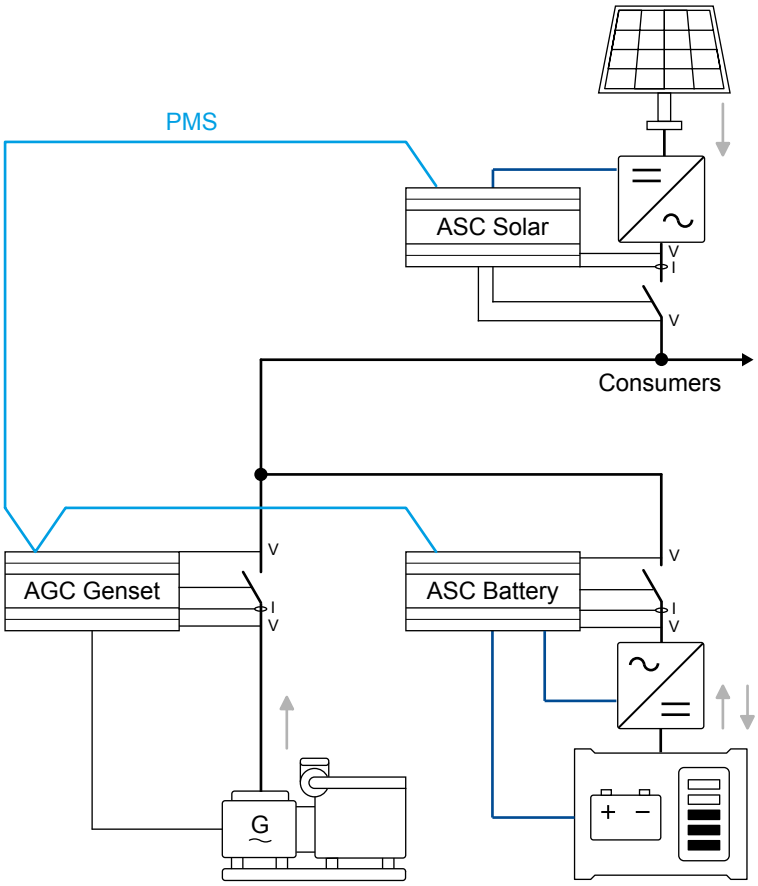
ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

ASC Solar configuration

Parameter	Name	Setting
6071	Operating mode	Power management

5.5.3 Off-grid with genset(s), solar and battery



ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

ASC Solar configuration

Parameter	Name	Setting
6071	Operating mode	Power management

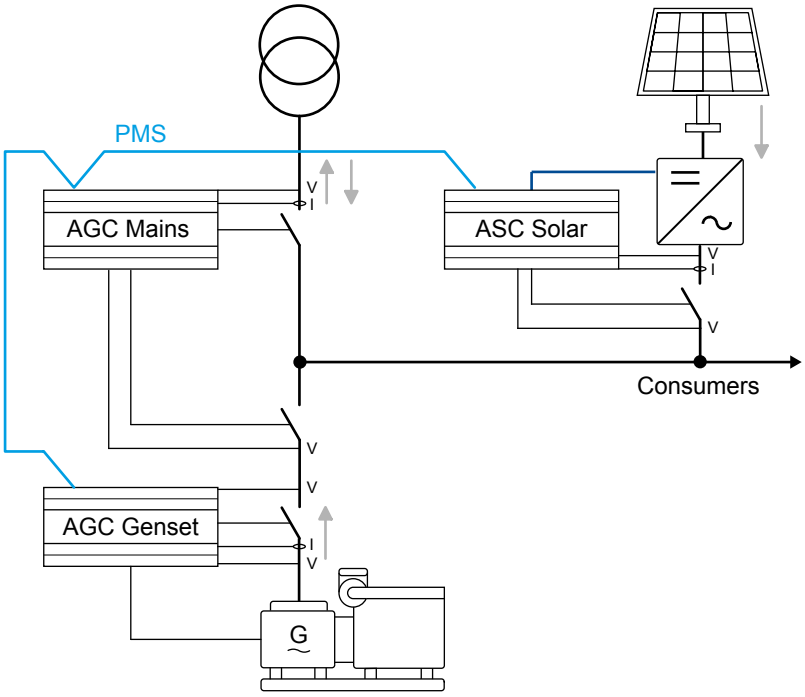
AGC Genset configuration

Parameter	Name	Setting
6071	Operating mode	Power management

5.6 Grid-tied applications

These applications use CAN bus power management communication between the DEIF controllers. It is therefore not necessary to install additional wiring between the ASCs and the AGC.

5.6.1 Grid-tied hybrid genset solar



ASC solar configuration

Parameter	Name	Setting
6071	Operating mode	Power management

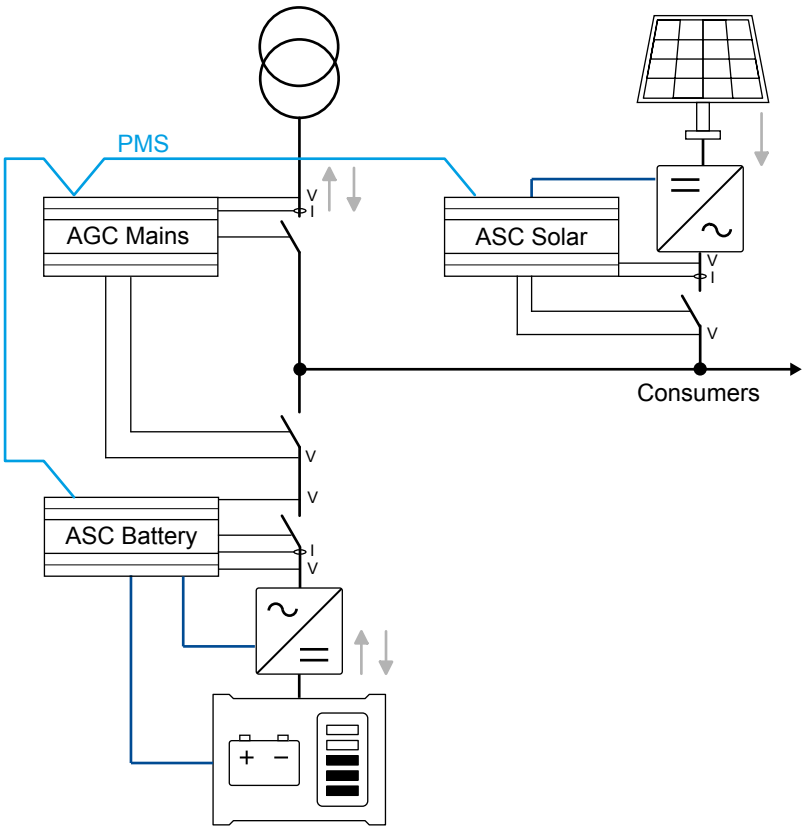
AGC genset configuration

Parameter	Name	Setting
6071	Operating 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.

5.6.2 Grid-tied hybrid solar-battery



ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

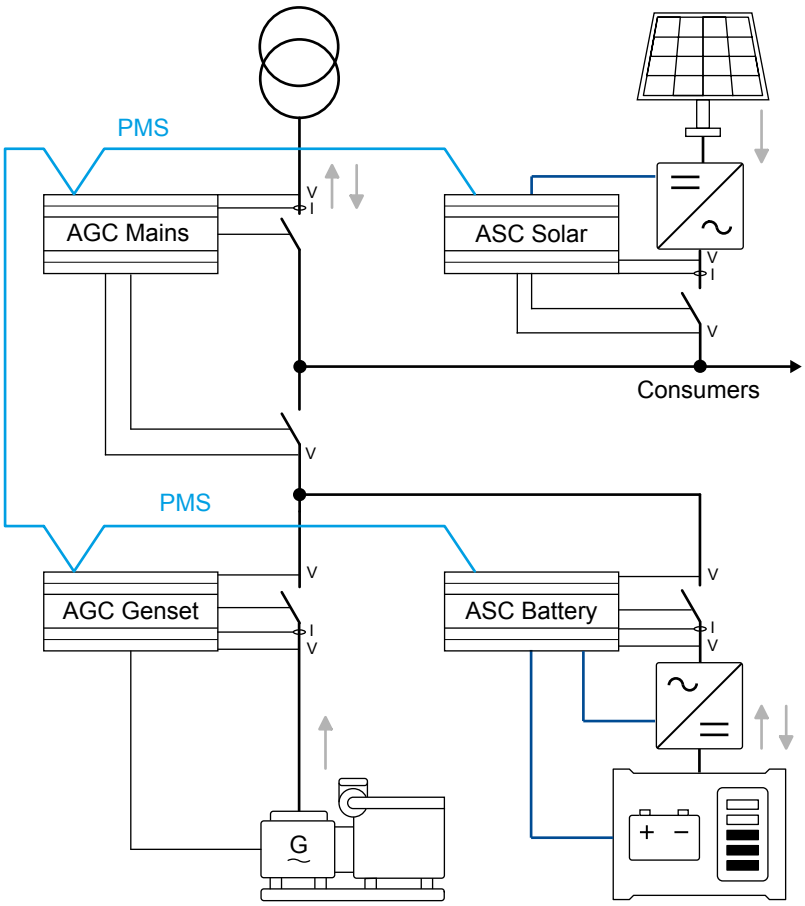
ASC Solar configuration

Parameter	Name	Setting
6071	Operating 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.

5.6.3 Grid-tied hybrid solar-genset-battery



ASC Battery, ASC Solar, and AGC Genset configuration

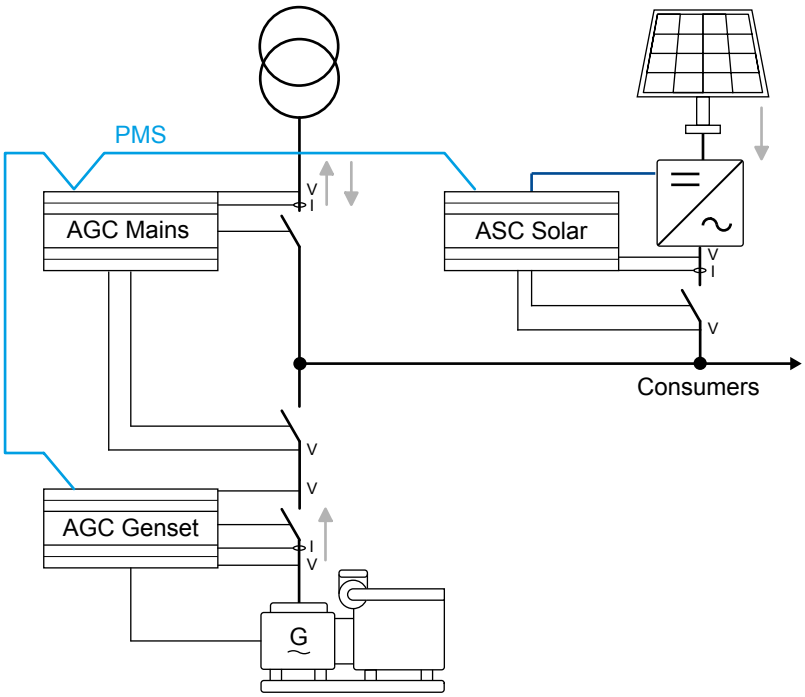
Parameter	Name	Setting
6071	Operating mode	Power management

AGC Mains configuration

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

5.7 Combination (off-grid + grid-tied)

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



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

- Mains breaker open (that is, off-grid):
  - Island operation
- Mains breaker closed (that is, grid-tied):
  - MPE (Mains Power Export)
  - Peak shaving
  - Fixed power

ASC Solar and AGC Genset configuration

Parameter	Name	Setting
6071	Operating 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.

5.8 Genset management

5.8.1 Genset load-dependent start and stop

The genset load-dependent start and stop (LDSS) parameters are configured in the AGC Genset controllers. You can configure two sets of LDSS parameters in each AGC Genset controller.

If the available PV is reduced (for example, due to clouds), the energy management system can be configured to tell the AGC Genset to use the second set of LDSS parameters. Set these LDSS parameters lower, to make sure that there is enough spinning reserve.

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.

5.8.2 Genset set points (kW)

In power management mode, the controllers force the gensets that are connected to the busbar to operate at or above a minimum load. This is to reduce the risk of engine problems, for example wet-stacking, fouling, or other issues caused by idling at low loads.

5.8.3 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 (8011 to 8013) on the ASC ensure that all engines connected to the busbar do not go below the minimum load.

If there are multiple ASC controllers in the application, the set point for these parameters must be the same in each controller.

5.8.4 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.

5.9 Spinning reserve

You can configure the spinning reserve on the busbar in the ASC controller.

Parameter	Name	Range	Default	Details
8001	Spin. reserve	0 to 100 %	0 %	Spinning reserve in mains parallel operation.
8002	Spin. reserve	0 to 100 %	10 %	Spinning reserve in island operation.
8003	Spin. reserve	ASC settings PV communication Forecast communication	ASC settings	• *ASC settings*: The spinning reserve is calculated as an adjusted percentage of the currently produced power. • *PV communication*: This can only be used with the *DEIF open protocol*. • *Forecast communication*

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 $P_{NOMINAL} - P_{SPINNING\ RESERVE}$: 400 – 250 = 150 kW.

At 150 kW loading, the power management system requests another genset to start (due to the load-dependent start set point).

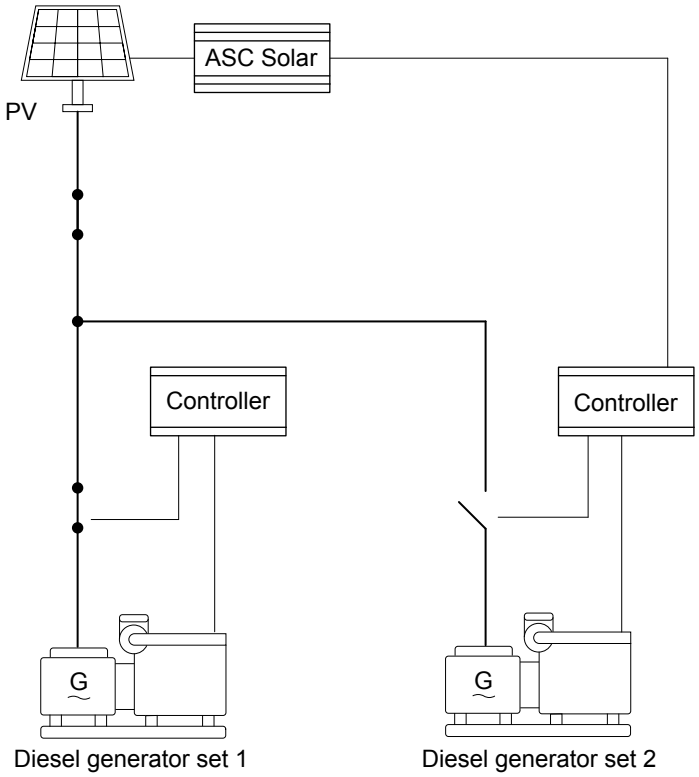
5.9.1 Alarms for spinning reserve

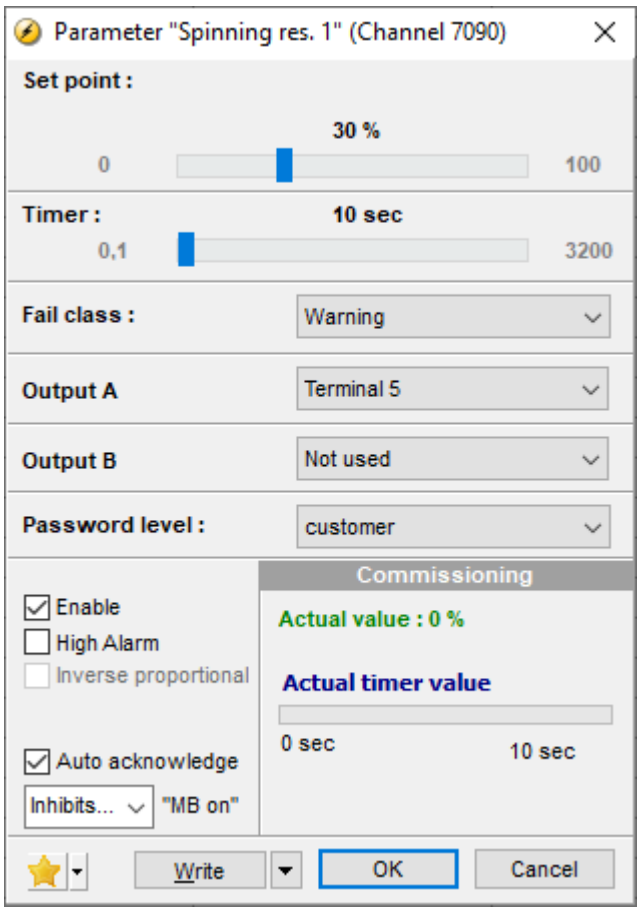
Two alarms are available for the spinning reserve function (menus 7090 and 7100). These alarms can be used in power management applications or in “stand-alone“ applications (that is, fuel save but no genset power management).

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.





Using the spinning reserve alarm for load management

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

5.10 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.

5.11 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 between the running inverters.

5.12 Dynamic frequency response

The AGC-4 Mk II can use the dynamic frequency response (DFR) function to automatically adjust the genset frequency set point, based on the genset load. DFR is designed for systems where photovoltaic (PV) power and a genset are connected. Without DFR, when the PV conditions are good, the PV can produce too much power.

More information
See **Dynamic frequency response** in the **AGC-4 Mk II Designer's handbook**.

6. Solar controller functions

6.1 Inverter set points

The inverters 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 operation).

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.

6.1.1 Reactive set points (kvar)

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

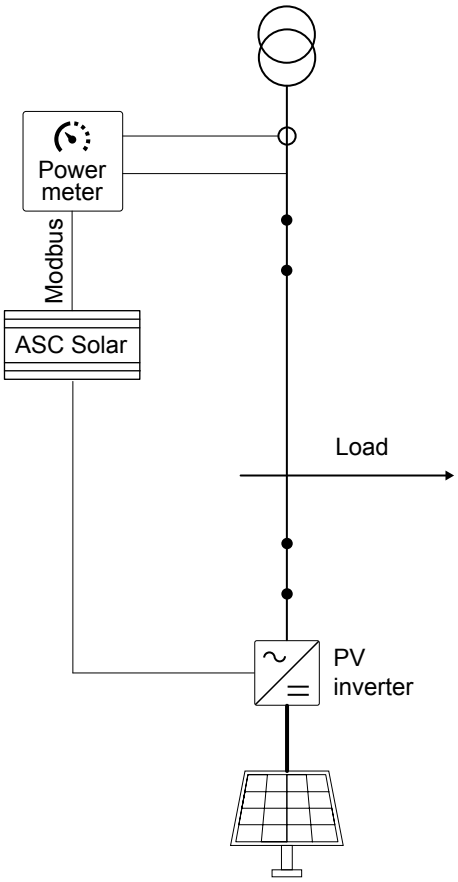
There are parameters for grid-tied and off-grid modes:

Parameter	Name	Default	Grid-tied	Off-grid	Details
7021	Cosphi ref	0.9	•		Use this parameter to configure the fixed power cos phi set point. When the PV is running in parallel to the utility with fixed cos phi reference, it follows this set point.
7022	Cosphi ref	Inductive	•		This parameter makes it possible to select inductive or capacitive reference from the cos phi dispatch.
7023	Q-ref	500 kvar	•		For a fixed Q [kvar], the inverters use the set point in this parameter. The inverters 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	•		See the section below.
7031	DG cosphi lim I	0.8		•	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 will carry the remainder from 0.95 to 0.9. If there are multiple ASC controllers in the application, the set point for this parameter must be the same in each controller.
7032	DG cosphi lim C	1.0		•	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 will supply all Q (under the assumption they support it). If there are multiple ASC controllers in the application, the set point for this parameter must be the same in each controller.
7033	Q type off-grid	Off		•	If equal var sharing (in percent) is requested between the gensets and the inverters, equal kvar sharing can be enabled in this parameter. If

Parameter	Name	Default	Grid-tied	Off-grid	Details
					var sharing is switched off, the settings in parameters 7031 or 7032 will be used.
7041	P/Q limit type	OFF	•	•	See the section below.
7042	P/Q cap limit %	95 %	•	•	See the section below.

7024, Method of var regulation

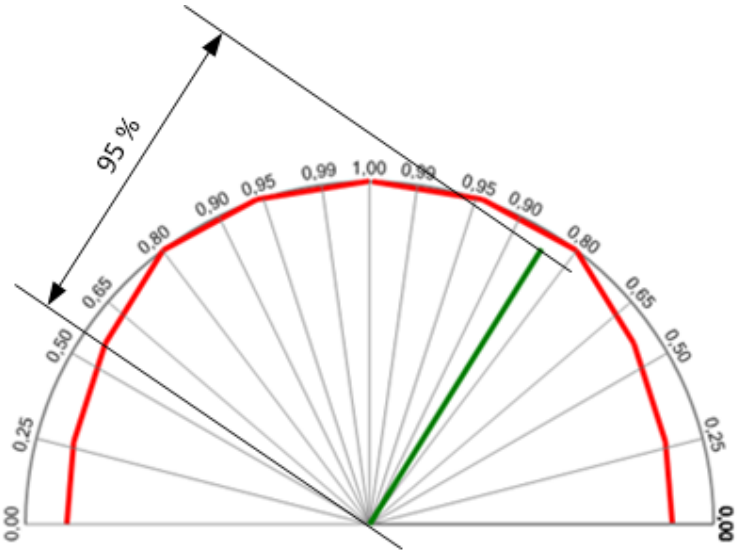
- **Off**: No Q control when the MB is closed or when fixed power mode is selected.
- **Cosphi fixed**: The inverters maintain a fixed cos phi (set in parameter 7021).
- **Cosphi imp/exp**: The inverters are regulated against a cos phi set point in parameter 7021.
  - **Measured at the point of connection**: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

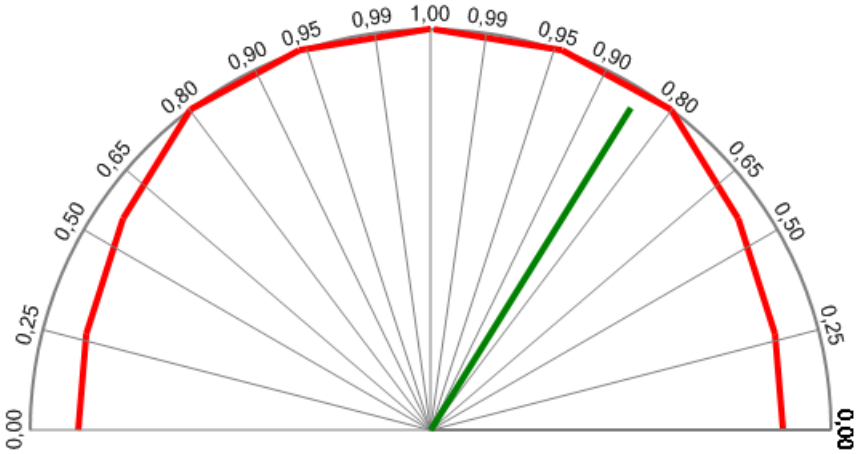


7041, use capability curve

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

Three selections are available:

OFF	The ASC does not limit the reactive power set point to the inverter. This means that the inverter will respond unless it limits itself. Some inverters have internal limits meaning that if the ASC issues a set point on the far side of the limit, the inverter ignores the set point.
Capability curve (Q)	The ASC limits the Q produced by the inverter. 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. 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 operation, the PVs 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 can be regulated according to an adjusted capability curve (explained in the Q-max derate section).

6.2 Penetration ratio

6.2.1 Optimal stability

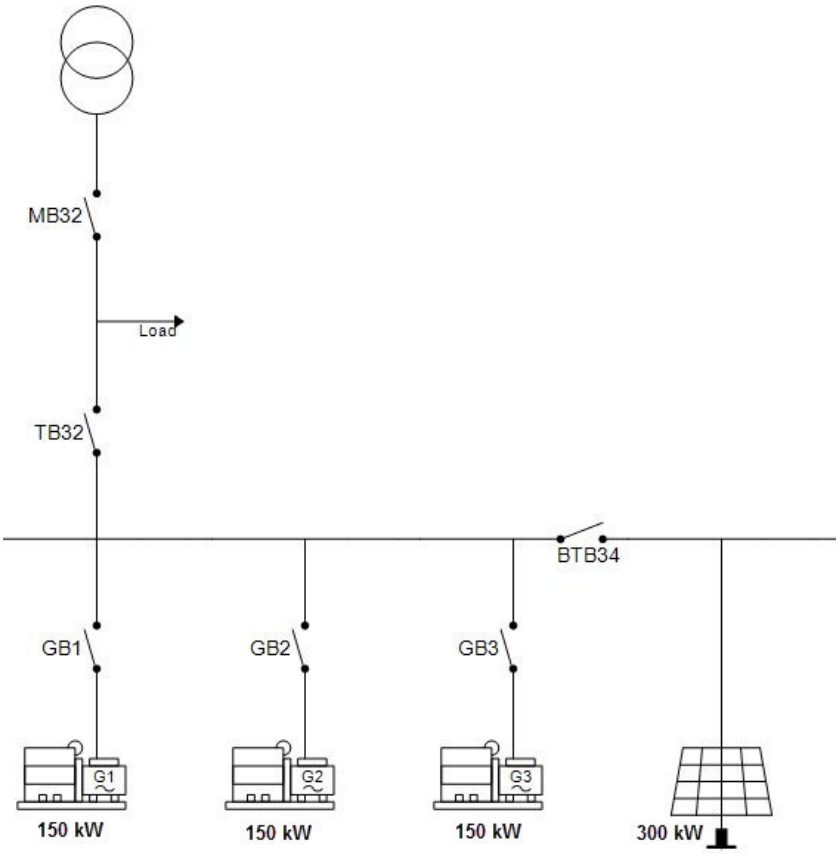
The inverter manufacturers describe a certain penetration rate. Different manufacturers could have different ratios. This could be (example in percent) 25:75, 40:60, 50:50 or 60:40 (PV:Diesel).

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.

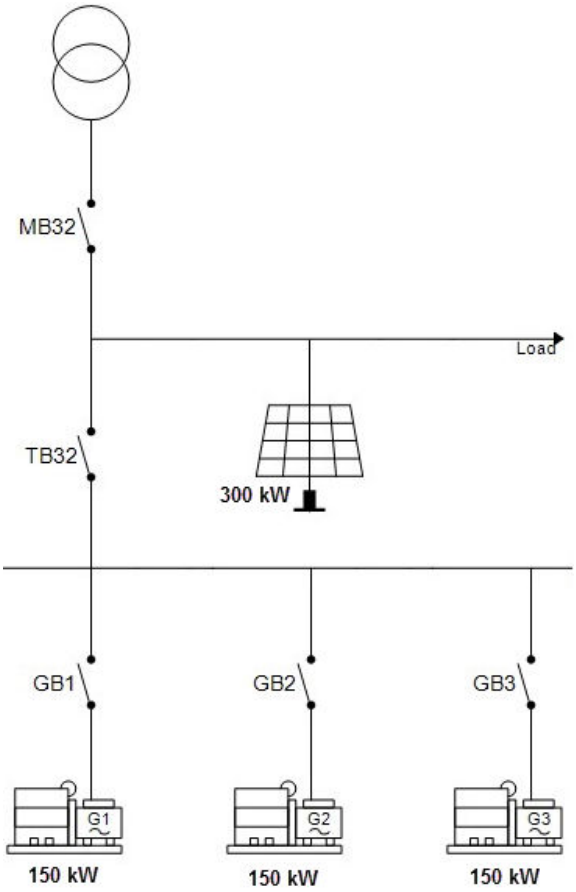
If one genset is too small compared to the PV facility and more than one genset is needed to achieve the correct penetration ratio then a BTB can be used.

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

The PV system can sometimes produce more power than the application needs. To prevent damage, instability, and/or exceeding a power export set point, the ASC reduces the PV set point.

Curtailment is the reduction of the PV power from what could be produced. Curtailment reduces the PV power penetration.

The ASC monitors curtailment, since curtailment shows when the energy production from the PV system is underused.

6.3.2 PV capacity

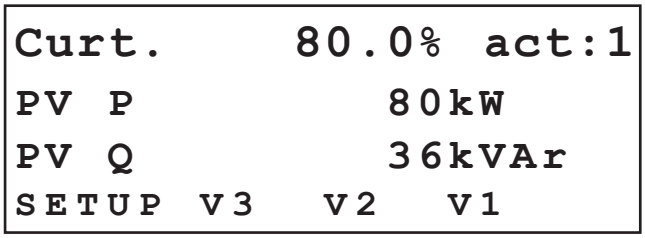
The PV capacity is the maximum PV power that the PV system can produce at a specific time. It is also called *Instant P max*.

The PV capacity calculation is based on the installed number of panels, and their back of module temperatures, as well as the irradiation.

6.3.3 Curtailment example

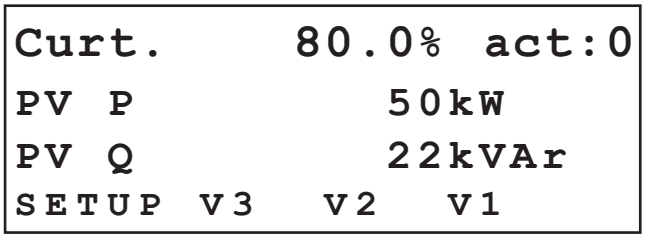
If the PV capacity is 100 kW and the set point requires 100 kW, the PV inverters are not curtailed. If the set point requires 80 kW and the ASC regulates the inverters to run at 80 kW and measures 80 kW, the curtailment is recorded in the curtailment counters. In this example, the curtailment is 20 kW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



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.



6.3.5 Curtailment threshold

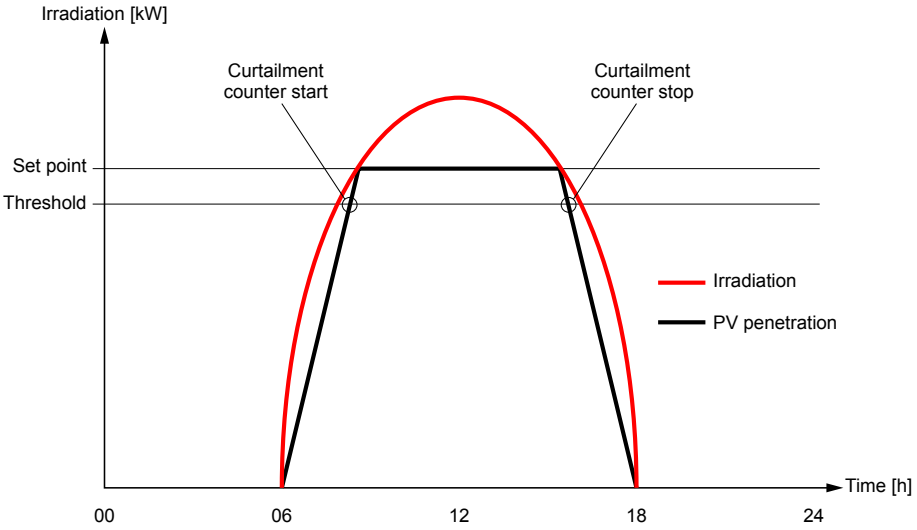
The PV penetration is measured by the ASC. If there are variations from the output of the PV panels compared to the power measured by the ASC, there can be false or missing increments of the curtailment counter.

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.

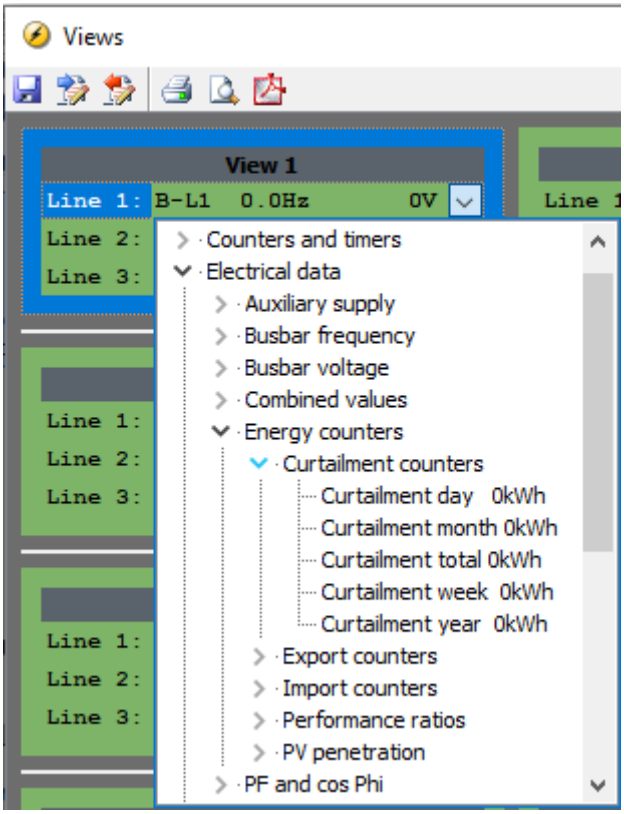
The threshold can be adjusted to match the expected deviation between the two systems, so that the curtailment counter starts at the correct level. The curtailment threshold can be up to 100 % (parameter 7052).

Simplified curtailment threshold diagram



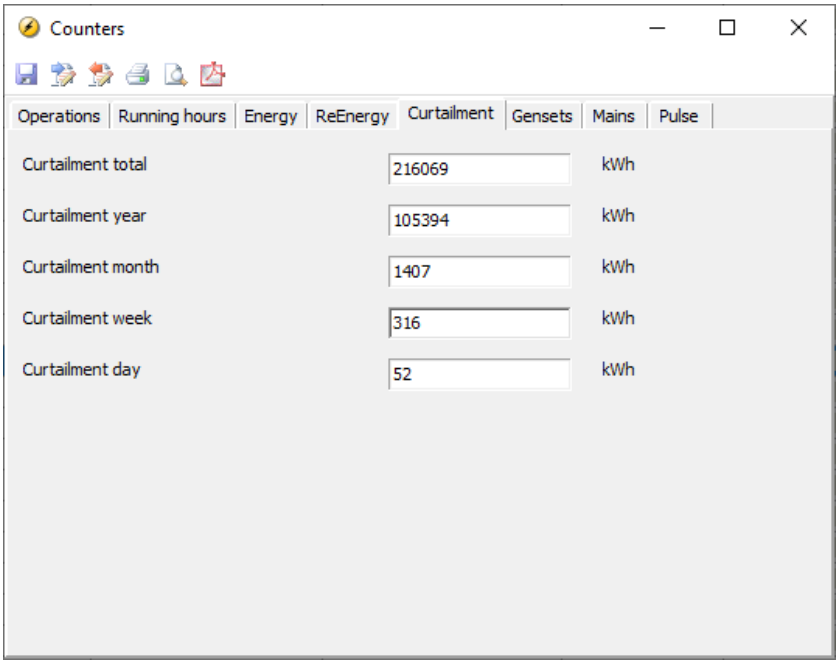
6.3.6 Curtailment counters

Options for the display unit views



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

Curtailment counters in the USW



You can also see and adjust the 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 irradiance	POA	POA is used to calculate the maximum active P that the PV plant can produce. There are three POA sensors (parameters 6271, 6273 and 6275). The irradiance can therefore be measured at up to three locations. The POA sensors can be weighted against each other (parameters 6291, 6292 and 6293), based on the PV capacity at each location.
Back of module temperature	BOM	BOM measurements are used to calculate the maximum active P that the PV plant can produce. There are three BOM sensors (parameters 6281, 6283 and 6285). The back of module temperature can therefore be measured at up to three locations. The BOM sensors can be weighted against each other (parameters 6294, 6295 and 6296), based on the PV capacity at each location.
Global horizontal irradiation	GHI irr.	For Instant P max. calculation, GHI irr. can be used instead of a POA sensor (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 POA and three BOM sensor inputs can be configured. If sensors are missing, a standard value is used for the missing sensors (1000 W/m^2 for POA and 25 °C for BOM).

POA and BOM sensor weighting example

The PV installation has the following locations:

- Area A: 500 panels, 250 Wp each
- Area B: 450 panels, 250 Wp each
- Area C: 600 panels, 265 Wp each

Total installation = 500 x 250 + 450 x 250 + 600 x 265 = 396.5 kWp

- POA and BOM weighting for Area A = 500 x 250 / 396 500 = 32 %
- POA and BOM weighting for Area B = 450 x 250 / 396 500 = 28 %
- POA and BOM weighting for Area C = 600 x 265 / 396 500 = 40 %

The following table shows an example of how the sensor weights can be used during operation.

Area	POA measurement	BOM measurement	Weight	POA contribution	BOM contribution
A	1000 W/m^2	40 °C	32 %	12.8	320
B	1000 W/m^2	30 °C	28 %	8.4	280
C	800 W/m^2	20 °C	40 %	8.0	320
Total				**29.2 °C**	**920 W/m^2**

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
7513	Forec. comm. ID	1 to 247	3	Modbus ID of the forecasting device.
7670	Weat. comm err	-	-	If the communication between the controller and weather station is interrupted, this alarm is activated. Check the communication cable for faults, and whether the communication ID in the controller parameters is the same as the weather station ID.
7631	Forecast prot.	OFF SteadySun SteadyEye Reuniwatt SkyInSight	OFF	See **DEIF hybrid controller compatibility**.
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	GHI	See below.

Parameter	Name	Range	Default	Details
		Power		
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. POA_forecast = GHI_forecast / GHI_measured * POA_measured

POA: This requires a POA sensor. To correct for the panel temperature, the ASC can use the power derating coefficient (parameter 6303) with the back of module (BOM) temperature.

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

6.5 Derate inverter

The inverters have an apparent power rating, so the derate is based on S [kvar]. The inverters can be derated, for example, based on the ambient temperature.

More information
See **Weather data** for Instant P max derating based on BOM and POA readings. P max relates to the Wp of the installed panels.

More information
See **Derate inverter instant Q-Max (capability curve)** for derating of the Q [kvar] production.

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

The derate function allows the controller to reduce the maximum output power of the inverter as required. Up to three derate curves can be used to derate the inverter independently of each other. The first curve active derates 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 ºC (max. 200ºC).

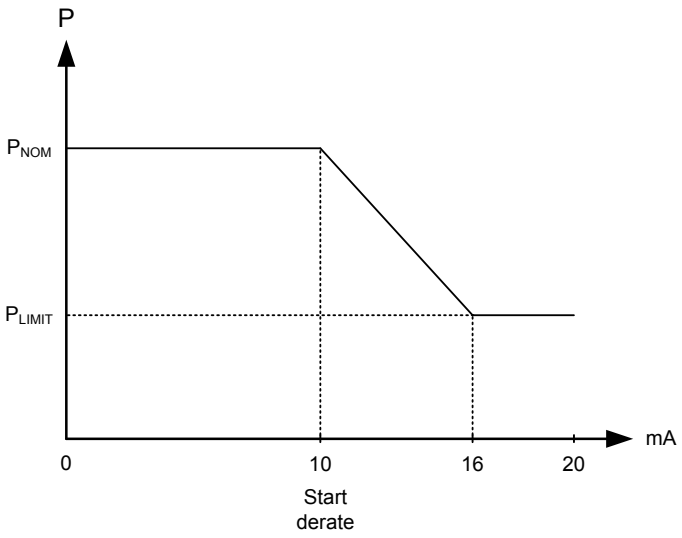
Slope (6243/6253/6263 Instant S max derate)

Adjust the derating speed. The adjustment is in percent per unit. If the 4 to 20 mA input is used, the derating is in %/mA. If the Pt100/Pt1000/RMI input is used, the derating is in %/C.

NOTE For the 4 to 20 mA input, the minimum and maximum settings can be configured. The *Start derate point* and *Slope* settings use these new settings.

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

This is the lowest derate level:

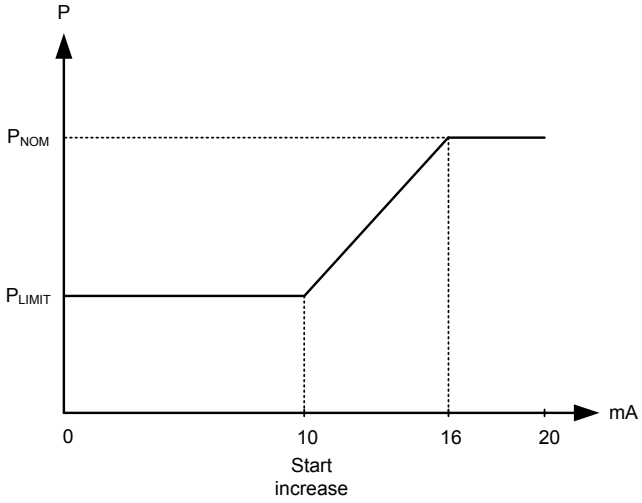


6.5.3 Derate characteristic

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

Select the derate characteristic in *6241/6251/6261 Instant S max derate*. *Enabled*: Proportional derating. *Not enabled*: Inverse proportional derating.

Proportional derating



The inverter is derated when the control value is lower than the set point. In the example above, the control value is a mA signal.

6.6 Derate inverter instant P-max

Three POA (Plane Of Array) sensors and three BOM (Back Of Module) sensors can be connected. In addition, one GHI sensor 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.

Parameters

Parameter	Name	Range	Default	Details
6301	Instant P max.	POA + BOM GHI + BOM No sensors	POA + BOM	Select the basis for the instant P max calculation. See below.
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. • Use > 100 % for reduced sensor output (for example, dirt or shadow on the sensor). • Use < 100 % for sensor output too high (for example, dirt or shadow on the panels).

POA + BOM

The ASC uses the back of module temperature with the plane of array to derate the maximum PV power.

GHI + BOM

The ASC uses the back of module temperature with the global horizontal irradiation to derate the maximum PV power.

No sensors

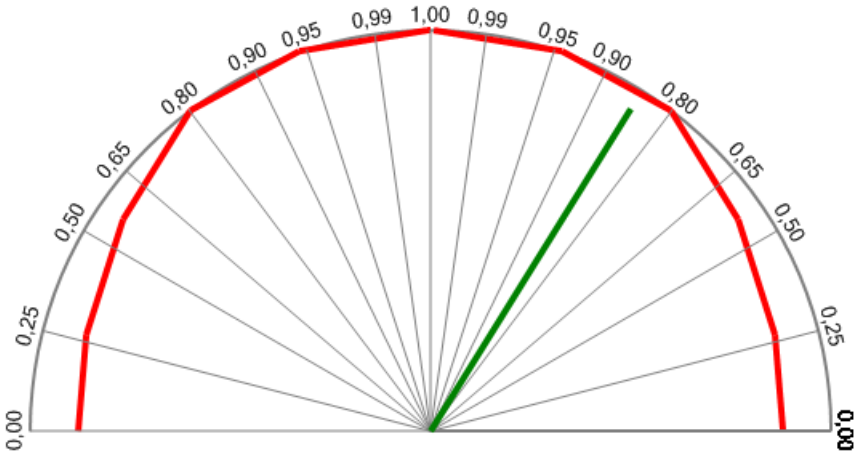
The ASC requests the maximum PV power allowed by the power management system (PMS). This is to make sure that the system uses as much PV power as possible.

Without sensors, the PMS cannot know whether more PV power is available. For power management calculations, the ASC therefore uses the actual PV power.

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.

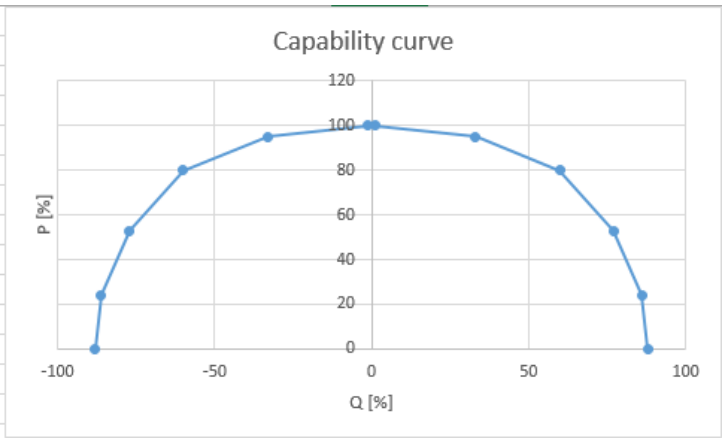


The curve is described by 6 points on the capacitive side and 6 points on the inductive side using these settings:

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	%

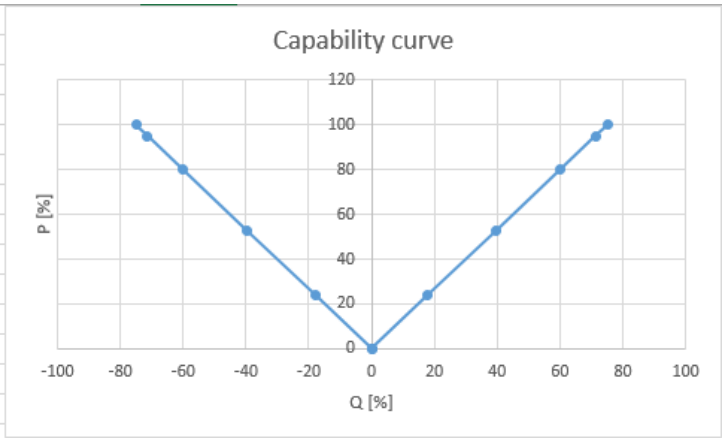
Microsoft Excel is a good tool to use for visualising the graph.

Q	Q (neg)	P
88	-88	0
86	-86	24
77	-77	53
60	-60	80
33	-33	95
1	-1	100
88	88	0
86	86	24
77	77	53
60	60	80
33	33	95
1	1	100



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

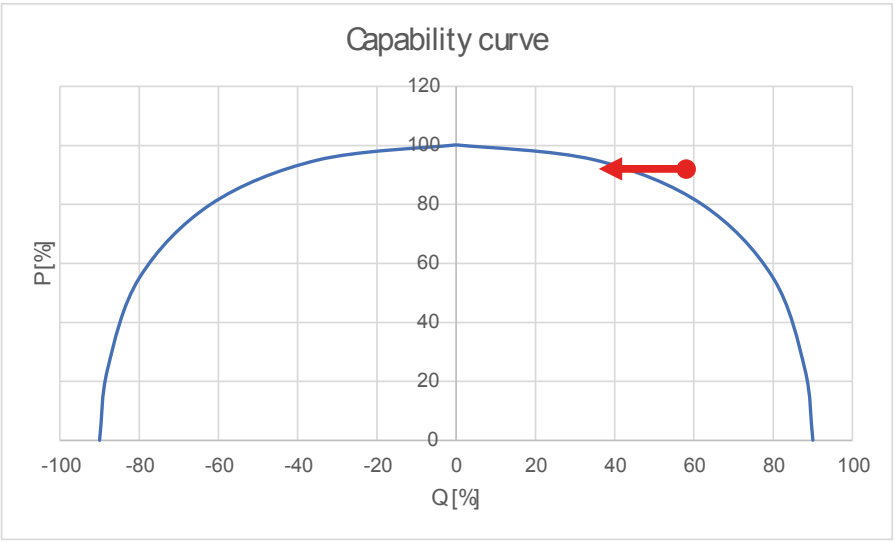
Q	Q (neg)	P
0	0	0
18	-18	24
40	-40	53
60	-60	80
71	-71	95
75	-75	100
0	0	0
18	18	24
40	40	53
60	60	80
71	71	95
75	75	100



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 +/- 0.8PF, 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.

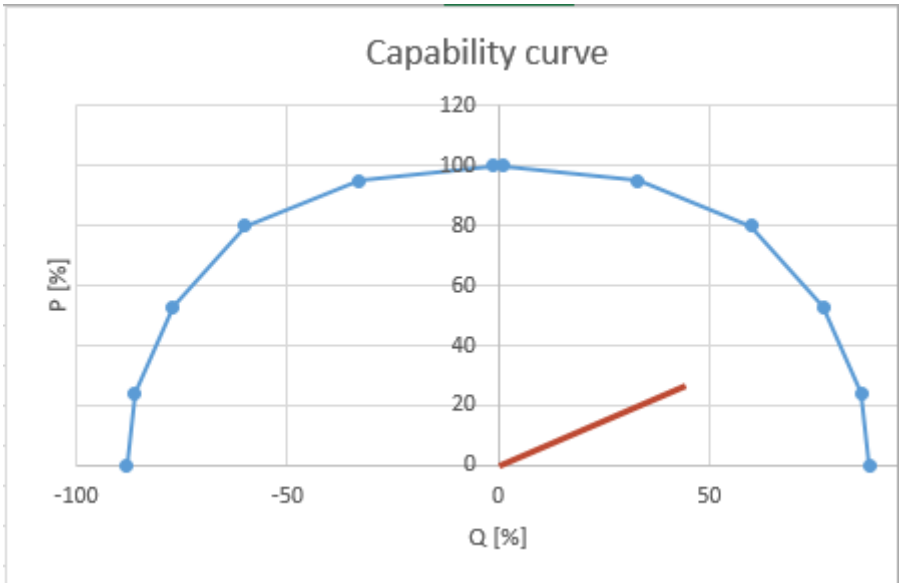
6.7.2 Genset-controlled Power Factor (PF)

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.

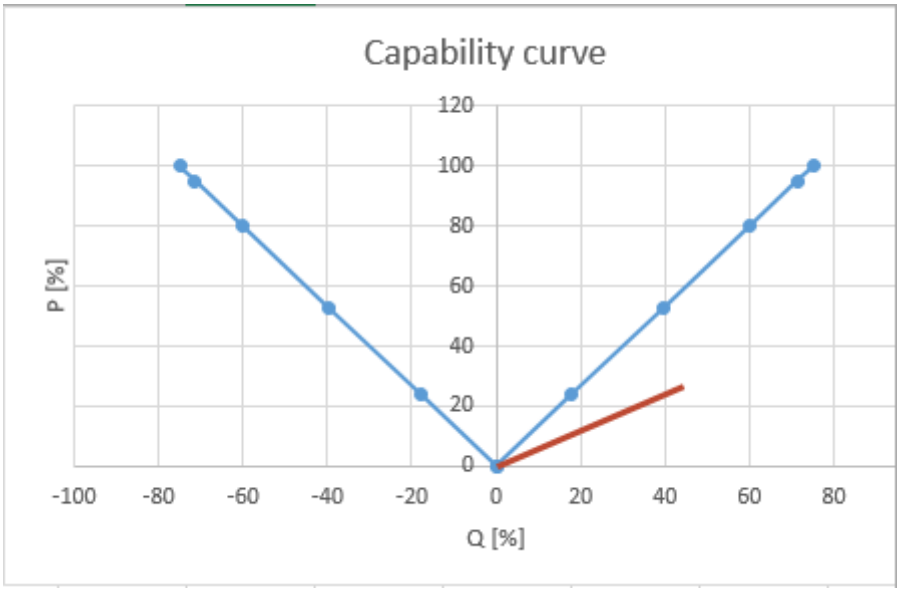
This is done by adjusting the DG limits as requested:

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.



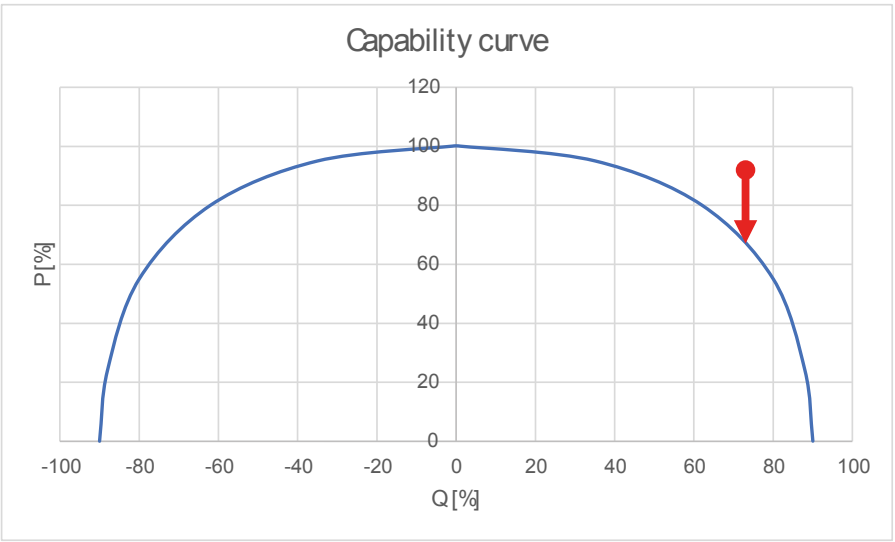
It can be seen that the current running condition is out of the capabilities of the inverters and the set point will (typically) be ignored (depends on inverter design).

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

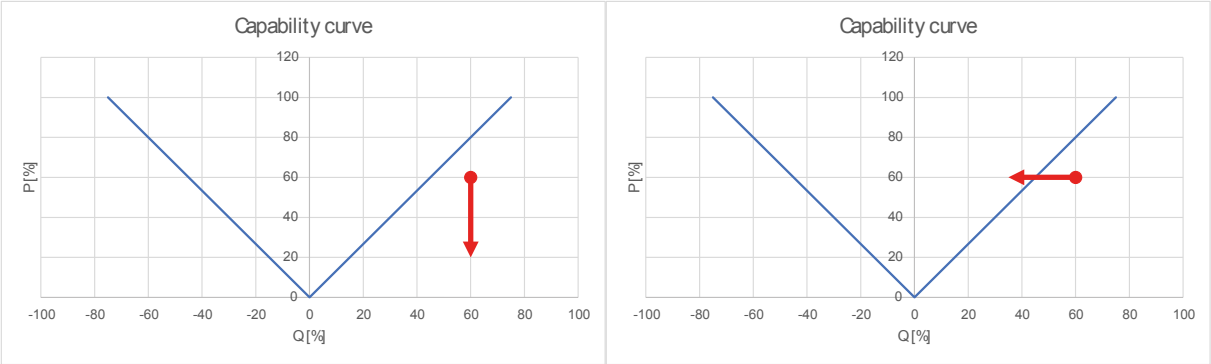
6.7.3 P derate based on capability curve

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

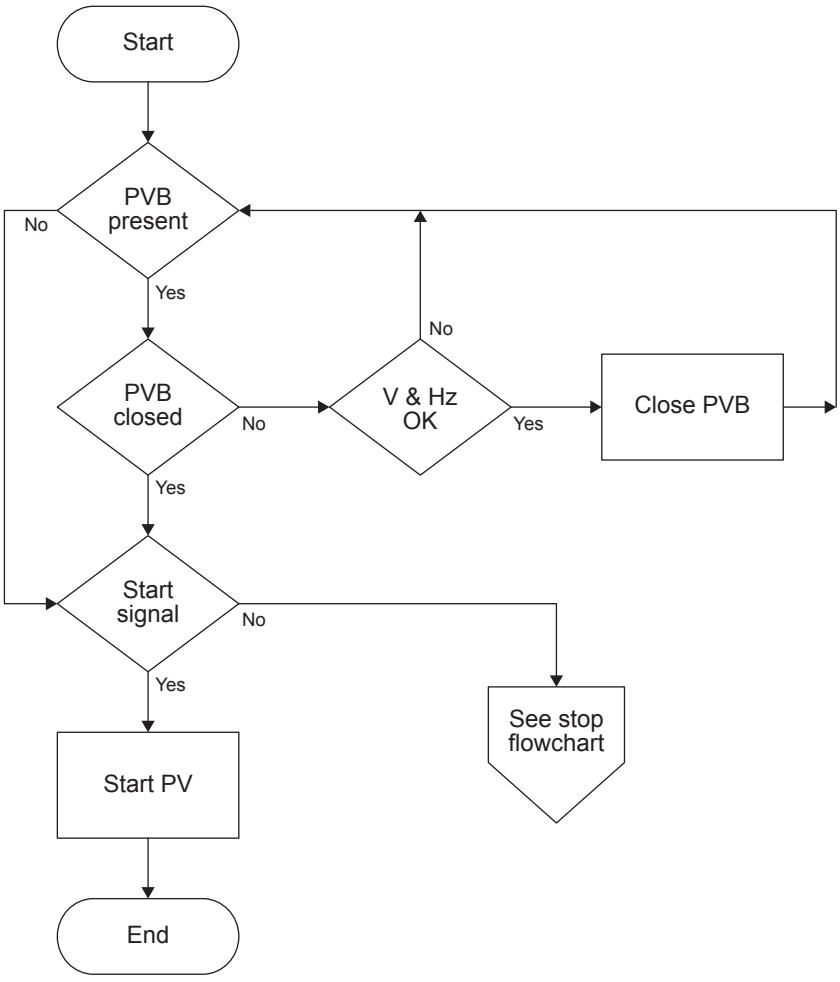
The following flowcharts show the most important function principles. The functions included are:

- Start sequence
- Stop sequence

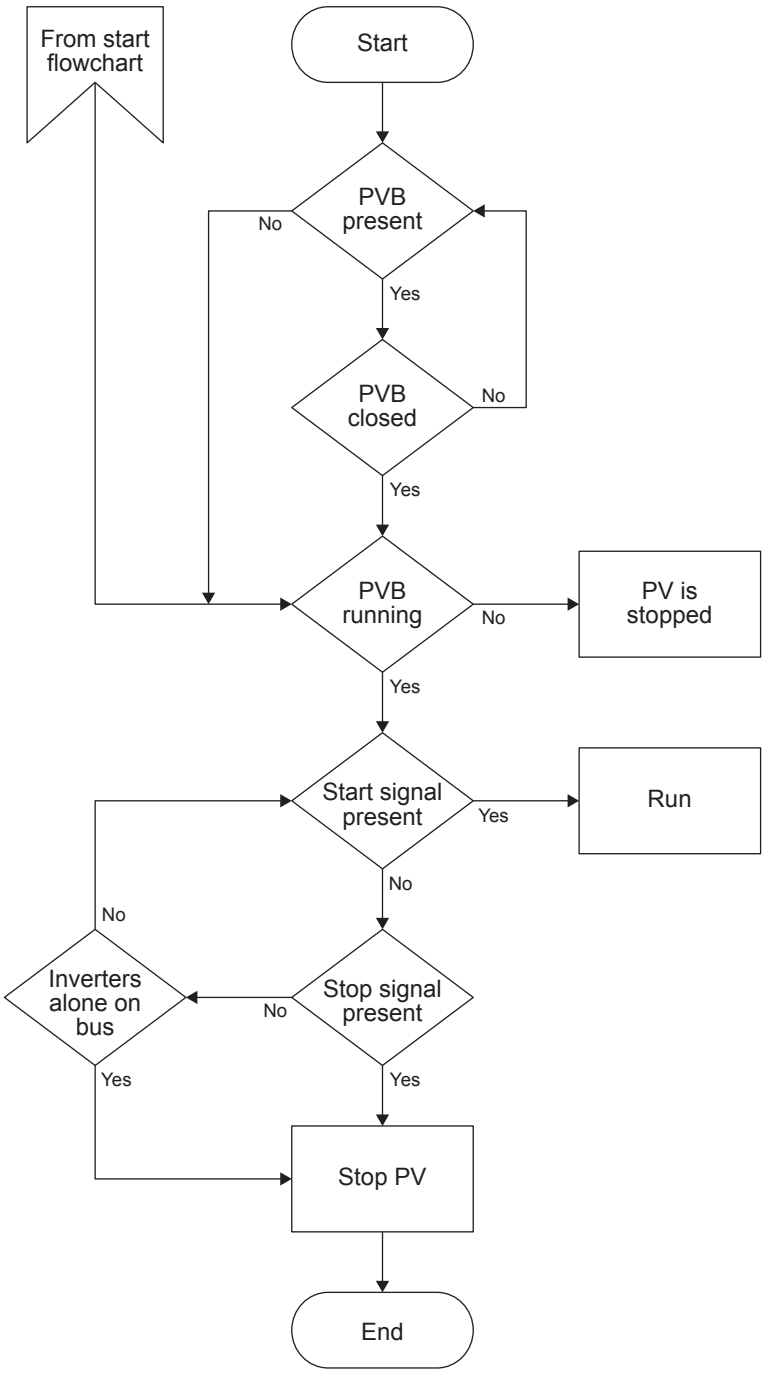
Flowcharts for the mode descriptions are in the **AGC Designer's handbook**.

NOTE These simplified flowcharts are only for guidance.

6.8.2 Start sequence



6.8.3 Stop sequence



6.9 Modes of operation

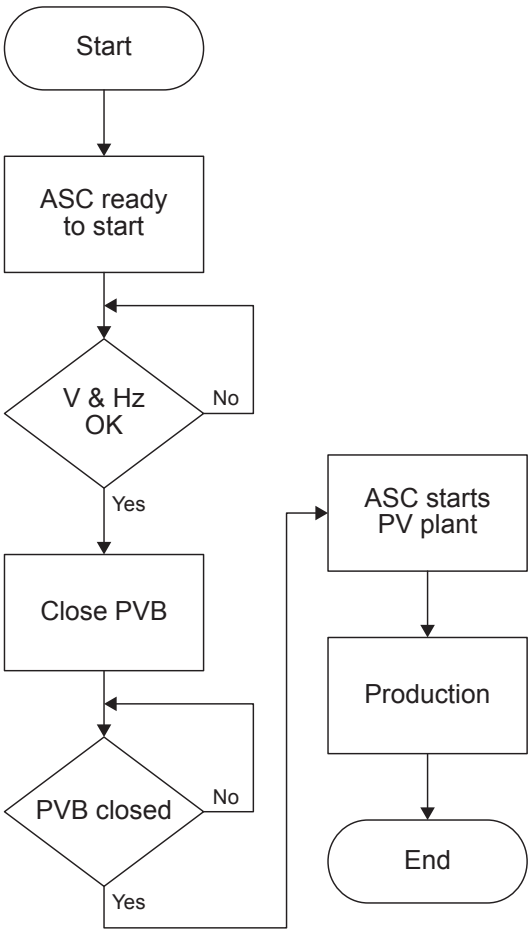
6.9.1 Operation mode

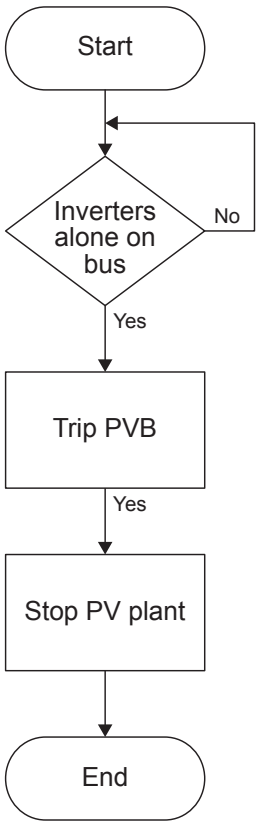
The ASC can be operated in semi mode (local) or in automatic mode (remote). In automatic, the system will close the PV breaker (if present) and start PV penetration if the plant has a start signal.

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.

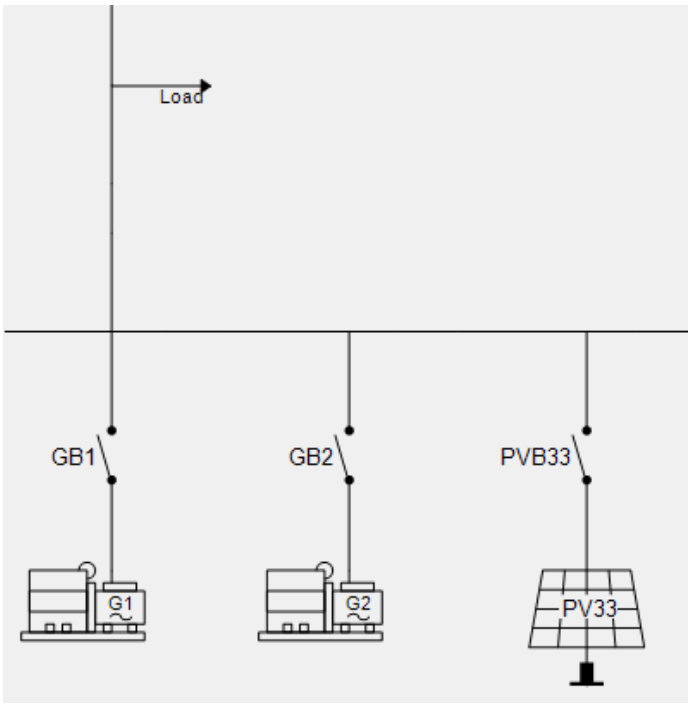
- If the PVB is open, the PV plant is stopped.





6.9.2 Island start

This is how the plant starts in island operation (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 Island operation

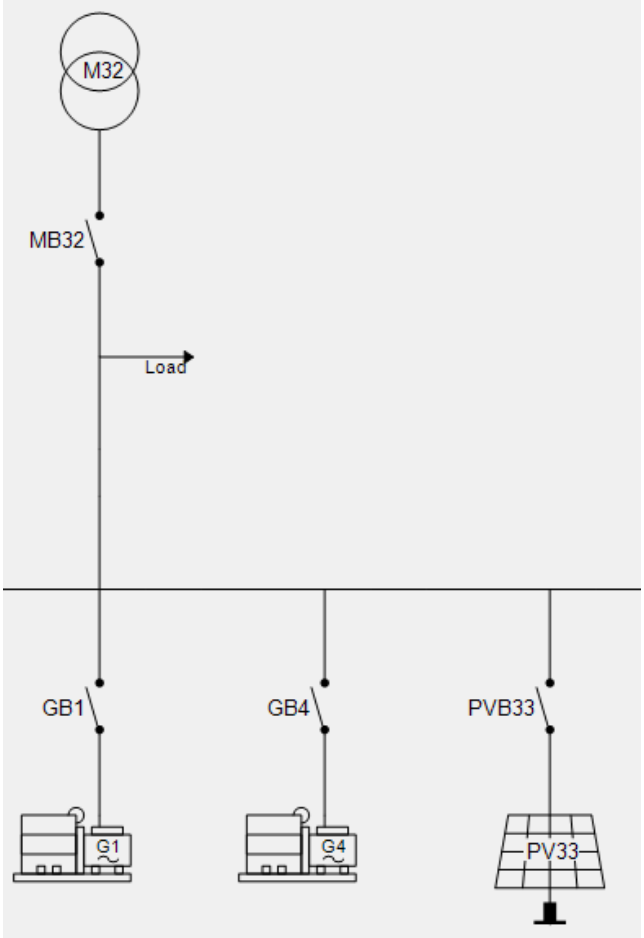
During island operation the connected genset load can be between -50 and 100 % of engine nominal power. The *Min DG load 01/02* parameters on the ASC are shared parameters that ensure all engines connected to the busbar are loaded to the same level. Since the gensets are in frequency control mode, the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

6.9.4 Parallel mains start

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

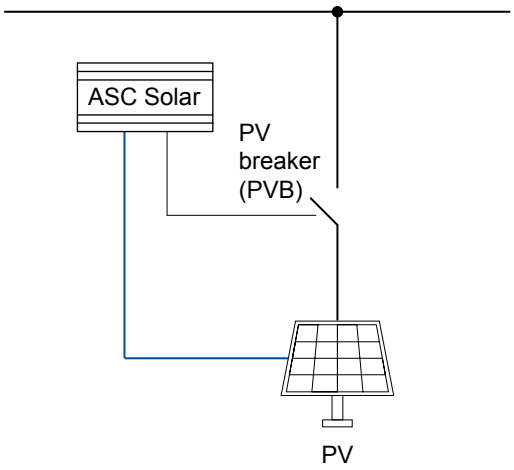


1. Activate the start signal on the AGC Mains.
2. When the mains breaker is closed and the busbar is energised, PV penetration starts.

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.

6.9.5 Fixed power

Single-line diagram



AUTO mode

When the controller is in AUTO mode, it automatically starts the PV system and connects to the busbar. The fixed power is sent to the PV system as the set point. If the PV system can produce more power than required, it is curtailed.

For fixed power, the controller does not need power measurements from other power sources, for example, the mains power measurement.

SEMI AUTO mode

If the PV system is already connected to the busbar, as required, the PV is curtailed so that it does not exceed the fixed power set point.

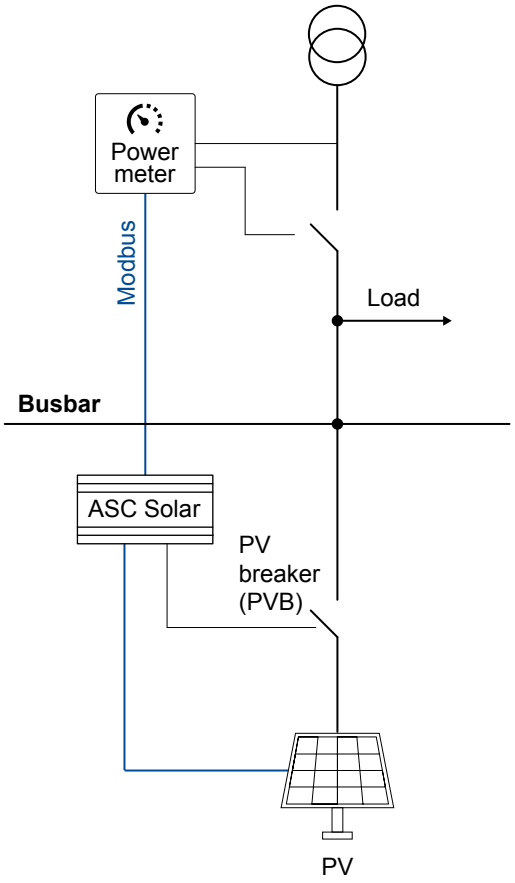
If the PV system is not connected to the busbar, the operator has to start the PV system and close the PV breaker.

Parameters

Parameter	Text	Range	Default
7001	Fixed power	0 to 20000kW	500 kW
7002	FP scale	1kW:1kW 1kW:10kW 1kW:100kW 1kW:1000kW	1kW:1kW

6.9.6 Mains power export

Single-line diagram



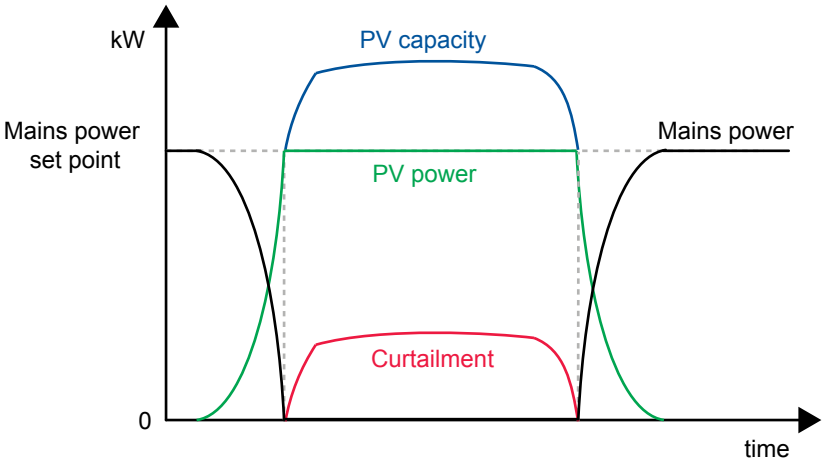
AUTO mode

The mains power export mode can be used to maintain a constant level of exported or imported power through the mains breaker.

The mains power measurement is required. See **Mains power measurement**.

The ASC monitors the mains power. As required, the ASC curtails the PV power, so that the mains power export set point is not exceeded.

Mains power export example



SEMI-AUTO mode

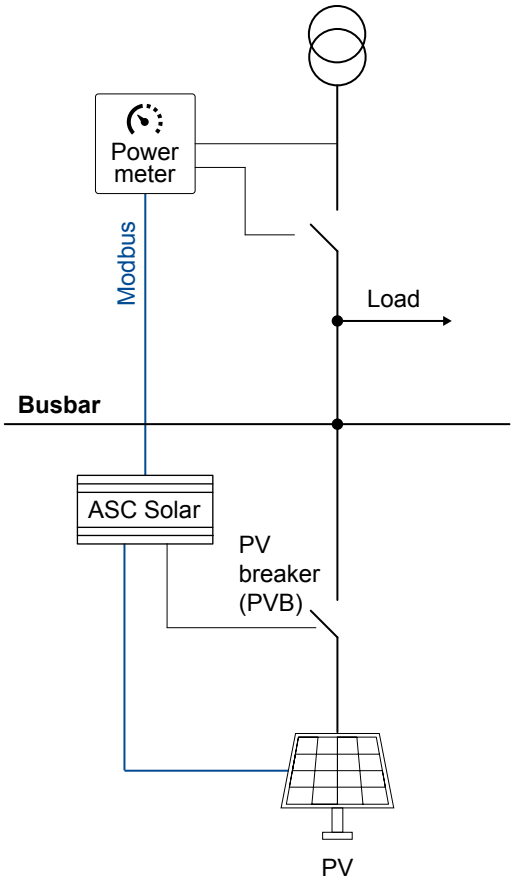
When the PV is paralleled to the mains, as required, it is curtailed to meet the mains power export set point.

Parameters

Parameter	Text	Range	Default
7012	Mains power exp.	-20000 to 20000kW	1000 kW
7013	MPE/PS scale	1kW:1kW 1kW:10kW 1kW:100kW 1kW:1000kW	1kW:1kW

6.9.7 Peak shaving

Single-line diagram

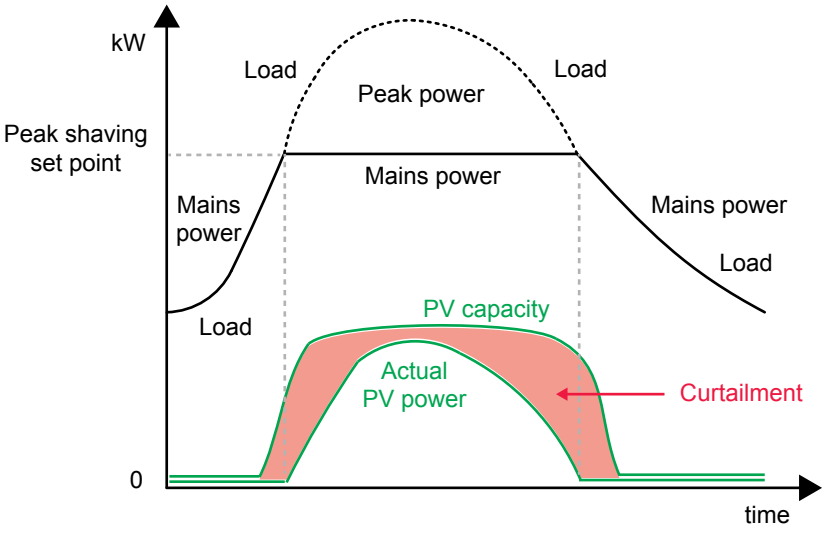


AUTO mode

When the mains import increases above the maximum mains import set point, the PV system supplies the extra load, to keep the mains import at the maximum import level.

The mains power measurement is required. See **Mains power measurement**.

Peak shaving example



SEMI AUTO mode

When the PV system is parallel to the mains, as required, the PV is curtailed according to the peak shaving set point. The maximum mains import is not exceeded in spite of the SEMI AUTO mode.

Parameters

Parameter	Text	Range	Default
7011	Peak shaving	-20000 to 20000kW	750 kW
7013	MPE/PS scale	1kW:1kW 1kW:10kW 1kW:100kW 1kW:1000kW	1kW:1kW

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 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 on the running status of the inverter.

6.11.1 Inverter running

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

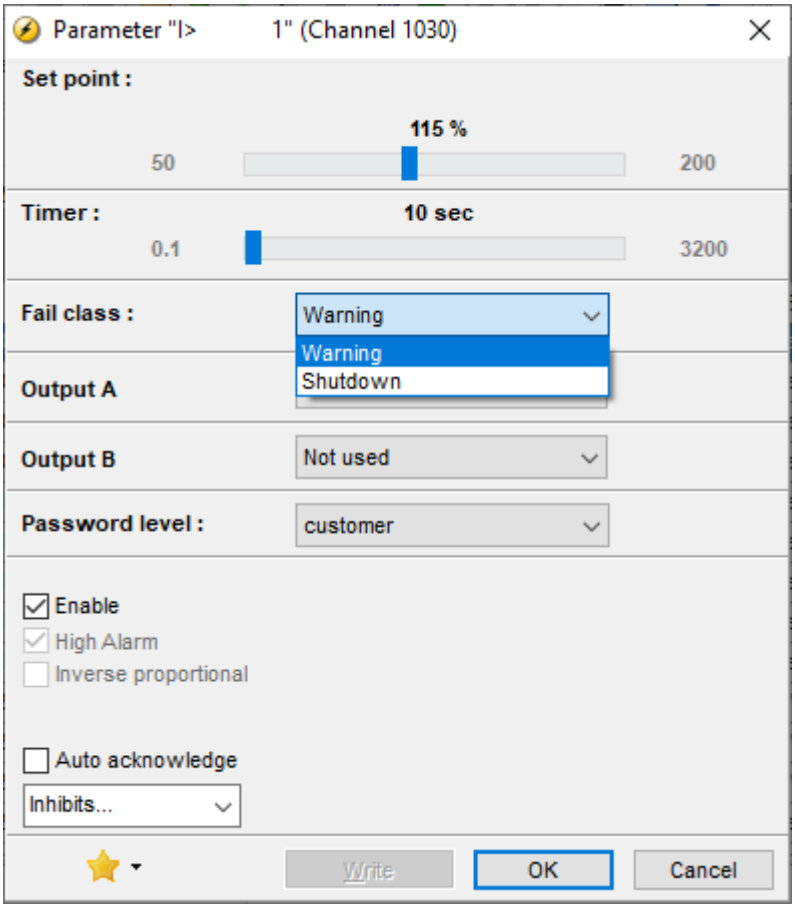
Example: An alarm with the fail class *Shutdown* is activated:

- 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).

6.11.2 Inverter stopped

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

6.11.3 Fail class selection



Using the display or the utility software, you can select a fail class for each alarm.

6.12 Alarm inhibit

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

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.

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 (single controller application).
MB off	The mains breaker is open (single controller 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).

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

6.13 Other functions

6.13.1 Busbar AC measurements

Parameter	Name	Range	Default	Details
7053	BB PV V/f meas	ASC measurements PV communication	ASC measurements	**ASC measurements**: The ASC uses its own measurements for the busbar voltage and frequency. **PV communication**: The ASC uses the measurements from the PV communication for the busbar voltage and frequency. See the requirements below.

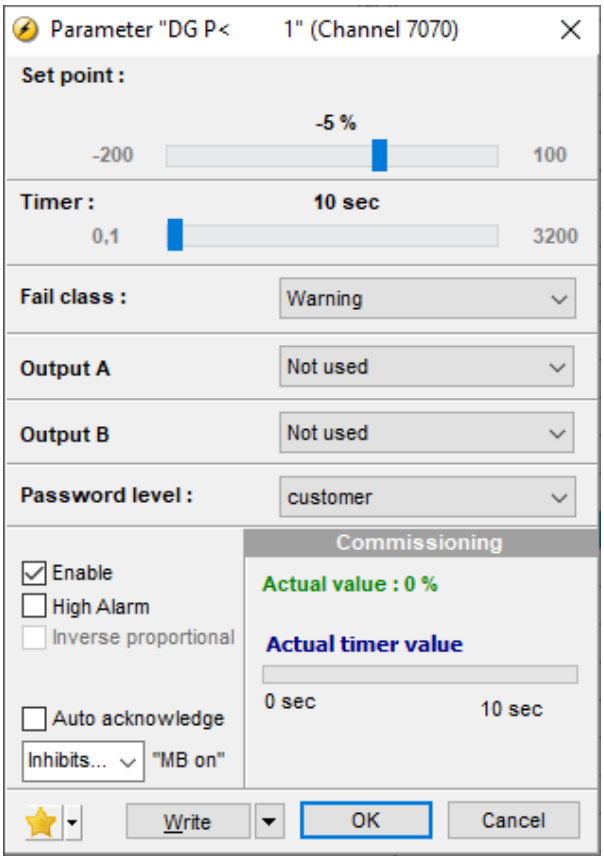
Requirements for measurements from PV communication

- **Externally controlled PV breaker, or no PV breaker**: If the application is changed so that the ASC controls the PV breaker, the ASC activates the *Unsupported application* alarm.
- **Voltage and frequency values must be available from the inverter(s)**: The inverter protocol must include these values.
- **Communication with the inverter(s)**: If the ASC cannot communicate with the inverter(s), it activates the *PV comm. error* alarm (menu 7570).

6.13.2 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.



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

6.13.3 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 Modbus RTU (RS-485), the maximum number of inverters is typically 32.

For Modbus TCP, the maximum number of inverters is limited by the TCP setup. If there are more than 32 inverters, a splitter is also required.

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.

6.13.4 Continuous writing of P/Q

In general, you can enable writing the **P ref** to the inverter(s) in *P reference* (parameter 2781). Similarly, you can enable writing the **Q ref** to the inverter(s) in *Q reference* (parameter 2782).

Some inverters cannot process a lot of data from the ASC. For these inverters, use *P ref. enable* (parameters 2783) and *Q ref. enable* (parameter 2784) to disable continuous writing of **P ref** and **Q ref**.

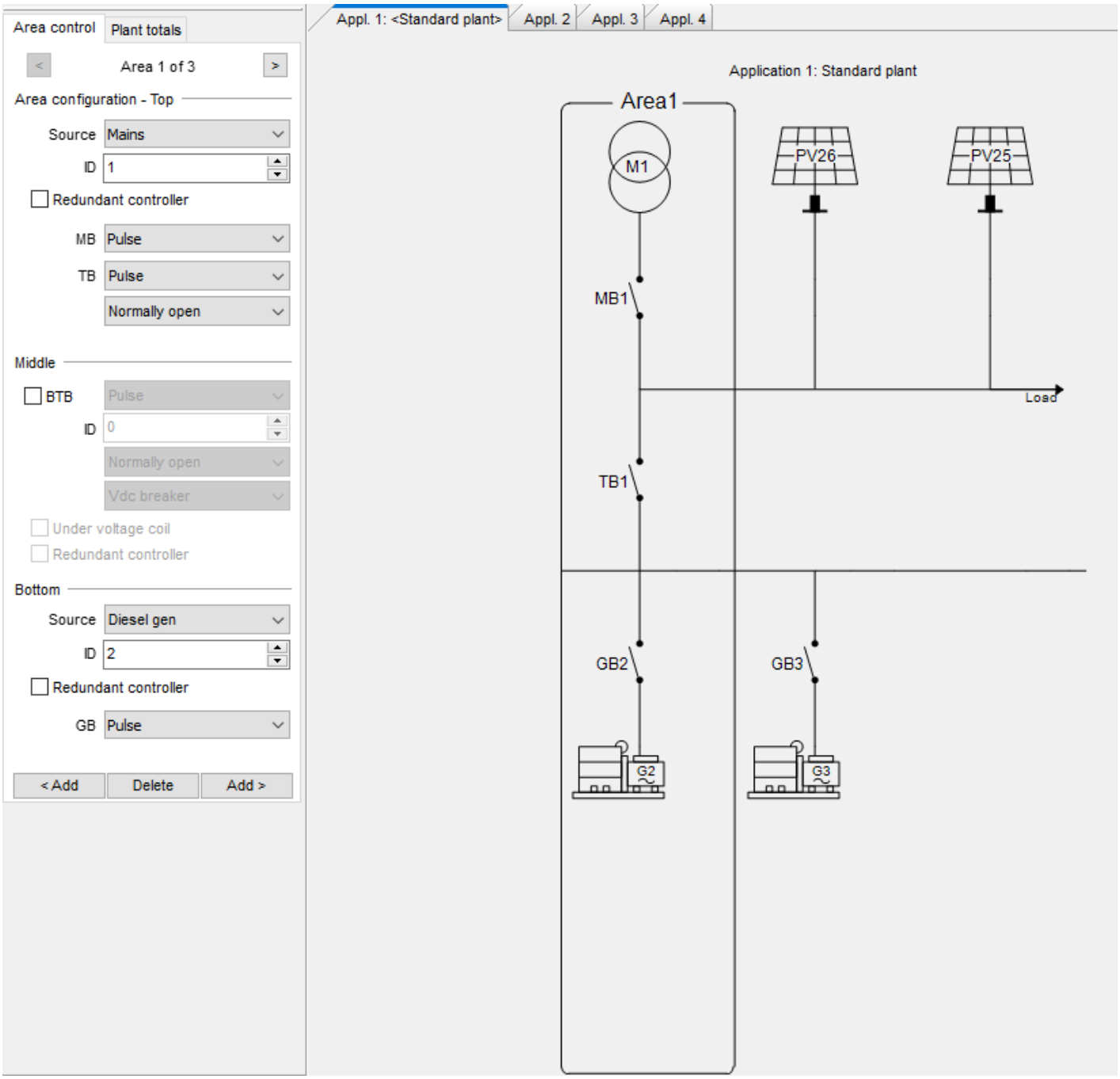
Note: This feature is only available when using the **SunSpec Generic** PV protocol.

Parameter	Name	Range	Default	Details
2783	P ref. Enable	Enabled Not enabled	Enabled	**Enabled**: The controller continuously sends the state of the **P reference** parameter (2781) to the inverter. **Not enabled**: The controller only sends the state of the **P reference** parameter (2781) to the inverter when the state changes.
2784	Q ref. Enable	Enabled Not enabled	Enabled	**Enabled**: The controller continuously sends the state of the **Q reference** parameter (2782) to the inverter. **Not enabled**: The controller only sends the state of the **Q reference** parameter (2782) to the inverter when the state changes.

6.13.5 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.

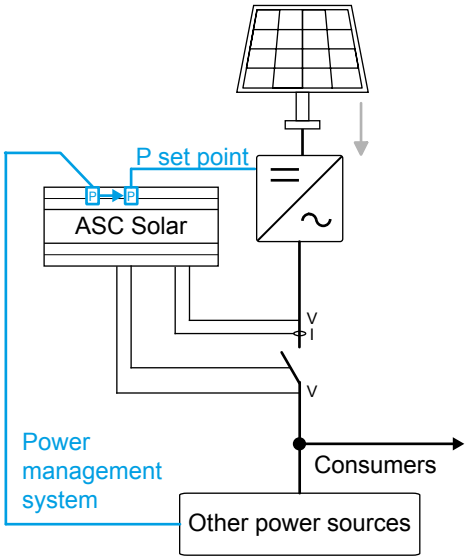
Here is an example of a plant with two gensets, a mains feeder, and two PV power sources connected to the load point.



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 utility software.

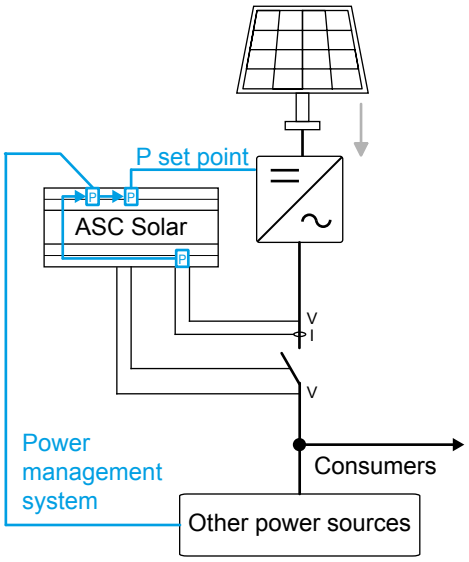
6.13.6 Closed loop

Open loop



By default, *Closed loop* (parameter 2631) is **Not enabled**. The ASC sends the power set point from the power management system to the PV system.

Closed loop



To use the closed loop function, select **Enable** for *Closed loop* (parameter 2631).

The closed loop function is useful if:

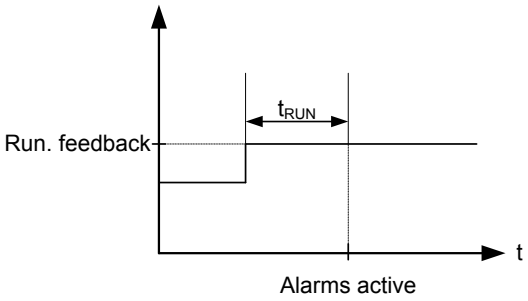
- One or more PV inverters do not produce the expected power. This may be due to different PV panel angles. PV failures and/or manual stops can also cause lower than expected power.
- The inverters are very far from the ASC.

To compensate, the ASC can use its AC measurements to adjust the power set point to the PV system.

6.13.7 Run status alarm

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

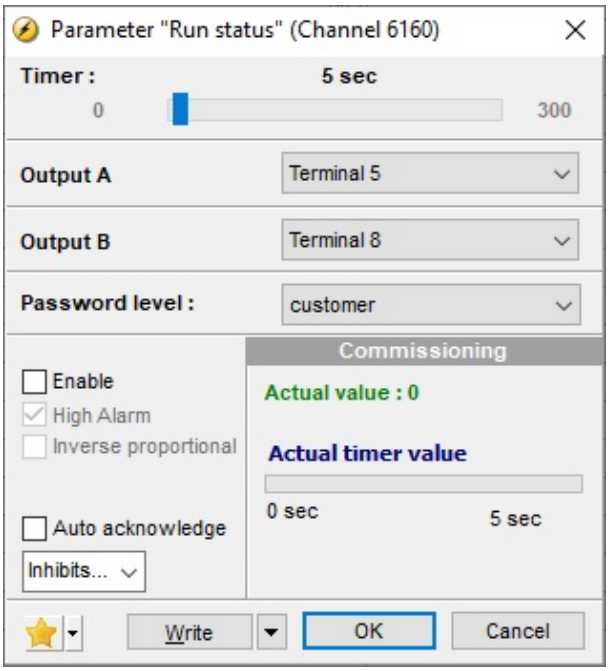
The diagram shows that after the running feedback is activated, the run status delay expires. When the delay expires, the *Run status* alarm (6160) is activated.



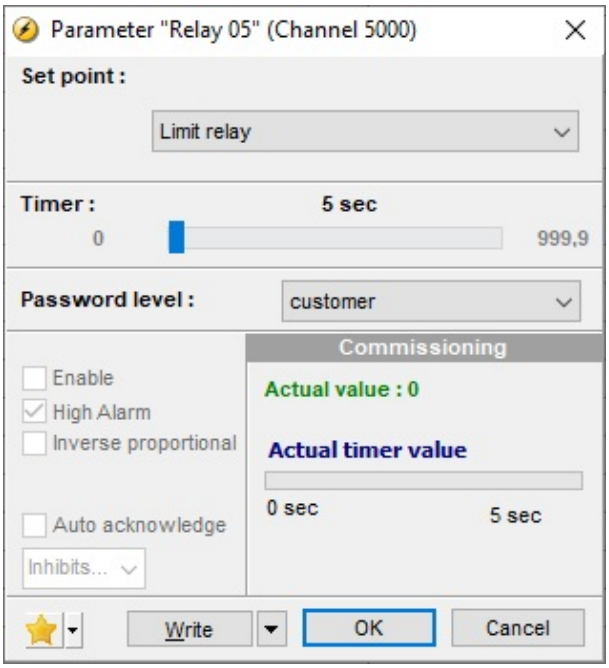
NOTE The timer is ignored if digital running feedback is used.

6.13.8 Running output

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



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.



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

6.13.9 Other parameters

Set point control

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

Inverter communication configuration (ASC is Modbus client)

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 inverters included in the PV monitoring scheme.
7514	Ext. comm 1 spd	9600 Baud 19200 Baud	9600 Baud	Select communication speed for external communication 1.
7515	Broadcast ID	0 to 255 Not enabled, Enabled	0 Not enabled	If enabled, this ID is used as the broadcast ID for write telegrams.
7520	Ext. comm 1 err	1 to 100 s	10 s	External communication 1 alarm.

Parameter	Name	Range	Default	Details
		Not enabled, Enabled	Not enabled	

7. General functions

7.1 Standard functions

Operation modes

Grid-tied, off-grid, or combination (grid-tied and off-grid):

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

Protections (ANSI)

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

Busbar protections (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
- Buttons for start and stop
- 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

7.2 Measurement systems

The AC configuration can be three-phase, split-phase, or single-phase.

More information
See **AC connections** in the **Installation instructions**.

Parameter	Name	Range	Default
9130	AC config.	3 phase L1L2L3 2 phase L1L3 2 phase L1L2 1 phase L1	3 phase L1L2L3

NOTE The settings can also be changed using the display. Push the JUMP button, then go to menu 9130.

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.

7.2.1 Three-phase system

By default, the controller is configured for a three-phase system. All three phases must be connected to the ASC. You must configure the following parameters.

Parameter	Name	Description	Set point
6004*	Nom. U voltage	Phase-phase voltage of the source	For example, for a 400/230 V AC system, use 400 V AC
6041	BA transformer	Primary voltage of the source voltage transformer (if installed)	Primary source U_{NOM}
6042	BA transformer	Secondary voltage of the source voltage transformer (if installed)	U_{NOM}
6051**	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	Primary transformer 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	Busbar U_{NOM}

NOTE * The ASC has four sets of nominal settings. Set 1 is shown in this table. Use parameter 6045 to select which set is used.
NOTE ** The ASC has two sets of BB transformer settings. Set 1 is shown in this table. Use parameter 6054 to select which set is used.

7.2.2 Single-phase system

A single-phase system consists of one phase and the neutral. You must configure the following parameters.

Setting	Adjustment	Description	Adjust to value
6004*	Nom. voltage	Phase-phase voltage of the source	For example, for a 230 V AC system, U_{NOM} = 230 V AC***
6041	BA transformer	Primary voltage of the source voltage transformer (if installed)	Primary source $U_{NOM} \times \sqrt{3}$
6042	BA transformer	Secondary voltage of the source voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
6051**	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	Primary transformer $U_{NOM} \times \sqrt{3}$
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	Busbar $U_{NOM} \times \sqrt{3}$

NOTE * The ASC has four sets of nominal settings. Set 1 is shown in this table. Use parameter 6045 to select which set is used.
NOTE ** The ASC has two sets of BB transformer settings. Set 1 is shown in this table. Use parameter 6054 to select which set is used.
NOTE *** The voltage alarms use U_{NOM}.

7.2.3 Phase-phase or phase-neutral measurements

The AC protections can use phase-phase or phase-neutral measurement.

Parameter	Name	Range	Default	Details
1201	PV voltage trip	Ph-Ph Ph-N	Ph-Ph	To configure this parameter, look at how the loads in the application are connected. If many of the loads are connected as phase-neutral, select 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

7.3 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.

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.

7.3.1 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

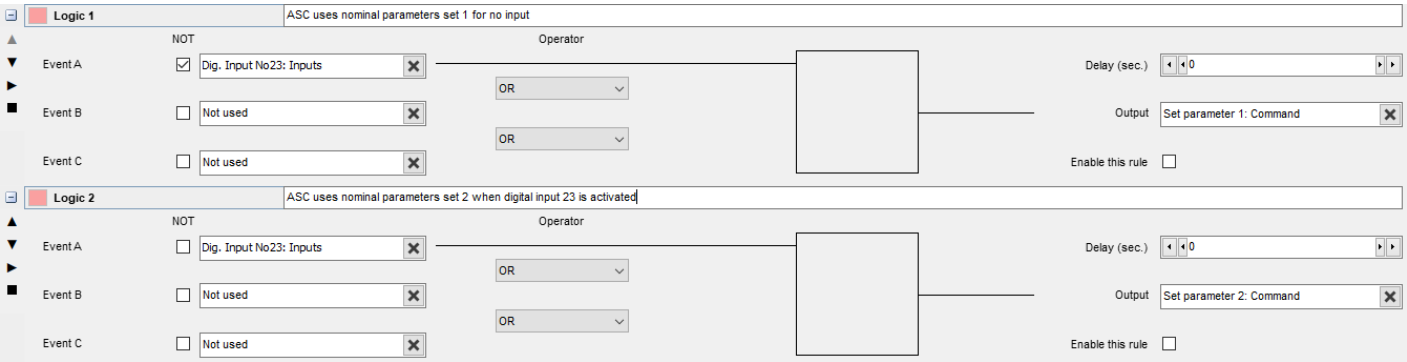
Switching between the nominal set points can be done in the following ways:

- 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



AOP

In M-Logic, select the AOP tab. Select buttons as the input events. 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.

7.3.2 Scaling

To handle applications above 2500 V or below 100 V, you can adjust the scaling to match the primary voltage transformer. Master password level access is required to change this parameter. Changing the voltage scaling also affects the nominal setting ranges.

Scaling set point (9030)	Range for nominal power	Range for nominal voltage	Range for transformer primary (6041, 6051, 6061)
100V-25000 V (default)	10 to 20000 kW	100 V to 25000 V	100 V to 25000 V
10V-2500V	1 to 900 kW	10 V to 2500 V	10 V to 2500 V

CAUTION

Incorrect configuration is dangerous

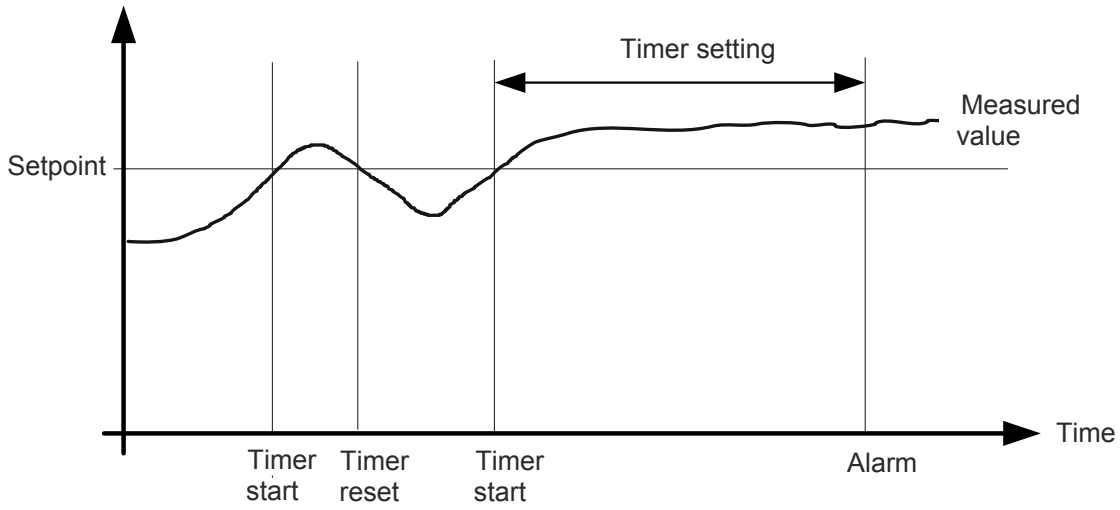
All nominal settings and the primary VT settings must be corrected after the scaling has been changed in parameter 9030.

7.4 Protections

7.4.1 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.

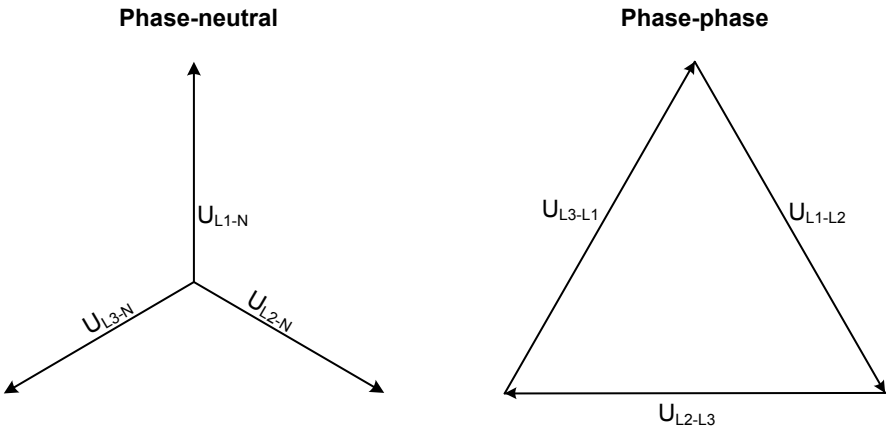


When the timer runs out, the output is activated. The total delay will be the delay setting + the reaction time.

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 % of Un +/-0 % ≤ U ≤ 110 % +/-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 +/-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

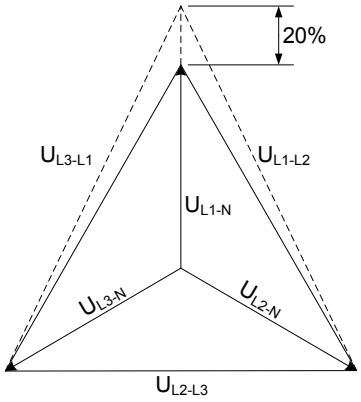
The below 400 V AC system shows that the phase-neutral voltage must change 20 %, when the phase-phase voltage changes 40 volts (10 %).

Example:
U_{NOM} = 400/230 V AC

Error situation:
U_{L1L2} = 360 V AC
U_{L3L1} = 360 V AC

U_{L1-N} = 185 V AC

ΔU_{PH-N} = 20 %



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

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

7.5.1 M-Logic events

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

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	16 power meters with 4 inputs each.
PV power meter inputs	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.
Flip flops	16 functions to use in M-Logic.

7.5.2 M-Logic outputs

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

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.

Output group	Description
MB feedbacks	Activate MB feedback.
Flip flops	16 functions to use in M-Logic.

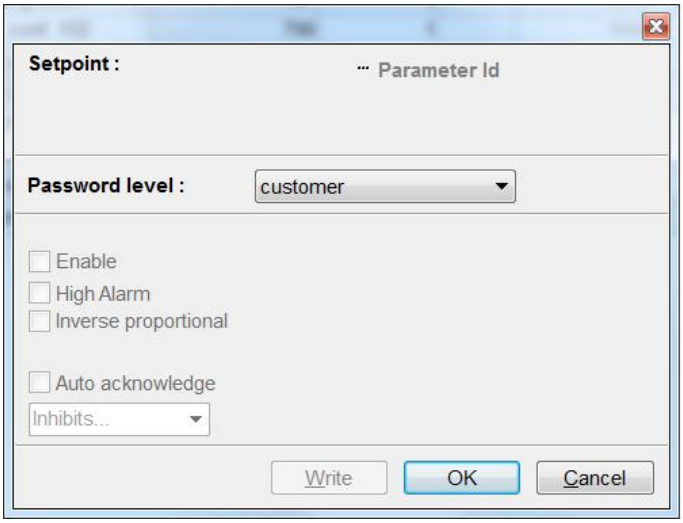
7.6 Language selection

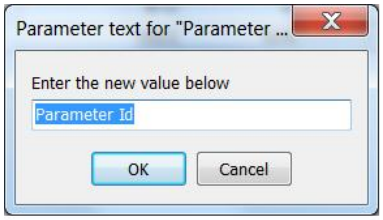
The unit has the possibility to display different languages. It is delivered with one master language which is English. This is the default language, and it cannot be changed. In addition to the master language, 4 different languages can be configured. This is done via the PC utility software. Four languages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

7.7 Parameter ID

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





7.8 Breaker types

It is optional to use a PV 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.

7.9 Not in auto

This function can be used for indication, or to activate an alarm when the controller is not in auto. The function is set up in menu 6540.

7.10 Access lock

Access lock stops the operator from configuring the controller parameters and changing the running modes. The input used for the access lock function is selected in the utility software (USW).

Access lock is typically activated from a key switch installed behind the switchboard cabinet door. Access lock only locks the display and does not lock any AOP or digital input. The AOP can be locked by using M-Logic.

This function is ideal for a rental, or critical power equipment. As soon as access lock is activated, changes cannot be made from the display. However, if there is an AOP-2, the operator can change up to 8 predefined things.

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. However, the operator cannot acknowledge alarms when access lock is activated.

NOTE The stop button is not active (in semi-auto mode) when the access lock is activated. Therefore, for safety reasons, an emergency stop switch is recommended.

7.11 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 take-over, 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.

7.12 Internal battery

7.12.1 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	●
Counters	●
Views configuration	●

Type	Stored
Inputs configuration	●
Outputs configuration	●
Translations	
M-Logic configuration	●
AOP-1 configuration	●
AOP-2 configuration	●
Application configuration	●
Parameters	●
Modbus configuration	●
Permissions	●
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.

7.12.2 Internal battery alarm

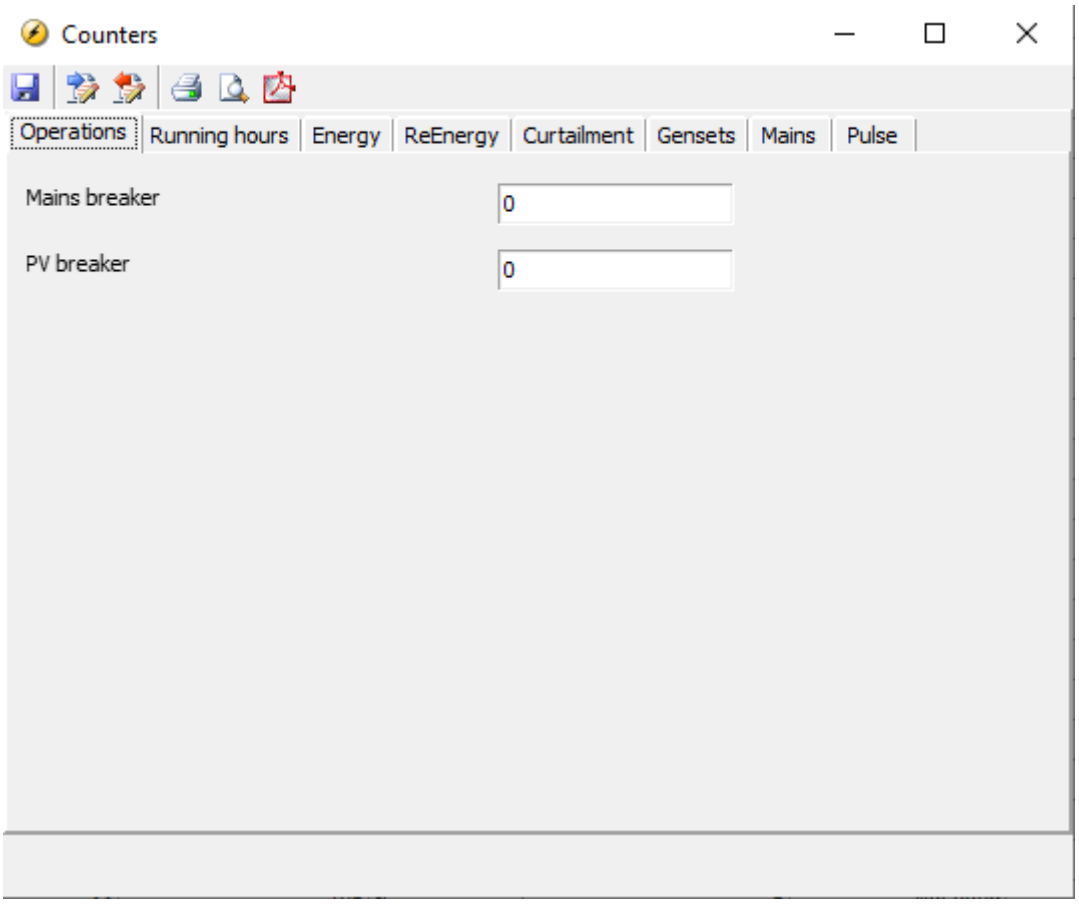
If the internal battery is dismounted during operation, a failure will appear on the display.

7.13 Counters

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

7.13.1 Utility software counters

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



7.13.2 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:

Power	Value	Number of pulses (kWh)	Number of pulses (kvarh)
P_{NOM}	<100 kW	1 pulse/kWh	1 pulse/kvarh
P_{NOM}	100 to 1000 kW	1 pulse/10 kWh	1 pulse/10 kvarh
P_{NOM}	>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.

7.14 RRCR external set point control

The grid can use a Radio Ripple Control Receiver (RRCR) for load management. The ASC can use the RRCR signals for power and reactive power regulation.

You can use four binary inputs (from an external RRCR) to configure 16 signal combinations. Each of the 16 signal combinations can used for a set point for *Power*, and a set point for *Reactive Power* or *cos phi*.

You can also make combined set points, for example, *Power* and *Reactive Power*, using the same inputs.

For feedback to the RRCR, you can use four relay outputs to configure 16 signal combinations. This feedback can only be used to represent the *Power* set point.

More information
See **RRCR configuration** in the **AGC-4 Mk II Designer's handbook** for how to use the utility software to configure RRCR.

8. Inputs and outputs

8.1 Digital inputs

8.1.1 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	If a PVB is present, 2 digital inputs are not configurable If a PVB and MB are present (single controller application), 4 digital inputs are not configurable
Option M4	7	1 digital input is not configurable
Option M12 I/O extension	13	

Not configurable digital input functions

Function	Mode	Terminal	Input type	Details
MB pos. feedb. OFF*	Auto, Semi	24	Constant	The MB is open. The ASC uses this feedback to confirm that the breaker is open.
MB pos. feedb. ON*	Auto, Semi	25	Constant	The MB is closed. The ASC uses this feedback to confirm that the breaker is closed.
PVB pos. feedb. OFF	Auto, Semi	26	Constant	The PVB 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 pos. feedb. ON	Auto, Semi	27	Constant	The PVB 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 and stops the PV system. Requires option M4.

NOTE * Only present for a single controller application with an externally controlled mains. If not, these terminals are configurable.

Configurable digital input functions

Function	Mode	Input type	Details
Access lock	Auto, Semi	Constant	Deactivates the display buttons. You can view measurements, alarms, and the log.
Remote start	Semi	Pulse	Initiates the start sequence of the PV system when semi or manual mode is selected.
Remote stop	Semi	Pulse	Initiates the stop sequence of the PV system 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.

Function	Mode	Input type	Details
Remote PVB On	Semi	Pulse	Initiates the PVB ON sequence (to close the breaker).
Remote PVB Off	Semi	Pulse	Initiates the PVB 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 system when this input is activated. The ASC stops the PV system if the input is deactivated. The input can be used when the ASC is in island operation, fixed power, load take-over 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 single controller 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 *RRCR Input Reference* window in the utility software to configure how the set points correspond to the RRCR input patterns.

NOTE The input functions are set up in the utility software. See the utility software help for more information.

8.1.2 Digital input alarms

Use the digital input menu to configure a digital input alarm. For example, for Digital input 23, use menu 3000.

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

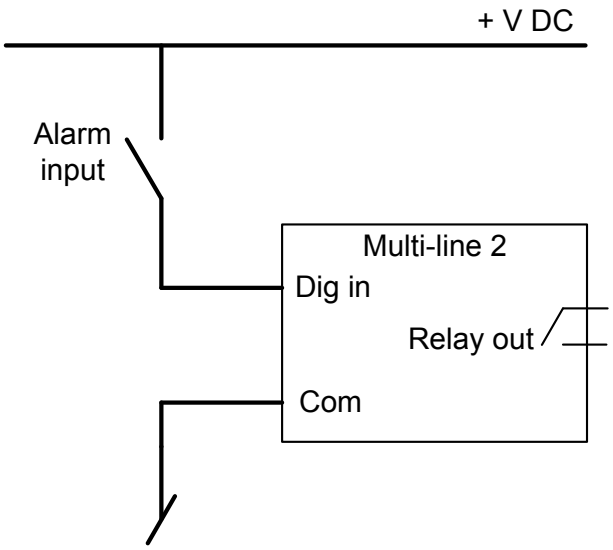
- **Normally closed (NC) alarm**

  Select **Enable** and deselect **High alarm**.

  The controller activates an alarm when the digital input is deactivated.
- **Normally open (NO) alarm**

  Select **Enable** and select **High alarm**.

  The controller activates an alarm when the digital input is activated.



NOTE You can use *Output A* and *Output B* to select a relay output for the digital input alarm.

8.2 Digital outputs

8.2.1 Relay outputs

The standard controller has the following relays.

Relay	Menu	Default setting
Relay 5	5000	No default
Relay 8	5010	No default
Relay 11	5020	No default
Relay 14	5030	PVB OFF relay
Relay 17	5040	PVB ON relay
Relay 20	5050	No default
Relay 21	5060	No default

Alarm functions

For each relay, you can select one of these alarm functions.

- Alarm relay ND
- Limit relay
- Horn relay
- Siren relay
- Alarm relay NE

When the alarm function is activated, the controller activates the relay.

Relay output functions

On the *Inputs/Outputs* page of the utility software, you can select one of the following functions for the selected relay.

Function	Description
Not used	Selected by default.
RRCR output [1 to 4]	See the **AGC-4 Mk II Designer's handbook** for information about RRCR.

8.3 Analogue inputs

8.3.1 Multi-inputs

The standard ASC controller has three multi-inputs. You can select options to have additional multi-inputs. The multi-inputs can be configured as follows in the utility software:

1. 4 to 20 mA
2. 0 to 40 V DC
3. Pt100
4. Pt1000
5. Digital

Select the input type in menus 10980-11000 for multi-input 102-108, and in menus 11120-11190 for option M15 or M16. To see and configure the input parameters, select the input types, write the input types to the controller, then reload the parameters.

Two alarm levels are available for each multi-input.

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
Digital*	3400	3410	3420

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

8.3.2 4 to 20 mA

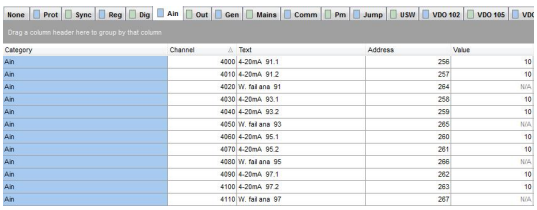
If one of the multi-inputs has been configured as 4 to 20 mA, the unit and range of the measured value corresponding to 4 to 20 mA can be changed in the PC utility software in order to get the correct reading in the display.

8.3.3 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.

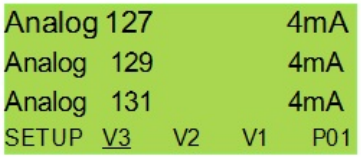


Setup with no decimals

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.



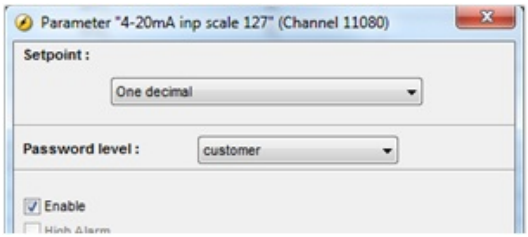
The display will show 0 to 5 [units] in the measuring range 4 to 20 mA.

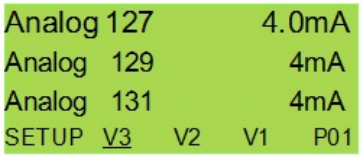
Setup with one decimal

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

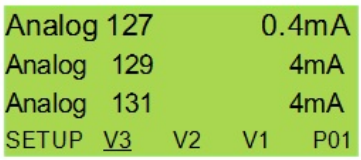
Decimals = 1

Auto scale = enable





Decimals = 1, AUTO SCALE = enabled



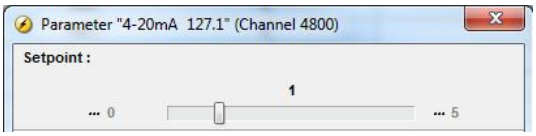
Decimals = 1, AUTO SCALE = not enabled

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

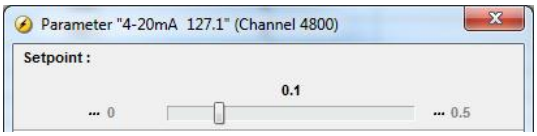
The measuring range of the multi-input is set up inside the actual alarm:

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

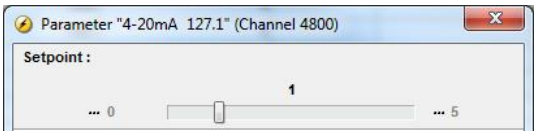


The display will then show 0 at 4 mA.

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:



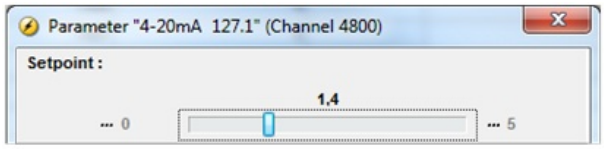
Change it to match the new selection of decimals.



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).

8.3.4 0 to 40 V DC

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

8.3.5 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.

8.3.6 Digital

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

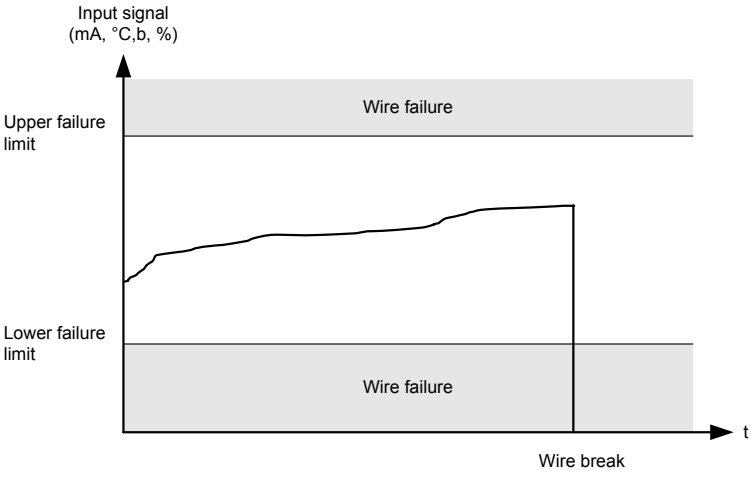
8.3.7 Wire fail detection

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	≤ 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

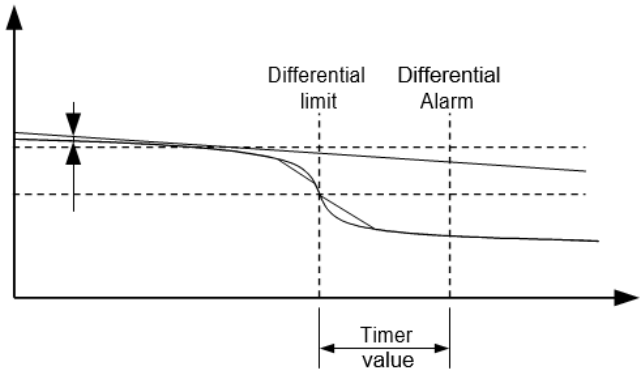
The illustration below shows that when the wire of the input breaks, the measured value will drop to zero. Then the alarm will occur.



8.3.8 Differential measurement

With the differential measurement function, you can compare two inputs and then activate an alarm or outputs based on the difference between the two values. You can also use differential measurement to create an extra analogue alarm.

The timer is activated when the configured difference between analogue A and analogue B is exceeded. If the differential value drops below the set point value before the timer runs out, then the timer is stopped and reset. If the timer runs out, the alarm is activated.



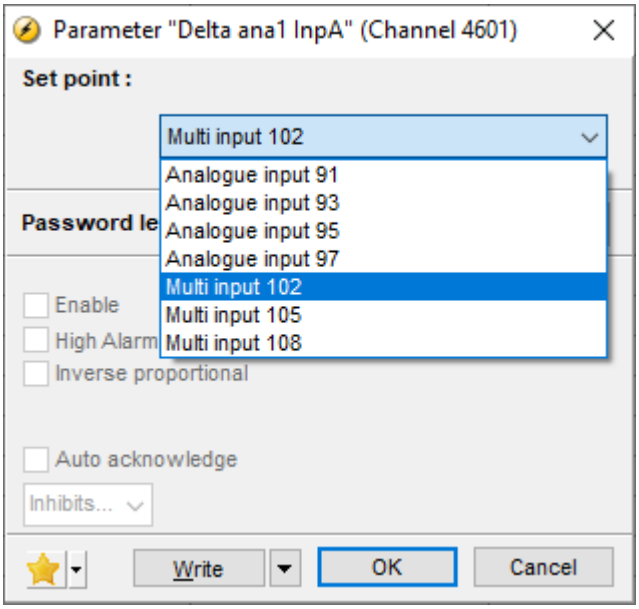
Three different differential measurements between two analogue input values can be configured.

Differential measurements between two sensors can be configured in menus 4600-4606. 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. The inputs include:

- Analogue inputs
- Multi-inputs



The alarm is configured using parameters 4610-4660. There are two alarm levels for each set of differential measurements.

Using differential measurement to create an extra analogue alarm

If the same measurement is selected for input A and input B, the controller uses the value of the input for the differential measurement alarm.

8.4 Analogue outputs

If the ASC-4 has analogue outputs, you can configure these to output operating values. For example, if you have option E2, you can use analogue output 66 and analogue output 71.

Configure the analogue outputs (example for option E2)

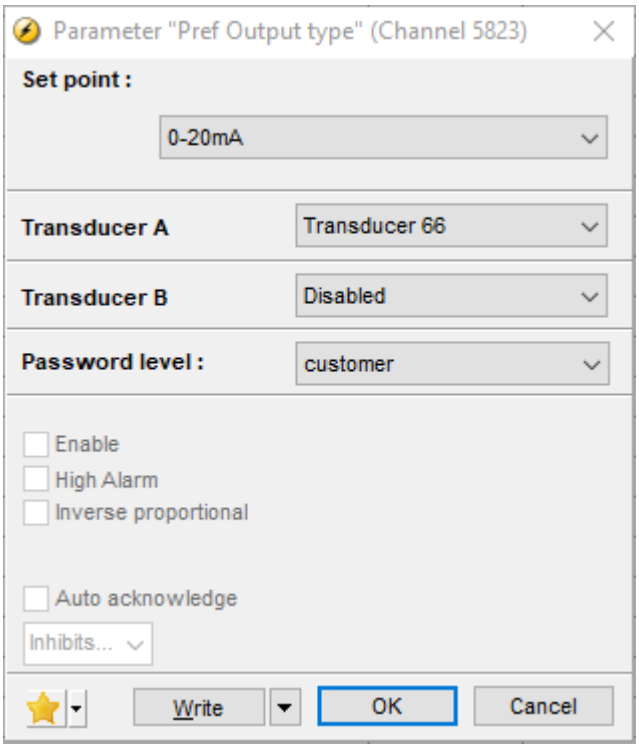
Parameter	Name	Default	Range	Details
5781	AOUT 66 LIMITS	0 mA	0 to 10 mA	Lower limit for the output from AO 66.
5782	AOUT 66 LIMITS	20 mA	10 to 20 mA	Upper limit for the output from AO 66.
5791	AOUT 71 LIMITS	0 mA	0 to 10 mA	Lower limit for the output from AO 71.
5792	AOUT 71 LIMITS	20 mA	10 to 20 mA	Upper limit for AO 71.

Configure the output type (example for Pref)

Parameter	Name	Default	Range	Details
5823 Pref Output type	Set point	0-20mA	Disabled 0-20mA 4-20mA 0-10V -10-0-10V	Select the output type and range for analogue output.
	Transducer A	Disabled	Disabled All the analogue outputs, for example, for option E2, *Transducer 66*	You can use this setting and/or Transducer B to select an analogue output for this measurement.
	Transducer B	Disabled	Disabled All the analogue outputs, for example, for option E2, *Transducer 66*	You can use this setting and/or Transducer A to select an analogue output for this measurement.

NOTE The configuration of the other analogue output types is the same. See the utility software.

Output type example from the utility software (transducer 66 outputs the Pref)



Configure the range for the analogue outputs

Parameter	Name	Default	Range
5824	Pref Output max	500 kW	0 to 20000 kW
5825	Pref Output min	0 kW	-9999 to 20000 kW

Parameter	Name	Default	Range
5834	Qref Output max	500 kvar	0 to 20000 kvar
5835	Qref Output min	0 kvar	-9999 to 20000 kvar
5844	P Output max	500 kW	0 to 20000 kW
5845	P Output min	0 kW	-9999 to 20000 kW
5854	S Output max	600 kVA	0 to 20000 kVA
5855	S Output min	0 kVA	0 to 20000 kVA
5864	Q Output max	400 kvar	0 to 16000 kvar
5865	Q Output min	0 kvar	-8000 to 16000 kvar
5874	Cosphi ref Out. max	0.8	0.5 to 0.99
5875	Cosphi ref Out. min	-0.8	-0.99 to -0.5
5884	Pmax Output max	500 kW	0 to 20000 kW
5885	Pmax Output min	0 kW	-9999 to 20000 kW
5894	Pcurtail Output max	500 kW	0 to 20000 kW
5895	Pcurtail Output min	0 kW	-9999 to 20000 kW
5904	PV pen year Out max	100 %	0 to 100 %
5905	PV pen year Out min	0 %	0 to 100 %
5914	PV pen day Out max	100 %	0 to 100 %
5915	PV pen day Out min	0 %	0 to 100 %
5924	P ratio year Out max	100 %	0 to 100 %
5925	P ratio year Out min	0 %	0 to 100 %
5934	P ratio day Out max	100 %	0 to 100 %
5935	P ratio day Out min	0 %	0 to 100 %
5944	POA Output max	1400	0 to 2000
5945	POA Output min	0	0 to 2000
5954	BOM Output max	50 A °C	-45 to 120 A °C
5955	BOM Output min	5 A °C	-45 to 120 A °C
5964	P DG Output max	500 kW	0 to 20000 kW
5965	P DG Output min	0 kW	-9999 to 20000 kW
5974	P Mains Output max	500 kW	0 to 20000 kW
5975	P Mains Output min	0 kW	-9999 to 20000 kW

9. Small Solar-Gensets-Mains example

9.1 Introduction

As this handbook shows, you can use the application drawing, inputs and outputs, parameters and M-Logic to use the ASC-4 controller in a wide variety of applications. To help you to set up a single ASC-4 controller quickly, this chapter has an example of a specific, simple, single controller application.

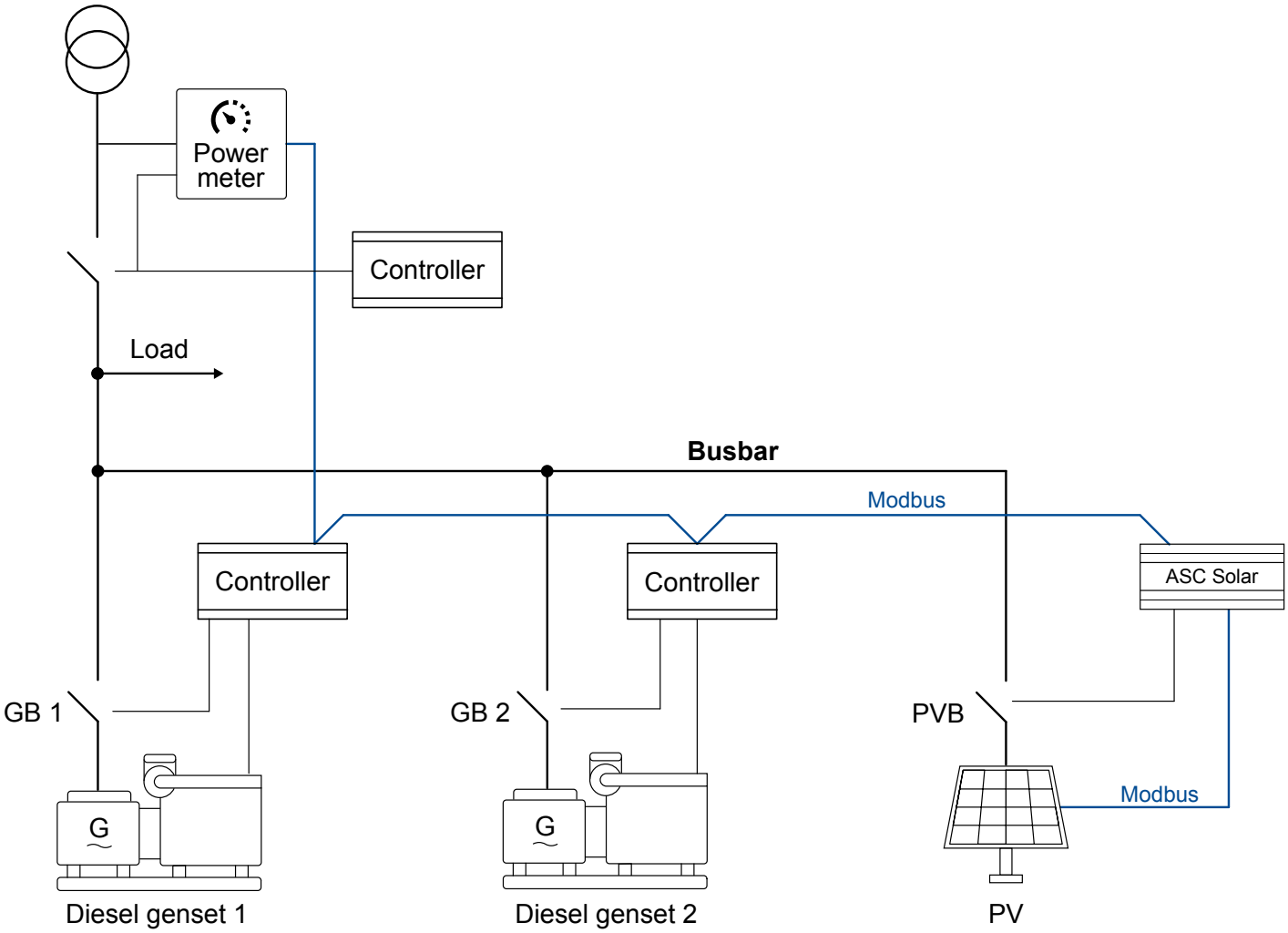
DANGER!

Incorrect configuration is dangerous

Only allow authorised personnel, who understand the risks involved in working with electrical systems, to do the installation and configuration. The configuration given here is an example. Do not blindly follow this example. Be careful to create a configuration that is suitable for your electrical system instead.

9.2 Application setup

Single-line diagram for the application example



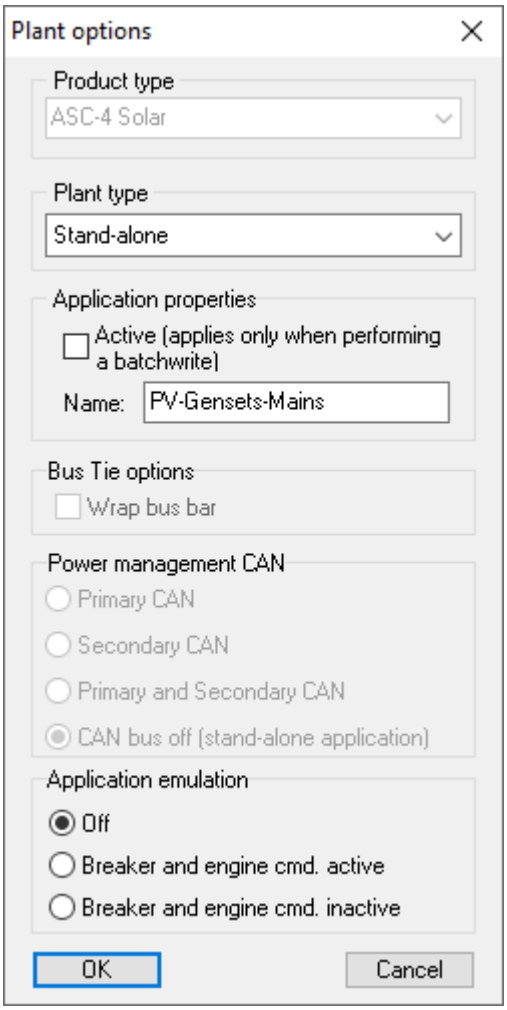
System information

- PV power and the ASC-4 Solar (with hardware option H2.8) are added to an existing application.
  - The application already had controllers for the gensets and the mains.
- Three-phase system, 50 Hz, 400 V phase-phase

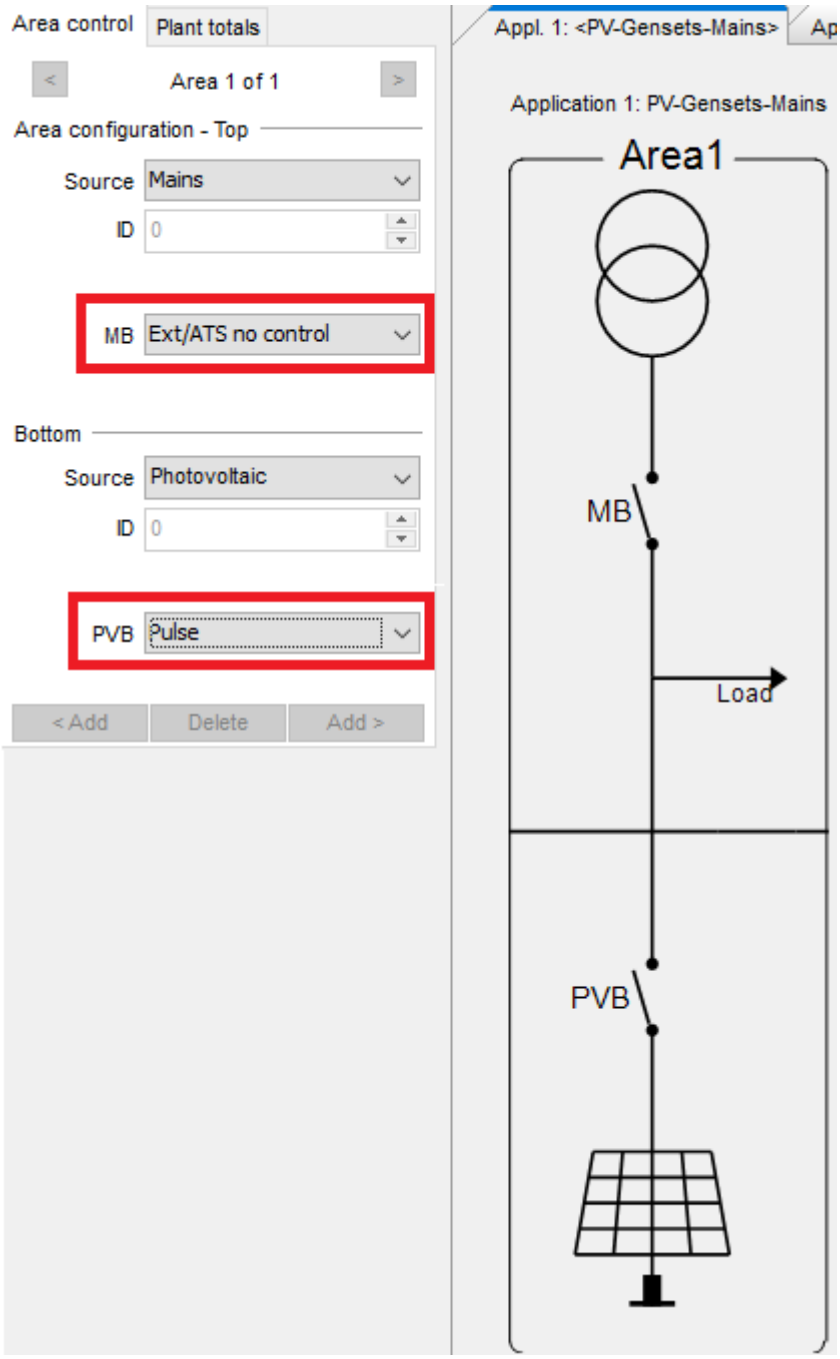
- PV system:
  - PV panels: 700 x 420 W panels
  - Inverters: 12 x Fronius Eco 25.0-3-S, each rated for 25 kVA (25 kW)
  - Total inverter nominal power = 300 kW
  - RS-485 Modbus RTU communication
  - Protocol = SunSpec Generic
- Genset 1 and Genset 2: 480 kW (600 kVA), with a DSE 8xxx controller each
  - Optimal genset load: 80 %
  - Minimum genset load: 30 %
- Mains power meter: ABB SACE Emax 2
- Operation strategy:
  - Maximise the power from the PV system.
  - Protect the gensets from low load.
  - Prevent power export to the mains.

Creating the application drawing in the USW

1. On the *Application configuration* page, use *New plant configuration* to open a *Plant options* window to create a new application. The *Plant type* must be *Stand-alone*.



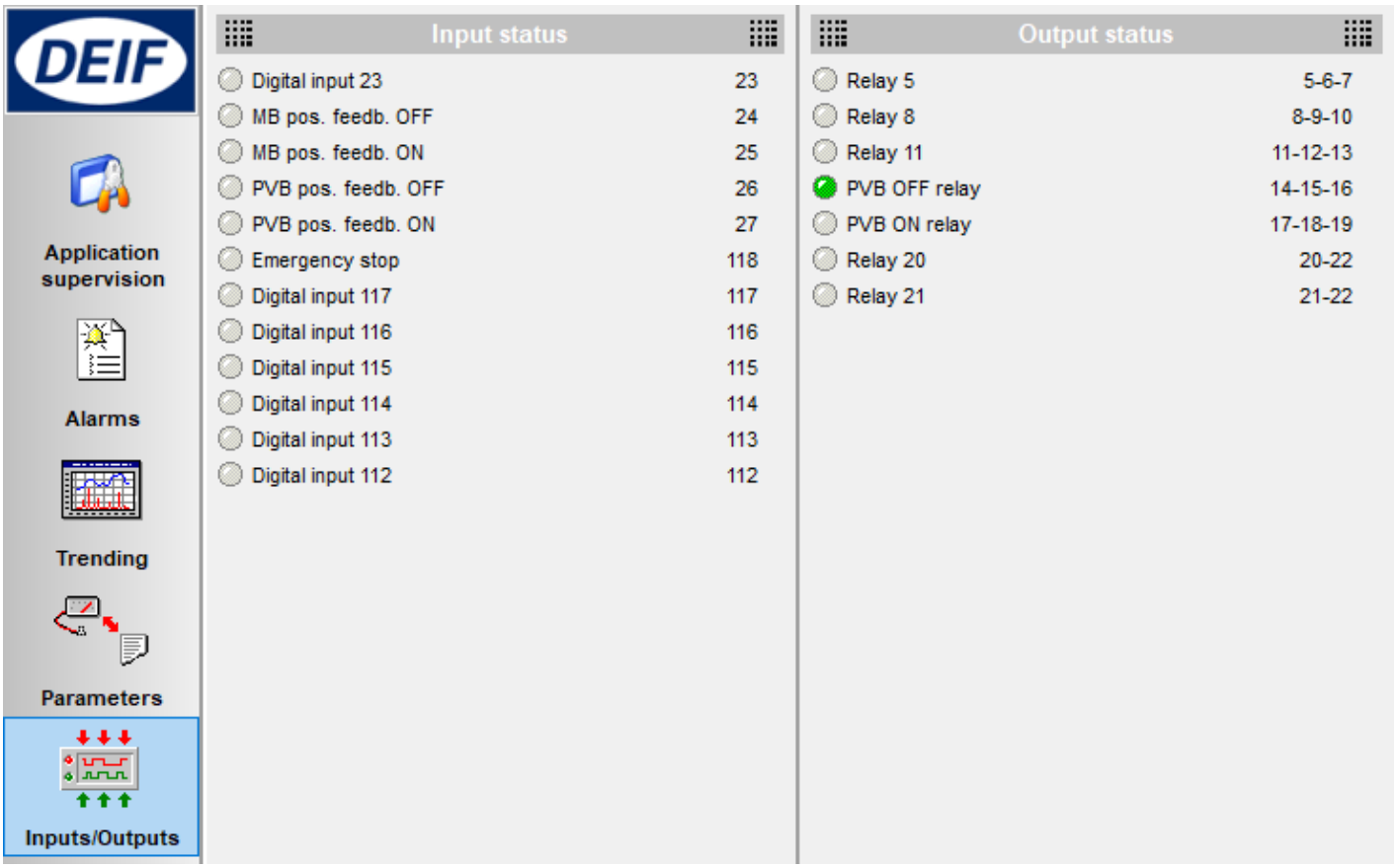
2. Under *Area control*, select *Ext/ATS no control* for the mains breaker. If the ASC-4 controls the PV breaker, select the breaker type. If not, select *Ext/ATS no control*.



3. Use *Write plant configuration to the device* to write the configuration to the controller.

9.3 Inputs/Outputs

For this example, the ASC-4 Solar automatically configures all the relays and inputs that are required based on the plant configuration.



9.4 Wiring

The minimum required wiring is listed in the following table.

More information
See the **Installation instructions** for complete wiring information.

Terminal(s)	Function	Details
1-2	Power supply	8 to 36 V DC, power for the controller
14-15-16	Open PV breaker	Maximum 250 V AC/8 A relay
17-18-19	Close PV breaker	Maximum 250 V AC/8 A relay
24	MB breaker open	ON: 8 to 36 V DC, OFF: <2 V DC
25	MB breaker closed	
26	PV breaker open	ON: 8 to 36 V DC, OFF: <2 V DC
27	PV breaker closed	
28	Common for 23-27	
29	PV comm DATA + (A)	Connect these terminals to the RTU connection of the inverters (daisy chained).
31	PV comm DATA - (B)	
73	S1 (k) L1 AC current	Use an x/1 A or x/5 A current transformer.
74	S2 (l) L1 AC current	
75	S1 (k) L2 AC current	Use an x/1 A or x/5 A current transformer.
76	S2 (l) L2 AC current	

Terminal(s)	Function	Details
77	S1 (k) L3 AC current	Use an x/1 A or x/5 A current transformer.
78	S2 (l) L3 AC current	
79	L1 PV voltage	Maximum 690 V AC phase-phase
81	L2 PV voltage	Maximum 690 V AC phase-phase
83	L3 PV voltage	Maximum 690 V AC phase-phase
85	L1 Busbar voltage	Maximum 690 V AC phase-phase
87	L2 Busbar voltage	Maximum 690 V AC phase-phase
89	L3 Busbar voltage	Maximum 690 V AC phase-phase
98	Power supply for emergency stop	+12/24 V DC (maximum 36 V DC)
99	Power supply for emergency stop	0 V DC
118	Emergency stop	Digital input
131	Genset/power meter comm DATA - (B)	Connect these terminals to the genset controller and power meter Modbus RTU terminals (daisy chained).
133	Genset/power meter comm DATA + (A)	

9.5 Parameters

For this example, set the following parameters. Select *Write parameters to the device* when you have finished.

NOTE Not all parameters are shown in the list below. Parameters with factory defaults that are suitable for this example are not included.

Parameter	Name	Description
6001	Nom. f 1	For this example, select *50 Hz*.
6002	Nom. P 1	Use the PV information to configure the nominal power. For example, if this plant consists of 700 x 420 W solar panels, the nominal power is 294 kW.
6003	Nom. I 1	Use the inverter information to configure the nominal current. For this example, **434 A** ((12 x 25)/(1.73 x 0.4)).
6004	Nom. U 1	Use the inverter information to configure the nominal voltage. For this example, select **400 V**.
6005	Nom. Q 1	Use the inverter information to configure the nominal reactive power. For this example, select **300 kvar**.
6006	Nom. S 1	Use the inverter information to configure the nominal apparent power. For this example, select **300 kVA** (12 x 25 kVA).
6041	BA primary U	The PV primary voltage. For this example, select **400 V**.
6042	BA secondary U	The PV secondary voltage. For this example, select **400 V**.
6043	BA Primary I	The PV primary current. If necessary, adjust this set point.
6044	BA Secondary I	The PV secondary current. If necessary, adjust this set point.
6051	BB Primary U 1	The busbar primary voltage. For this example, select **400 V**.
6052	BB second. U 1	The busbar secondary voltage. For this example, select **400 V**.
6053	BB Nominal U 1	The busbar nominal voltage. For this example, select **400 V**.
6071	Operation mode	For this example, select **Mains power export**.
7012	Mains Power Exp	Select **0 kW** to prevent mains power export.
7331	DG1 nom. power	Select the genset 1 nominal power.
7333	DG1 P input	Select *Power meter comm. 01*.

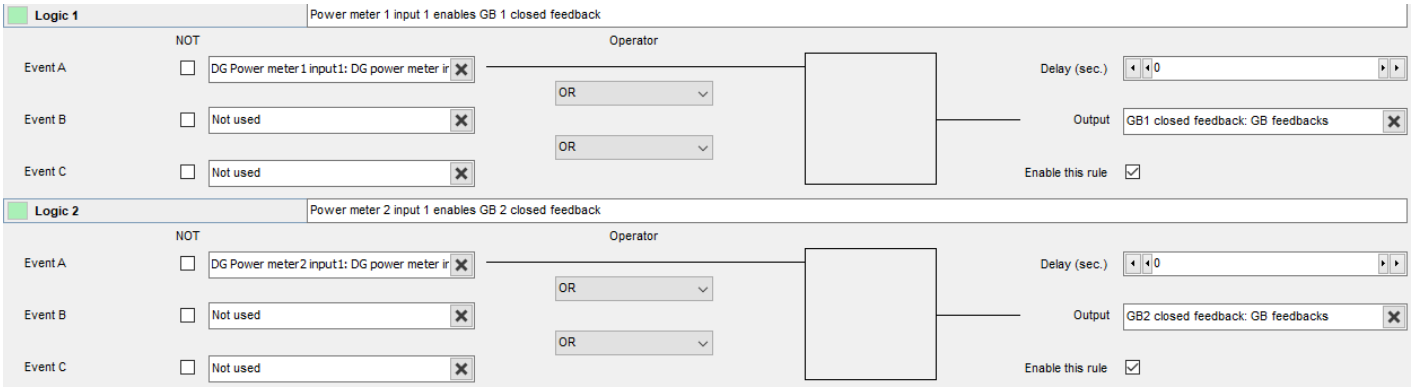
Parameter	Name	Description
7335	DG1 Q input	Select *Power meter comm. 01*.
7341	DG2 nom. power	Select the genset 2 nominal power.
7343	DG2 P input	Select *Power meter comm. 02*.
7345	DG2 Q input	Select *Power meter comm. 02*.
7491	Mains P input	Select *Power meter comm. 01*.
7493	Mains Q input	Select *Power meter comm. 01*.
7511	Ctrl. comm. ID	Select an ID for the ASC-4 Solar for communication with the PV system. Use the lowest communication ID of the inverters.
7512	Mon. comm ID	Select the lowest communication ID of the inverters.
7561	PV protocol	For this example, select *SunSpec Generic*.
7566	PV Monitoring	For this example, select **12** (inverters) and **Enable**.
7701	DG meter ID	If necessary, adjust this set point.
7703	Mains meter ID	If necessary, adjust this set point.
7721	DG meter prot.	For this example, select *DSE 8xxx, 7xxx, 6xxx and 4xxx*
7722	DG nbr. nodes	For this example, select **2**.
8011	Min DG load 01	If necessary, adjust this set point. For this example, select **30 %**.

NOTE You can configure additional parameters for additional functions. For example, to track curtailment, configure POA irradiation (6271) and BOM temperature (6281).

9.6 Configure logic

For this example, you must configure the following M-Logic in the utility software. You can also configure other M-Logic, as required.

Genset controllers breaker status inputs



9.7 Commissioning

DANGER!

Incorrect wiring and configuration are dangerous

Before using the system, check that the wiring and parameters are correct for the application.

Before starting operation, check that all the wiring is correct.

Check that the parameters are correct for the application.

Check that the controller can communicate with the PV system, the genset controller, and the power meters.

9.8 Operation

Push MODE on the display unit, then select AUTO.

The ASC-4 Solar receives breaker states for the mains and gensets, along with the power measurements.

The ASC-4 Solar automatically controls the PV system to:

- Maximise the power from the PV system.
- If necessary, curtail the PV production to:
  1. Protect the gensets from low load.
  2. Prevent power export to the mains.