DESIGNER'S HANDBOOK

ASC-4 Battery

Automatic Sustainable Controller

4189341320A

4. Single-controller applications

5. Energy management systems

6. Battery controller functions

1. Introduction

1.1 About

The ASC-4 Battery controller can be used as a single controller to add a storage system to an existing site, or with other DEIF controllers in a power/energy management system. The ASC-4 Battery controller controls and protects an energy storage system (ESS) with communication to a BCU, PCS, PDS and BMS. The ASC-4 Battery controller can instruct all gensets to stop, and supply the load from battery alone or in combination with sustainable power production.

In an energy management system, the controller is designed for seamless integration of electrical storage with other power sources. You can prioritise the energy sources for supplying the load, and recharging the battery. The ASC-4 Battery controller includes a configurable charge scheme (charge/discharge levels).

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 battery controller	Power management systems
Applications	Brownfield	Greenfield
Storage integration in hybrid systems (including microgrids)	•	•
Applications with sustainable power plants	-	Up to 16 power plants
Communicates with BCU, PCS, PDS and BMS over Modbus • Monitor and troubleshoot the Modbus communication from the ASC-4 display unit	•	•
Configurable charge scheme	•	•
Charging/discharging based on SOC or automatic timers	•	•
Controls functions, energy source or power source	•	•
Grid-forming (V/f mode) Grid-following (P/Q mode) Droop mode (P/f and Q/V) (like a virtual synchronous generator)	•	•
Ideal for self-consumption applications	•	•
Control of ESS breaker (optional)	•	•
AC- and DC-coupled storage systems	•	•
Frequency response	•	•
Using ASC-4 Battery with gensets		
Connect to gensets for storage-diesel	Up to 16 gensets (requires power meters)	Up to 32 gensets (with AGC-4 Mk II/AGC 150)

	Single battery controller	Power management systems
Power meter interfacing	●	Not required
Optimal genset load constraint	●	●
Minimum genset load constraint	●	●
Load-dependent genset start/stop	By digital output	By PMS
SOC-dependent genset start/stop	By digital output	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)	●	●
Optimal operation		
Define and change the priorities of connected power sources	-	●
Uptime guaranteed through spinning reserve	-	●
Maximised sustainable power production	*	●

NOTE * The single battery 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).

Hardware

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

1.1.2 Terms and abbreviations

Term	Abbreviation	Explanation
Automatic Sustainable Controller	ASC-4 Battery	DEIF's controller to integrate an energy storage system in an application with other power sources.
Automatic Sustainable Controller	ASC-4 Solar	DEIF's controller to integrate photovoltaic power in an application with other power sources.
AGC	AGC 150 AGC-4 Mk II AGC-4	A DEIF controller to control a genset (DG), bus tie breaker (BTB) or a mains (grid) connection.
Battery Control Unit	BCU	The control unit for the ESS. The BCU handles all the internal ESS controls. The BCU is the interface between the ESS and the energy management system.
Battery Management System	BMS	The monitoring system of the battery/energy clusters. The BMS monitors the SOC, and the maximum charge and discharge values.
Busbar	BB	The equipment for the electrical connection of all the sources and the loads. The busbar can also be connected to the mains (grid).
Charge		Power flows to the ESS.
Discharge		Power flows from the ESS.
Energy management	EM	The ASC and AGC 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.

Term	Abbreviation	Explanation
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.
Energy storage breaker	ESB	The breaker between the ESS and the conventional power system. The ASC Battery can control this breaker.
Energy storage system	ESS	A container-sized assembly that acts as a battery.
Frequency response	FR	Some power converters (the primary regulator) respond immediately to a frequency.
Grid		National or local electricity grid. Also known as mains.
Grid-tied		The energy storage system is connected to grid/mains power.
Load-dependent start or stop	LDSS	Controller settings that use the system load to determine when to start and stop gensets.
Mains breaker	MB	The breaker between the energy storage 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 energy storage 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.
Power conversion system	PCS	The PCS controls the AC/DC power. During discharging, the power converter changes the direct current from the ESS to alternating current to supply the busbar. During charging, the power converter changes the alternating current from the busbar to direct current to charge the ESS. The PCS also ensures that the ESS is grid forming (island), grid following (grid tie), or has droop control (grid tie-grid V/f support).
Power DC-DC system	PDS	In a DC-coupled application, the PDS is between the PV and ESS.
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.
State of charge	SOC	The charge in the ESS [%].
State of energy	SOE	The energy in the ESS [kWh].
State of health	SOH	The degree of degradation in the ESS. Could for example be based on the amount of charge and discharge cycles of the ESS.
Time of use	TOU	The amount charged for electricity changes according to the time of day.
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.
Virtual synchronous generator	VSG	A power source that follows a droop curve by using the system measurements to adjust its V/f or P/Q set points.

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 4.23.

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 energy storage system, genset(s), and/or mains connection. Check the ASC settings before starting any equipment.

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.

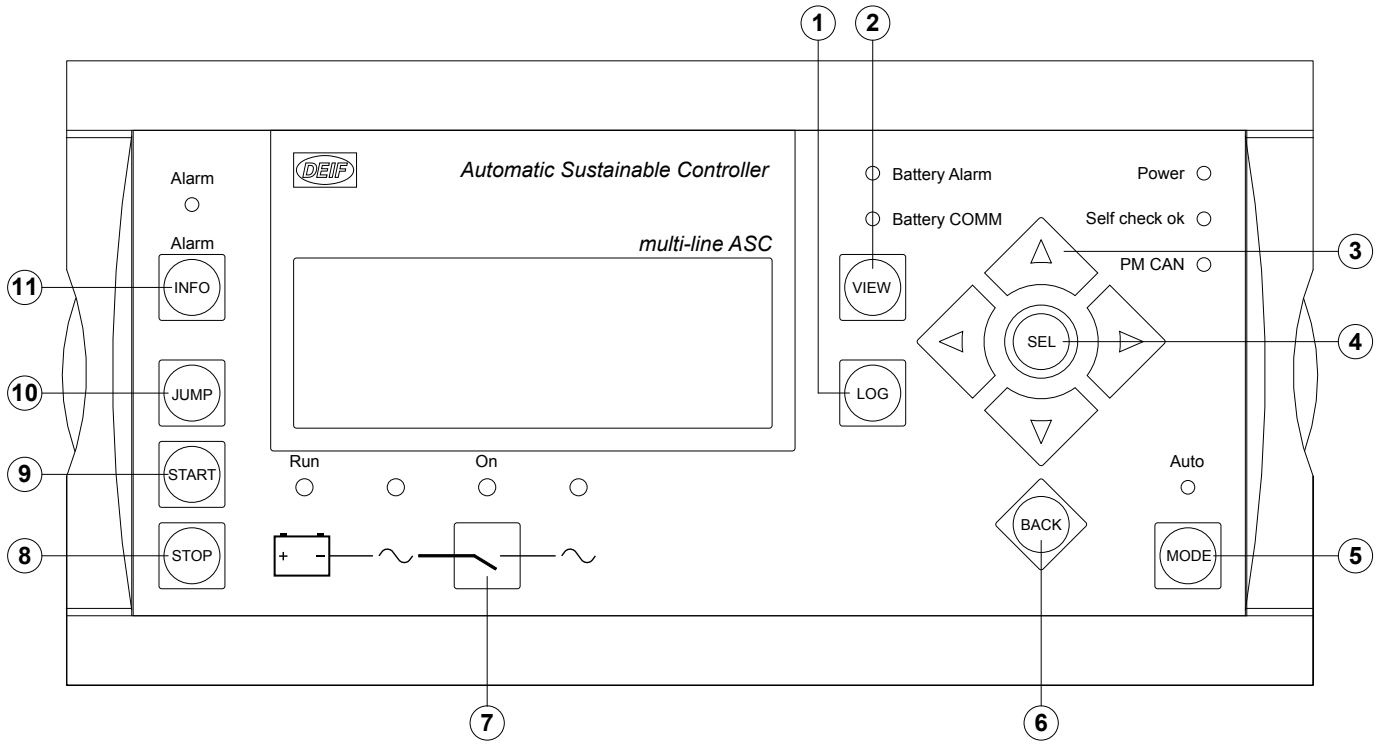
2. Display unit and menu structure

2.1 Display unit (DU-2)

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

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

2.1.1 Push-button functions

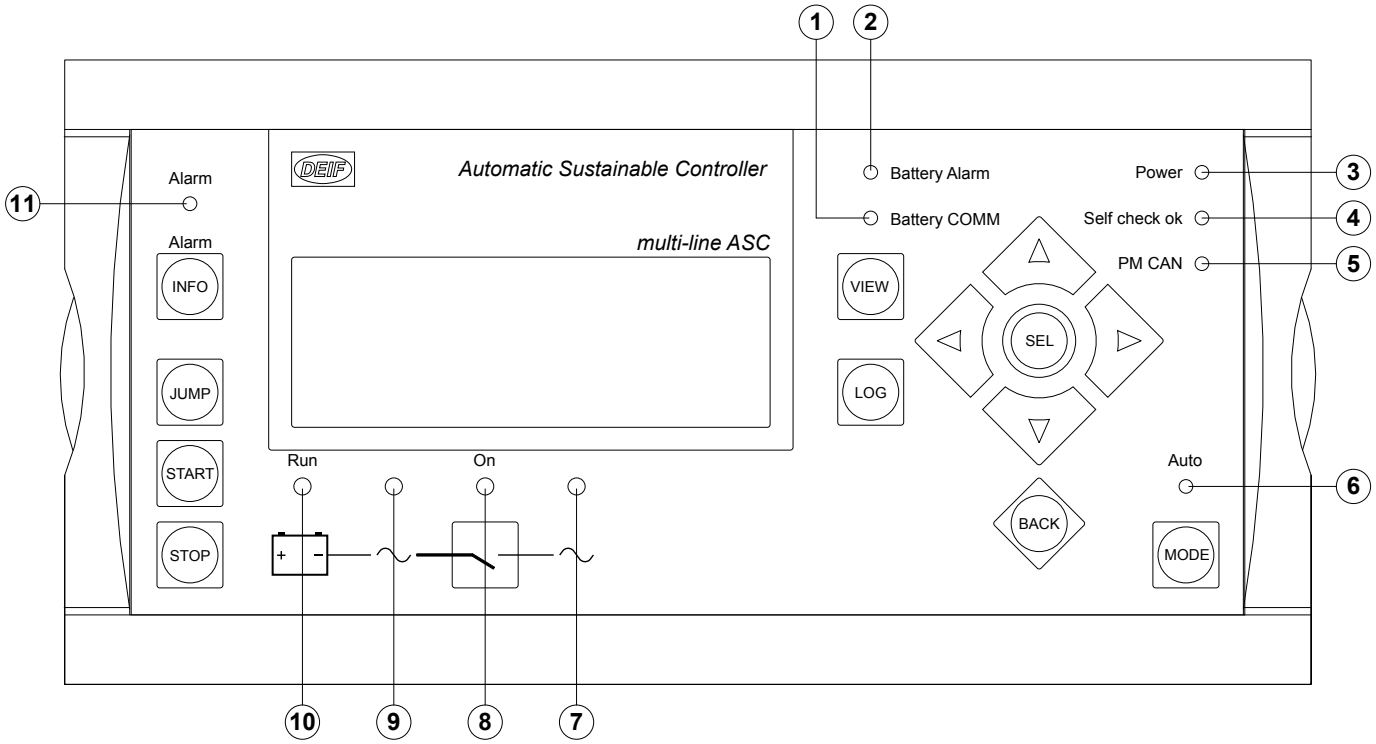


Button	Name	Notes
1	LOG	Displays the LOG SETUP window. You can view Event or Alarm logs. The logs are not deleted when the auxiliary supply is switched off.
2	VIEW	Shifts the first display line in the setup menus. No function in the View screen (V1-V2-V3). When more than one display is connected, push for two seconds to change the display to the master display.
3	UP/DOWN/ LEFT/RIGHT	Use up, down, left and right 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 the previous display or entry window).
7	ESB On/Off	Breaker is open: Press to start the close breaker sequence (if SEMI mode is selected). Breaker is closed: Press to start the open breaker sequence (if SEMI mode is selected).
8	STOP	Stops the ESS (if SEMI mode is selected).
9	START	Starts the ESS (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, press the button for two seconds.

2.1.2 LED functions

The display unit has 11 LEDs. Depending on the situation, the LED colour is green, red or yellow.



LED	Name	Notes
1	Battery COMM	Red (flashing): Communication with the ESS is faulty. Off: There is no communication with the ESS.
2	Battery Alarm	Red (flashing): Alarms are present on the ESS. Go to the ESS to see which alarms are present. Off: There are no ESS 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: ESS breaker is closed. Yellow (flashing): ESS breaker load time has not expired. Off: ESS breaker is open.
9	Source busbar status	Green: ESS voltage and frequency is OK. Off: There is no ESS voltage.
10	Source status	Green: ESS converter is running.

LED	Name	Notes
		Off: ESS converter is not running.
11	Alarm status	Red (flashing): Unacknowledged alarms are present on the controller. Red: All alarms acknowledged, but alarms are present on the controller. Off: No alarms are present on the controller.

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 presses one of the blocked keys.
AMF ACTIVE	ASC running in auto mode during a mains failure.
AMF AUTO	ASC in auto mode and ready to respond to a mains failure.
AMF SEMI	ASC in semi-automatic mode and waiting for operator input.
AWAITING ESS RUN OK	The ASC is waiting for "run okay" from the ESS.
BESS INITIALIZING	The BESS is initialising.
BLOCKED FOR CLOSING	The ESS breaker closing is blocked.
BLOCKED FOR START	Energy storage system stopped and active alarm(s) on the ESS.
BOOTING ETHERNET	The ASC's Ethernet communication is starting.
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.
DELOADING BTB ##	The power management system is adjusting the power set points in the system to download BTB ##.
DELOADING MB ##	The power management system is adjusting the power set points in the system to download MB ##.
DELOADING TB ##	The power management system is adjusting the power set points in the system to download TB ##.
DEVICE TYPE UNKNOWN	The controller does not recognise a device.
ESB EXTERN. TRIPPED	Some external equipment (not the ASC) tripped the ESB. An external trip is logged in the event log.
ESS NOT READY	ASC Battery: The ESS is not ready to start.
ESB OPEN BLOCKED	The ESS breaker opening is blocked.
FIXED POWER ACTIVE	ASC running in auto mode and supplying fixed power.
FIXED POWER AUTO	ASC in auto mode and ready to supply fixed power.
FIXED POWER SEMI	ASC in semi-automatic mode and waiting for operator input.
ISLAND ACTIVE	ASC running in auto mode and supplying power while not connected to a mains supply.
ISLAND AUTO	ASC in auto mode and ready to supply island power.
ISLAND SEMI	ASC in semi-automatic mode and waiting for operator input.
LOAD TAKEOVER AUTO	ASC in auto mode and ready to take over load.

Status text	Description
LOAD TAKEOVER SEMI	ASC in semi-automatic mode and waiting for operator input.
LTO ACTIVE	ASC running in auto mode and taking over the load.
MAINS P EXPORT AUTO	ASC in auto mode and ready to export power to the mains.
MAINS P EXPORT SEMI	ASC in semi-automatic mode and waiting for operator input.
MB EXTERN. TRIPPED	Some external equipment (not the ASC) tripped the MB. An external trip is logged in the event log.
MPE ACTIVE	ASC running in auto mode and exporting power to the mains.
PEAK SHAVING ACTIVE	ASC running in auto mode and doing peak shaving.
PEAK SHAVING AUTO	ASC in auto mode and ready to do peak shaving.
PEAK SHAVING SEMI	ASC in semi-automatic mode and waiting for operator input.
PREPARING ETHERNET	Preparing Ethernet connection.
PROGRAMMING LANGUAGE	The language file is downloaded from the USW.
PROGRAMMING M-LOGIC	Downloading M-Logic to the ASC.
RAMP FREEZED	The power ramp is stopped.
RAMP TO #####kW	The power is ramping in steps. The next step that will be reached after the timer has expired is displayed.
READY AMF AUTO	Energy storage system stopped in Auto.
READY FIXED P AUTO	Energy storage system stopped in Auto.
READY ISLAND AUTO	Energy storage system stopped in Auto.
READY LTO AUTO	Energy storage system stopped in Auto.
READY MPE AUTO	Energy storage system stopped in Auto.
READY PEAK SHAV AUTO	Energy storage system 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.
SOC STOP LIM > THR 2	The SOC DG stop limit is too high. See parameter 7153.
TOO SLOW 00<----------	Frequency too low during synchronising.
----------> 00 TOO FAST	Frequency too high during synchronising.

2.3 Mode overview

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

Auto

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

Semi-auto

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

2.4 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 push-buttons to change to the next/previous view page. Use the USW to select the values shown on the view pages.

Setup menu system

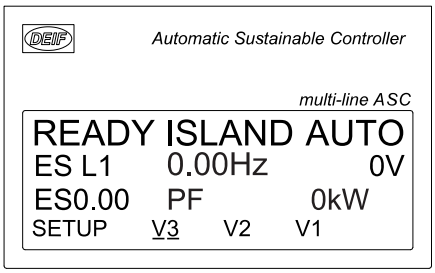
You can use this to see the parameters.

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

2.4.1 Start page

When the controller is powered up, the start page is shown. The start page can always be reached by pressing the BACK push-button (up to three times).

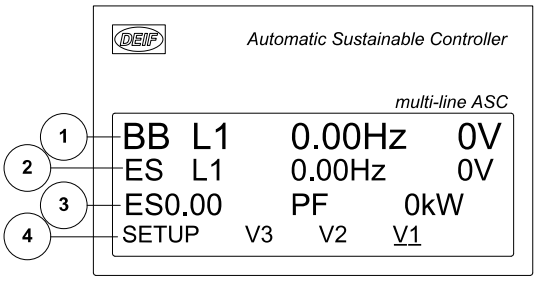
NOTE If an alarm is present, the alarm information page is shown at power up.



2.4.2 View menu

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

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 selectable windows displaying selected measurements.
- **V1** (View 1) – Access to up to 20 selectable windows displaying selected measurements.

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

2.4.3 Event log and alarm log

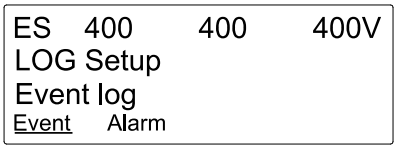
The controller has these logs:

- 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).

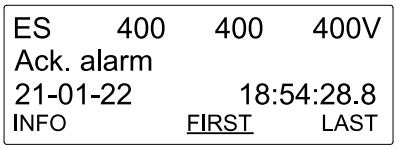
Display

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



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

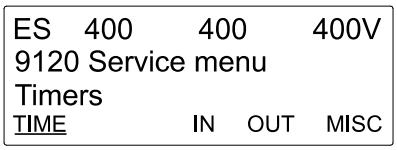
When INFO is selected, a value is shown if it is available.

2.4.4 Service menu

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

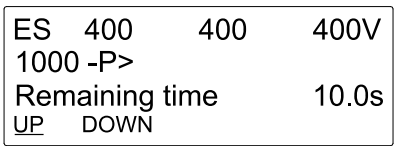
Service menu start page

The start page shows the selections in the service menu.



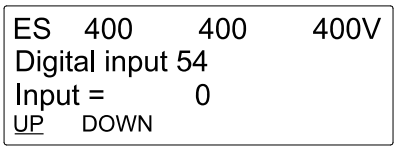
TIME (alarm timer)

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.



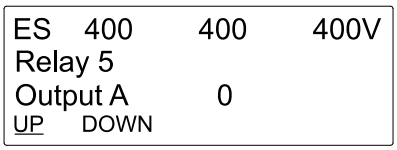
IN (digital input)

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



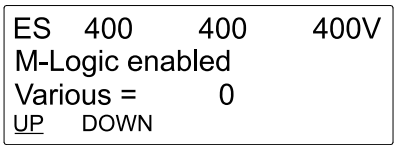
OUT (digital output)

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



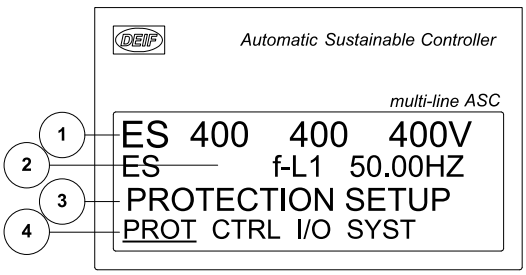
MISC (miscellaneous)

Shows miscellaneous messages.



2.4.5 Setup menu

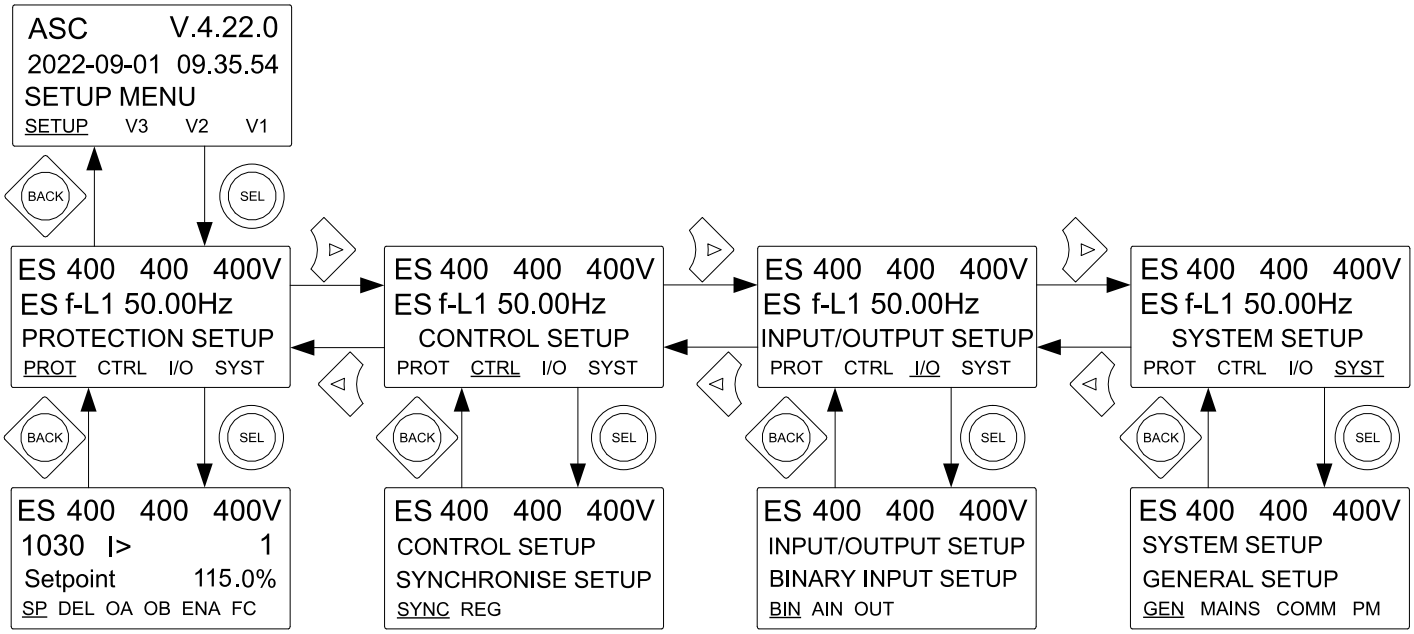
The setup menu system is used for parameter setup of the controller. It is also helpful if the user needs detailed information that is not available in the view menu system. Enter the Setup menu from the start page, by selecting SETUP in the fourth display line.



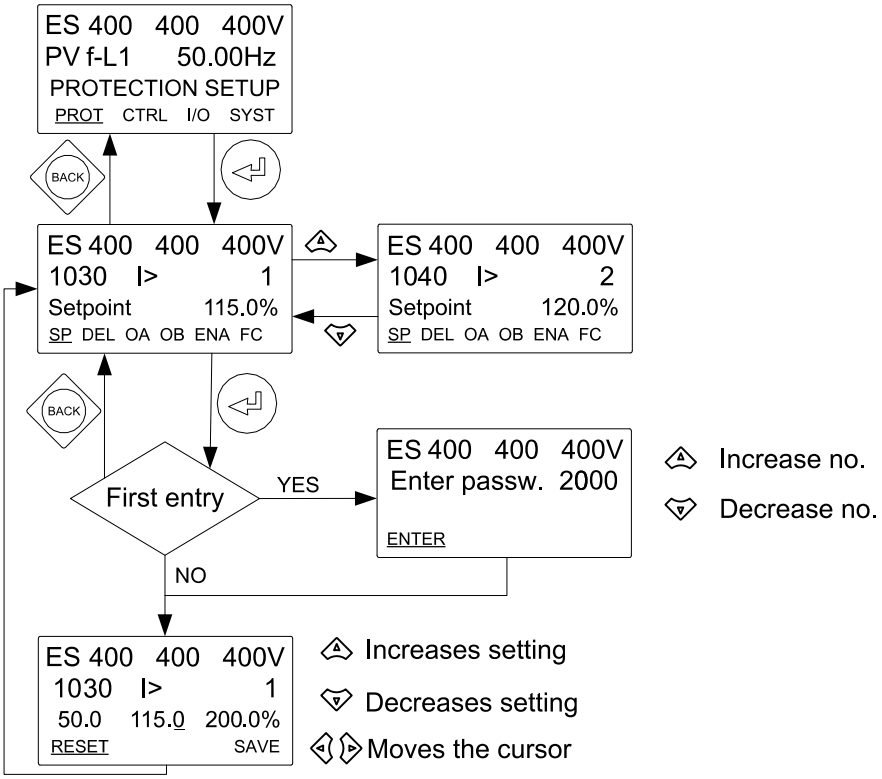
Display screen lines

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

Setup structure



Changing the over-current set point example



2.5 Password

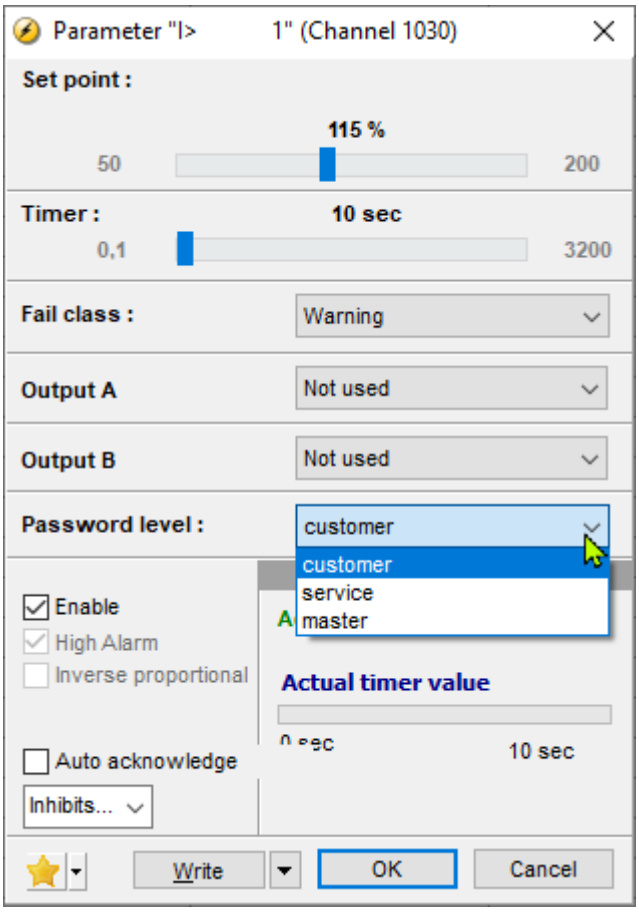
2.5.1 Password management

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

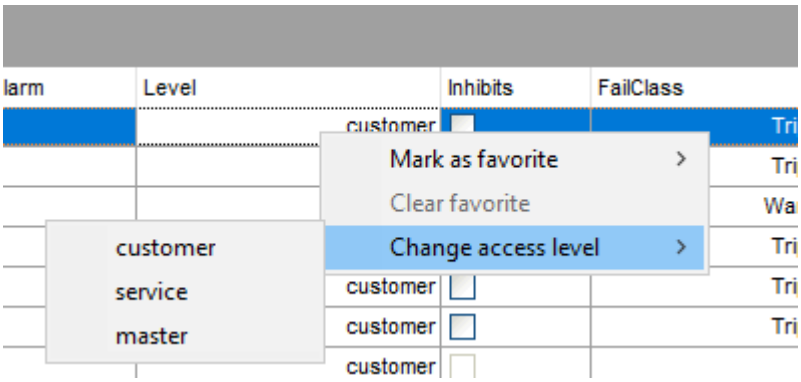
Password level	Factory setting	Access		
		Customer	Service	Master
Customer	2000	•		
Service	2001	•	•	
Master	2002	•	•	•

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.

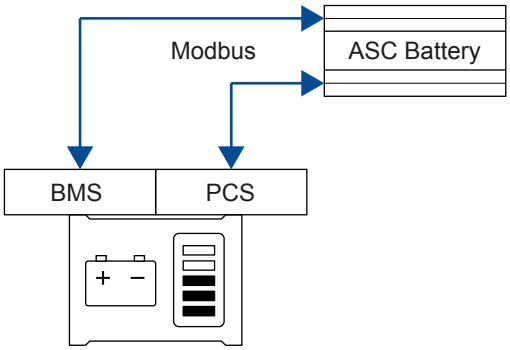
3. Communication

3.1 Overview

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

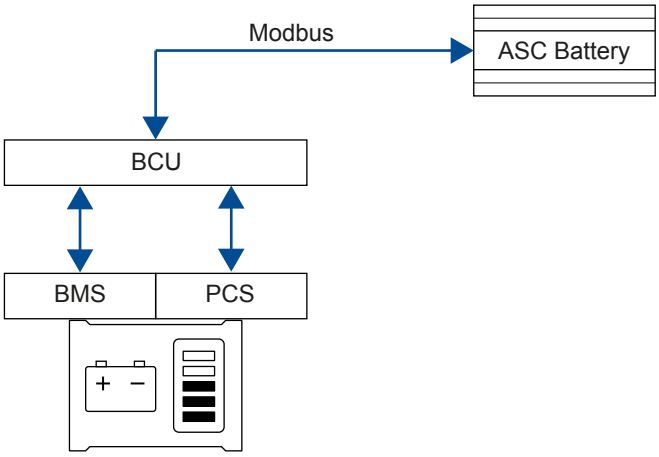
Communication with the battery management system and power conversion system

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



Communication with the battery control unit

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



Operation

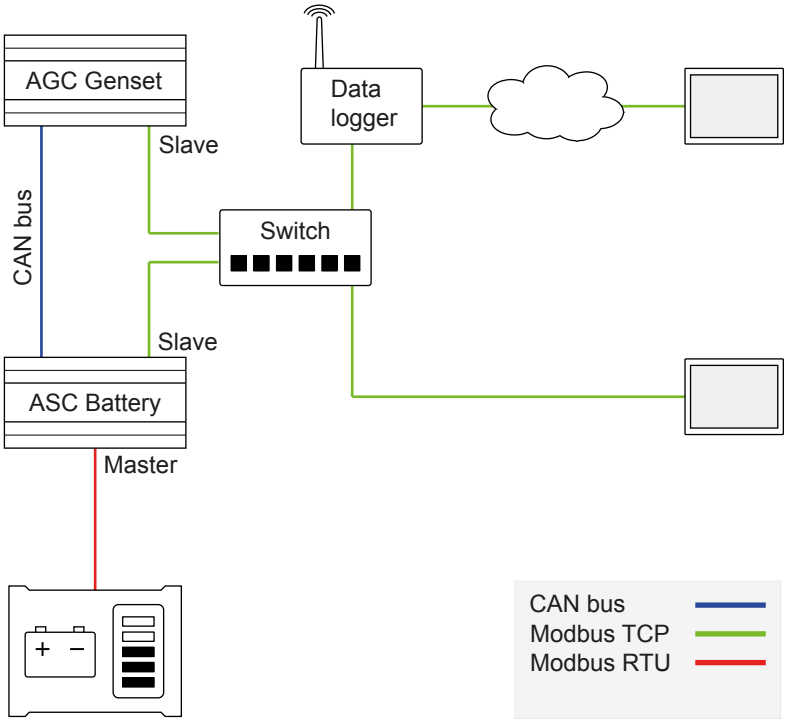
Once configured, the ASC Battery can run automatically. Alternatively, the display unit allows an operator to start and stop the ESS, and open and close the ES breaker.

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

3.2 ASC Battery communication

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

Example of ASC Battery communication



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

3.3 Compatible energy storage systems

The standard DEIF energy storage system interface is Modbus RTU (RS-485). When a TCP/IP interface is required, DEIF can supply and support an external converter.

System types

- BCU = Battery control unit
- BMS = Battery management system
- PCS = Power conversion system

COC = Certificate of compliance

ESS = Energy storage system

3.4 Communication protocols

ASC as Modbus master

The ASC can communicate with the energy storage system directly, or through a gateway device.

The ASC communication with the BCU, PCS, PDS, or BMS uses a Modbus RTU protocol. The ASC is the master and the energy storage system is the slave. Using this protocol, the ASC transmits the references to the energy storage system using Modbus RS-485 or by using the Ethernet gateway.

ASC as Modbus slave

The DEIF Open protocol uses Ethernet (Modbus TCP/IP) or Modbus RS-485. The ESS controller is the master device. Using this protocol, the energy storage system can read the references from the ASC, which is the slave device.

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

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

3.4.1 Communication parameters

Communication protocol

Parameter	Name	Range	Default	Details
7561	ASC Battery: ESS 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 master. * Broadcast is not available yet on the ASC-4 Battery.
7563	Tx maximum rate	0.1 to 10 s	0.5 s	Only affects protocols where the ASC is the master.
7564	Tx write fnc.	Single register 0x06 Multiple register 0x10	Multiple register 0x10	Only affects protocols where the ASC is the master.
7680	BMS comm. ID	1 to 247	3	The ID given to the BMS to receive and transmit data.
7681	BMS Protocol	See **DEIF Hybrid controller compatibility**	OFF	Select the battery management protocol that matches your BMS. If no BMS is available, or the BMS is not in the list, select OFF.
7881	PDS comm. ID	1 to 247	5	The ID given to the PDS to receive and transmit data.
7882	PDS protocol	See **DEIF Hybrid controller compatibility**	OFF	Select the Power DC-DC system protocol that matches your PDS. If no PDS is available, or the PDS is not in the list, select OFF.

ESS communication configuration

Parameter	Name	Range	Default	Details
7511	Ctrl. comm. ID	1 to 247	3	ESS communication ID.
7514	Ext. Comm. 1 Spd	9600 Baud 19200 Baud	9600 Baud	Communication speed selection for the ESS.
7515	Ext. Comm. 1 Mod	RTU ASCII	RTU	ESS communication type.
7520	Ext. Comm. 1 err.	1 to 100 s	10 s	ESS communication error alarm.

ESS monitoring

Parameter	Name	Range	Default	Details
7570	ESS COMM error	0 to 100 s	3 s	This alarm activates when a communication error alarm is present on the ESS.
7580	ESS Warning	0 to 100 s	0 s	This alarm activates when a Warning alarm is present on the ESS.
7590	ESS Shutdown	0 to 100 s	0 s	This alarm activates when there is a shutdown alarm present on the ESS.
7600	ESS monitor err	-	-	This alarm activates when there is no communication from the monitored ESS.

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

BMS monitoring

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

3.5 Consistency check

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

3.6 External 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.
7504	Comm. bus P Q scale	1% 0.1% 0.01%	1%	Change the scale of the external P and Q set points.

3.7 Remote monitoring

3.7.1 Monitoring solutions

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

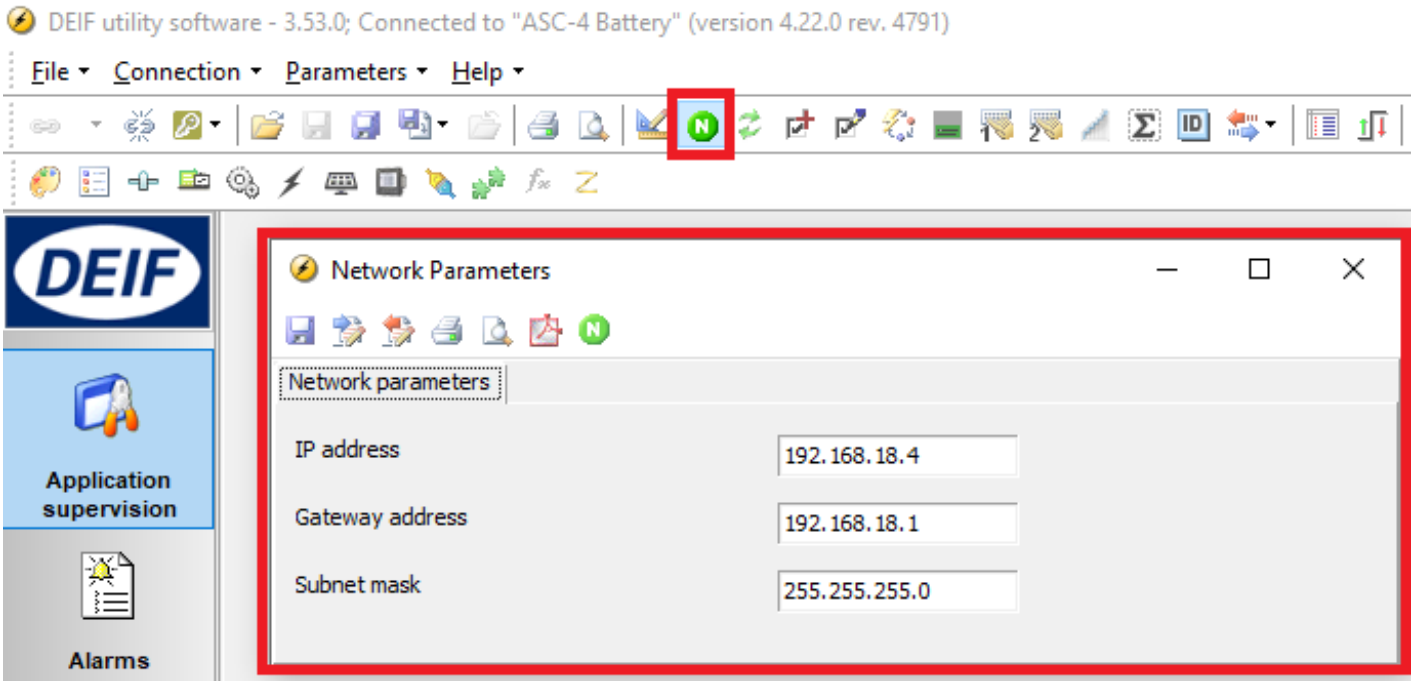
Another solution is to be installing a gateway giving access to a cloud-based database. This will give a front portal that can be accessed. This will show live data and log data to a server depending on the solution. DEIF offers a ready-made solution for this purpose.

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

3.7.2 DEIF Modbus connection

The Ethernet connection is used for remote or local monitoring.

To set up the IP, SM and GW, use the Ethernet configuration tool in the DEIF PC utility software.



3.7.3 Slave device, using Ethernet TCP/IP

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

More information
See the **ASC-4 Modbus slave User manual** for how to use the Modbus slave.

More information
See the **ASC-4 Modbus slave tables** for the Modbus slave addresses.

3.7.4 DEIF remote monitoring

The DEIF remote monitoring system is a hybrid monitoring system that provides ESS values and other relevant plant values. Values, alarms and logs can be seen from both the ASC-4 Battery and the BCU, PCS, PDS, and BMS. Alternatively, all the values, alarms and logs can be seen from the ASC-4 Battery.

3.7.5 ESS values

The controller includes a generic Modbus master that can access various values from the supported BCU, PCS, PDS, and BMS. The available values depend on the BCU, PCS, PDS, and BMS. For compatible systems, see **DEIF hybrid controller compatibility**.

The **ASC-4 Battery Modbus master tables** show which values are supported. Available ESS data can be read from the ASC Modbus slave using the TCP/IP port.

3.7.6 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

4. Single-controller applications

4.1 Single battery controller

The ASC-4 Battery can operate as a single controller, that is, without power management communication to other controllers. Single controllers are particularly useful for brownfield applications (the ASC is installed in a pre-existing plant). Single controllers can also be used in greenfield applications.

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, power meters, external genset controllers, or a PLC.

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.

The ASC-4 Battery controller calculates the charging and discharging set points. The set points are determined by:

- The operating mode
- The system load and configuration
- The state of charge in the storage
- The power readings from the other power source(s)
- The breaker position(s) of the other power source(s)

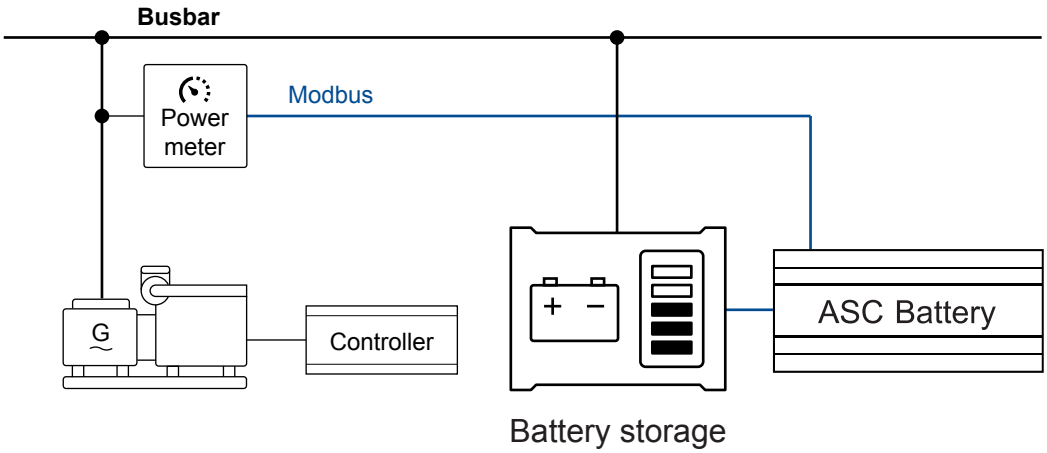
4.2 Modes of operation

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.

Off-grid applications

In a single controller off-grid application, the ASC can only operate in island mode.

Single controller off-grid ESS application

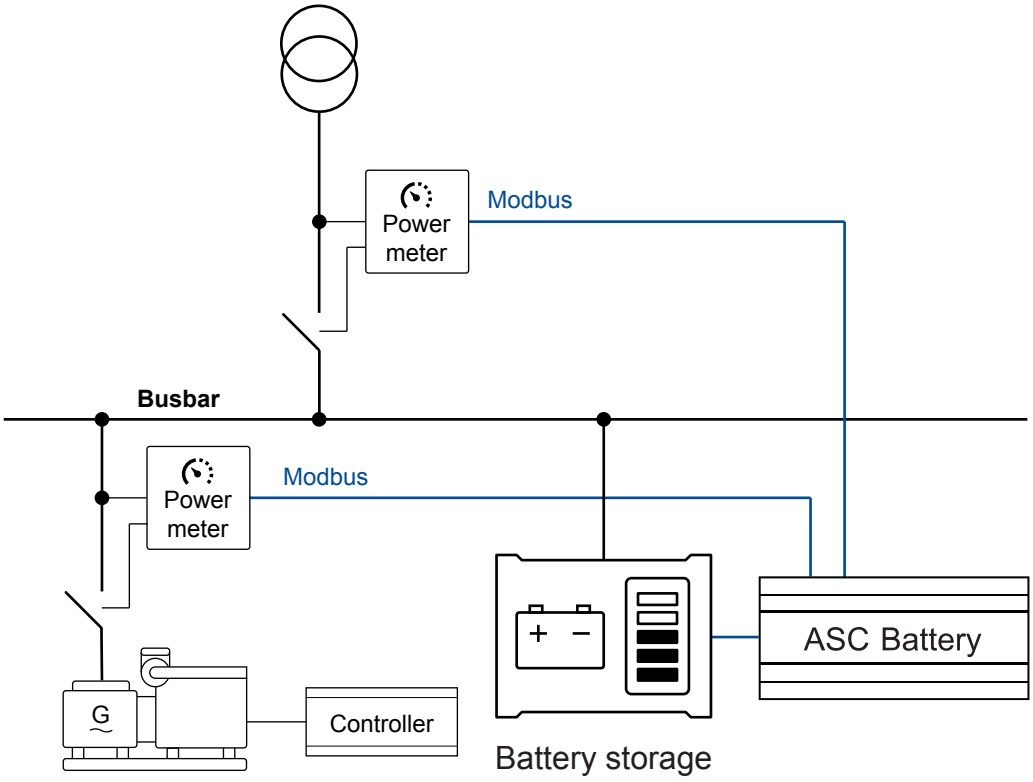


Grid-tied applications

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

4.3 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.

Adjust the maximum and minimum ranges in the analogue input setup. For example, for input 102, use menu 4120.

Connection status

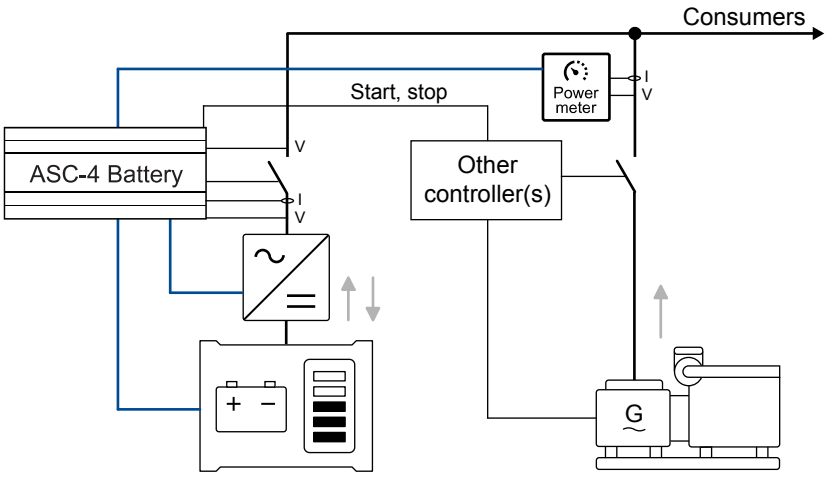
Transducers always also need a digital input for connection status. If the power meter/genset controller does not include the connection status, you must configure a digital input.

4.4 Genset applications

4.4.1 Gensets and single battery controller (off-grid)

A single controller application is used if the gensets already have a control system (shown by *Other controller(s)* in the diagram).

The ASC requires the GB breaker feedbacks (open or closed), and the active and reactive power from the gensets. For 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

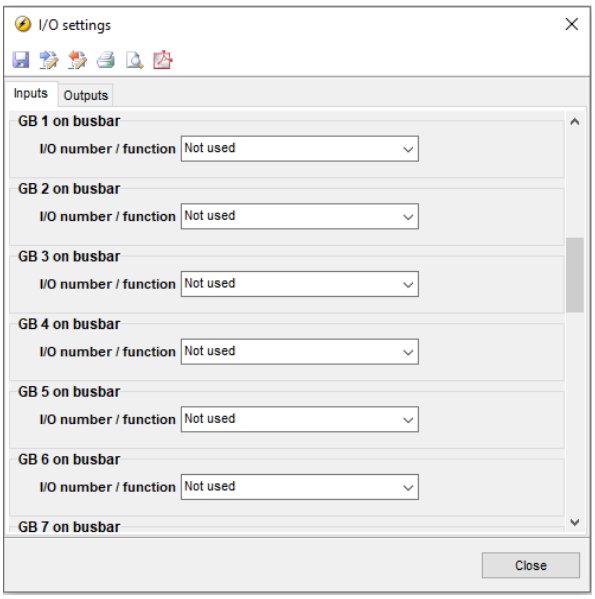
For a single controller application, the genset power (active and reactive) and breaker positions must be measured. You can use the following parameters to select the power and breaker measurements. The application can include up to sixteen (16) gensets.

Parameters

Parameter	Name	Range	Default	Description
7331 to 7481	DG[1 to 16] nom. power	0 to 3000 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	

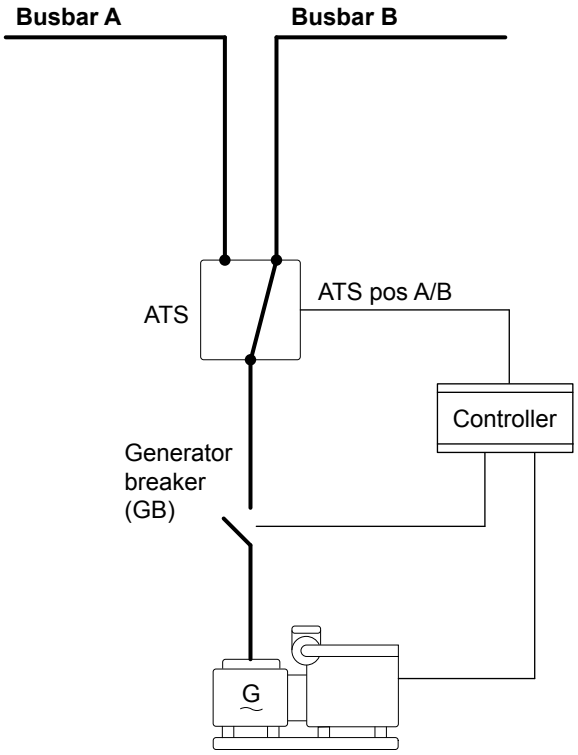
Gensets connected

The ASC also needs to know which gensets are connected. In the USW, on the *Inputs/Outputs* page, use the *I/O settings* box to configure the digital inputs.

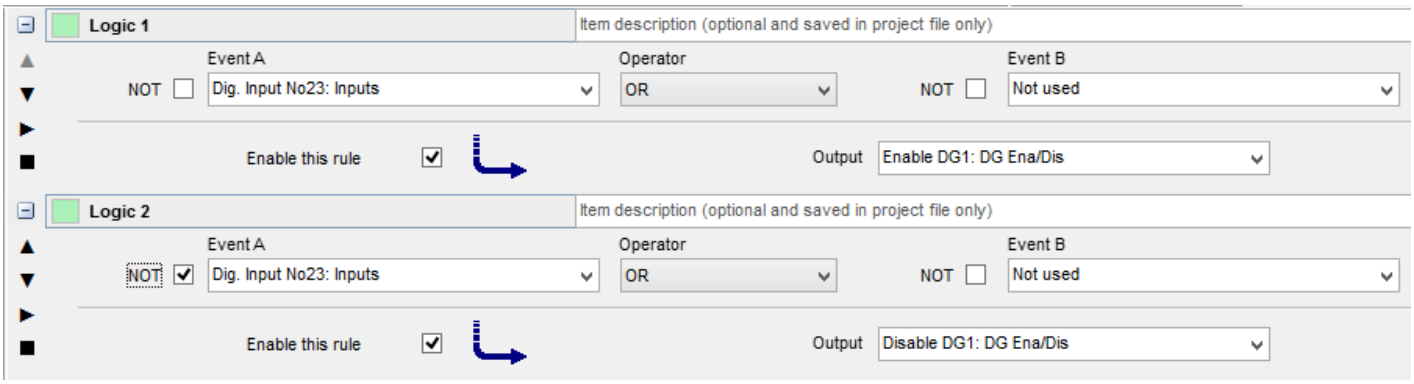

I/O settings
Inputs
Outputs
GB 1 on busbar
I/O number / function
Not used
GB 2 on busbar
I/O number / function
Not used
GB 3 on busbar
I/O number / function
Not used
GB 4 on busbar
I/O number / function
Not used
GB 5 on busbar
I/O number / function
Not used
GB 6 on busbar
I/O number / function
Not used
GB 7 on busbar
Close

4.4.3 Split busbar

In a single controller application, the generators can be enabled and disabled. This is useful if the generators can connect to two busbars.



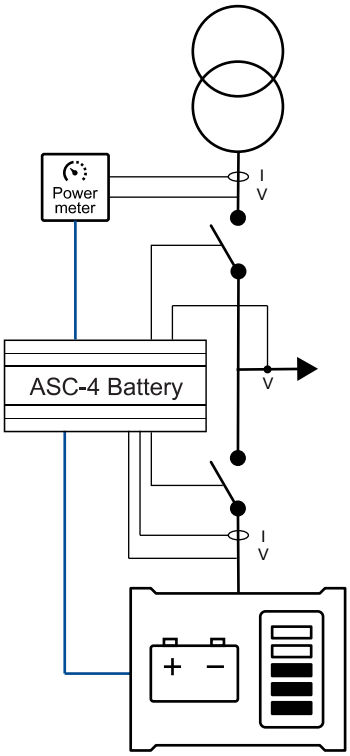
In the ASC in M-Logic, you can program whether the genset is connected to the ESS side (enabled) or connected to the side without the ESS (disabled):



4.5 Mains applications

4.5.1 Mains and single battery controller (grid-tied)

This application is used to operate parallel to mains when no AGC mains is installed. 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 Automatic mains failure

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 measured. You can use the following parameters to select a power meter and/or measurement transducers.

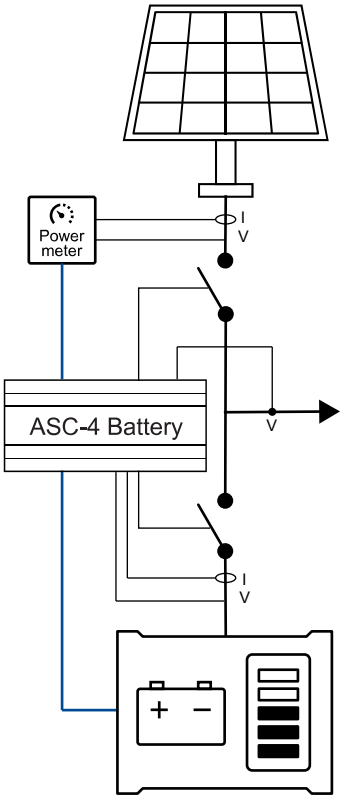
Parameters

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			

4.6 PV and single battery controller

A single controller application is used if the PV already has a control system (shown by *Other controller(s)* in the diagram).

The ASC requires the PV breaker feedback (open or closed), and the active and reactive power from the PV. For 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 meter.

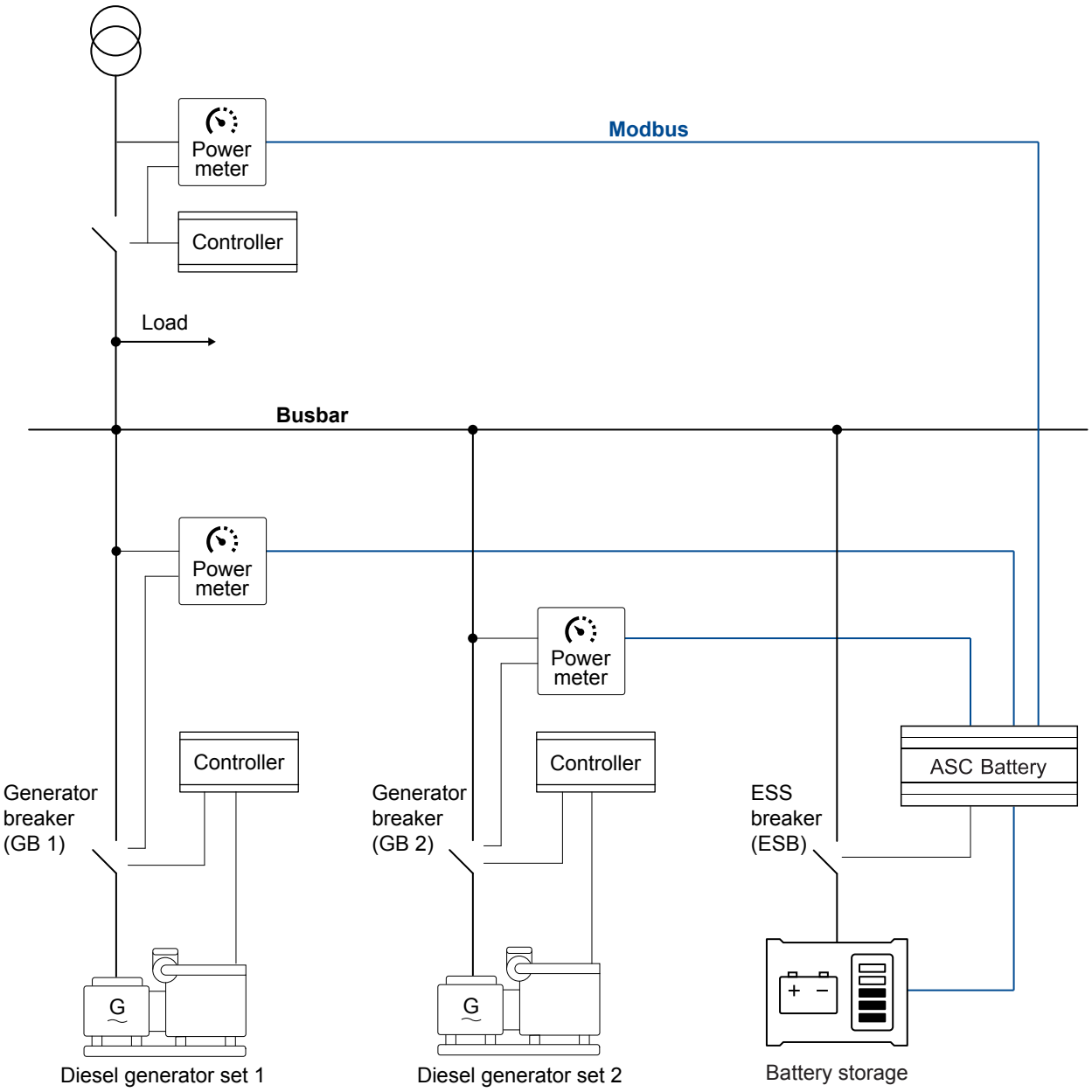


Setting in ASC

Parameter	Name	Setting
6071	Operating mode	Island operation

4.7 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).

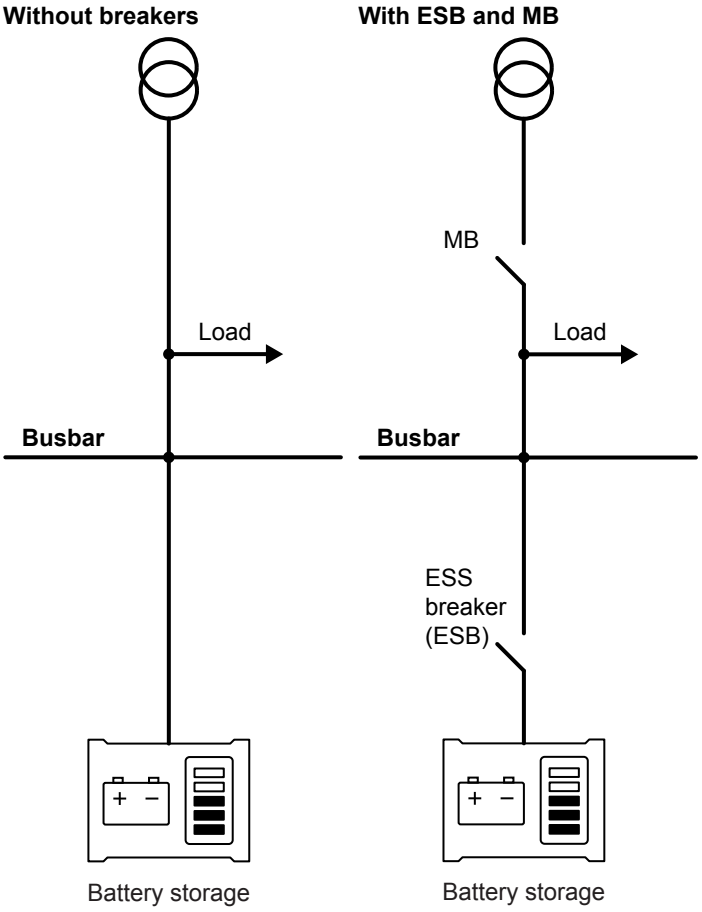
Setting in ASC

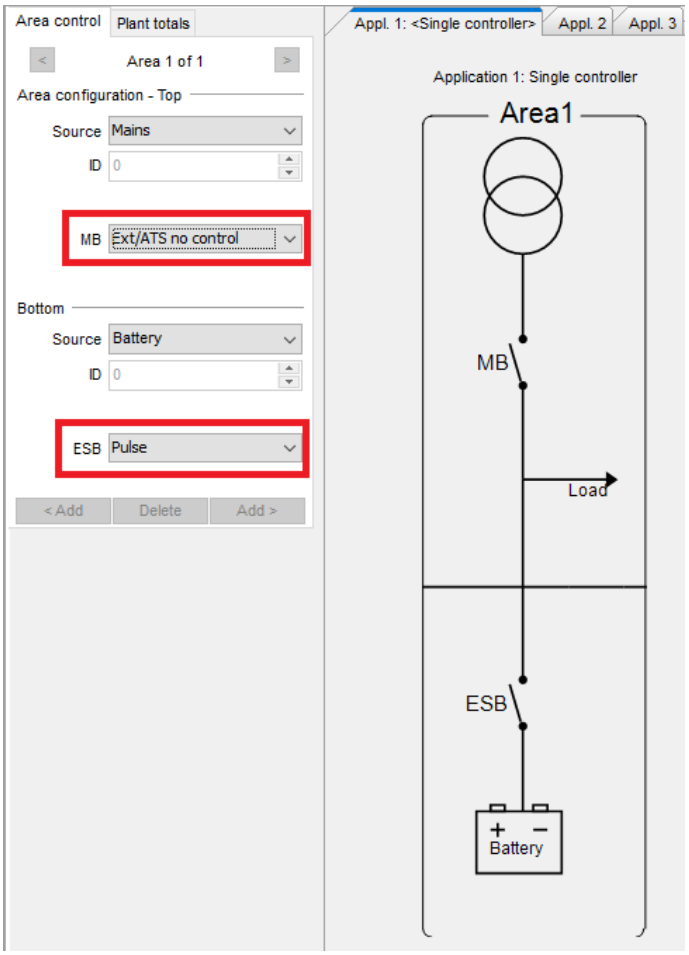
Parameter	Name	Range
6071	Operating mode	Island operation Fixed power Peak shaving Mains power export Automatic mains failure

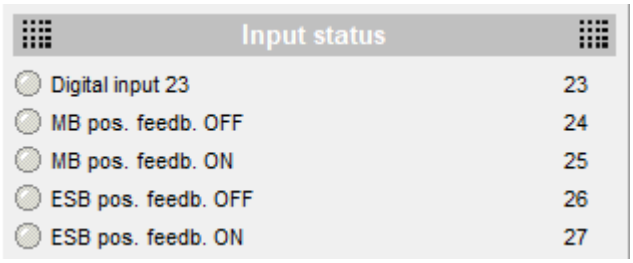
4.8 Breaker control

In a single controller application, the ASC Battery controller can control a ESB (energy storage breaker) (optional). If a mains or genset breakers are present, the ASC cannot control these breakers. The ASC only receives the breaker feedback (open/closed).

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







5. Energy management systems

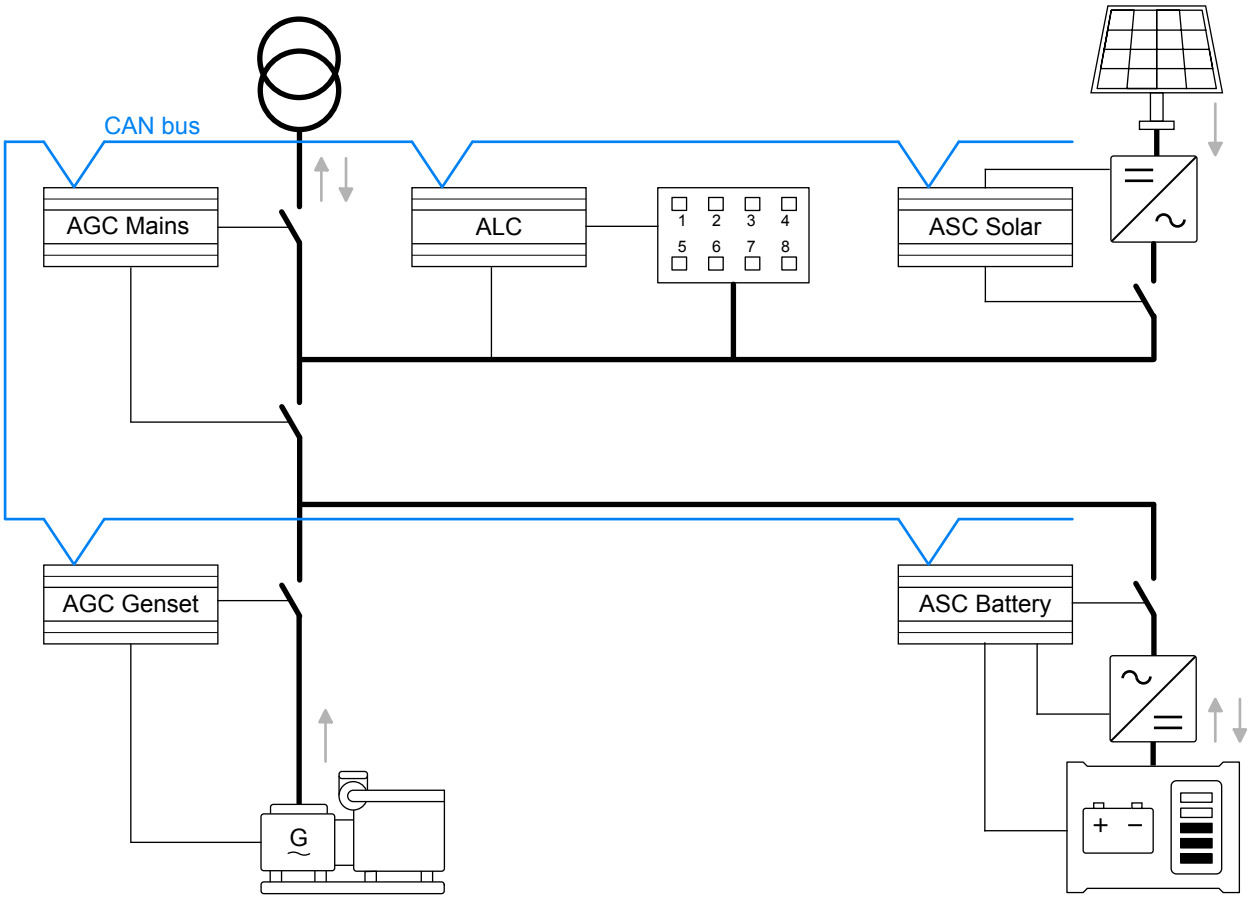
5.1 Overview

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 mains, gensets, PV and/or ESS to work together in an integrated system. Power management includes:

1. Automatic rotation of genset priority.
2. Fuel-optimised genset priority.
3. Control of plant spinning reserve.
4. Flexible application support with common grid-tied, combination, and off-grid applications.

ASC and ESS on the utility software application drawing

The ASC controls and monitors the ESS. In the application single line drawing, each ASC is shown as a battery.

Breaker control

The ASC can control an ESS breaker like an AGC controls a generator breaker. One ASC can control one ESS breaker.

If the ESS is grid-following, the ESS 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 ESS breaker but not close it. If the ASC is in AUTO mode, the ASC closes the breaker when the busbar is live. The ESS then starts. The ASC does not require a manual start signal if AUTO is selected.

In SEMI mode, an operator must press 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 mode

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

5.4 System limitations

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

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

Example

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

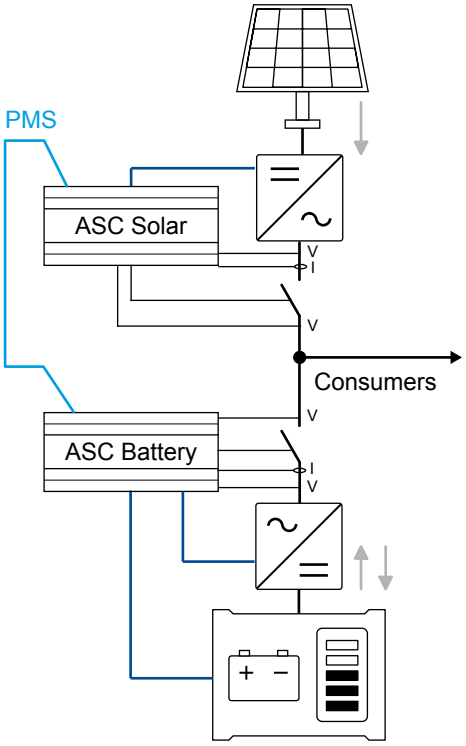
If you have a system with 14 ASC controllers, you can have 16-14=2 bus tie breakers.

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

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 solar and battery



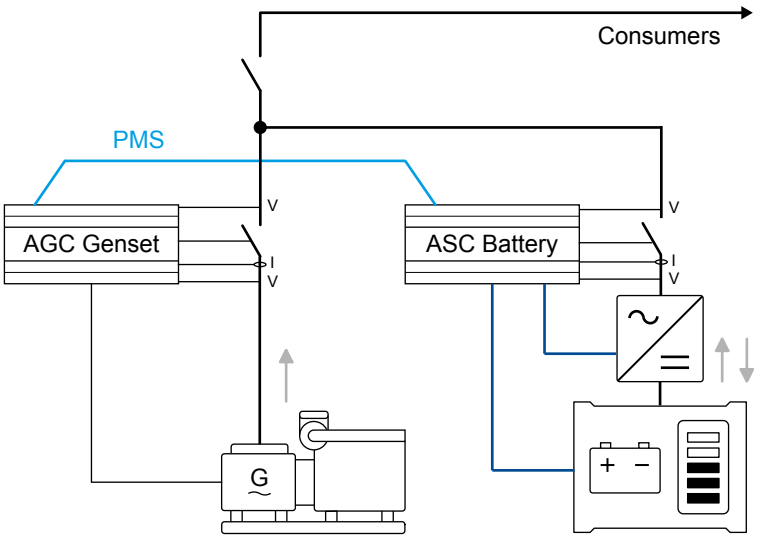
ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

ASC Solar configuration

Parameter	Name	Setting
6071	Operating mode	Power management

5.5.2 Off-grid with genset(s) and battery



To improve power quality, the ESS can supply peak loads while gensets start. The ASC Battery controller can support the load, so that the genset can run at its optimal load point. If the ESS is designed to supply the busbar load, the ESS can be the only source connected to the busbar.

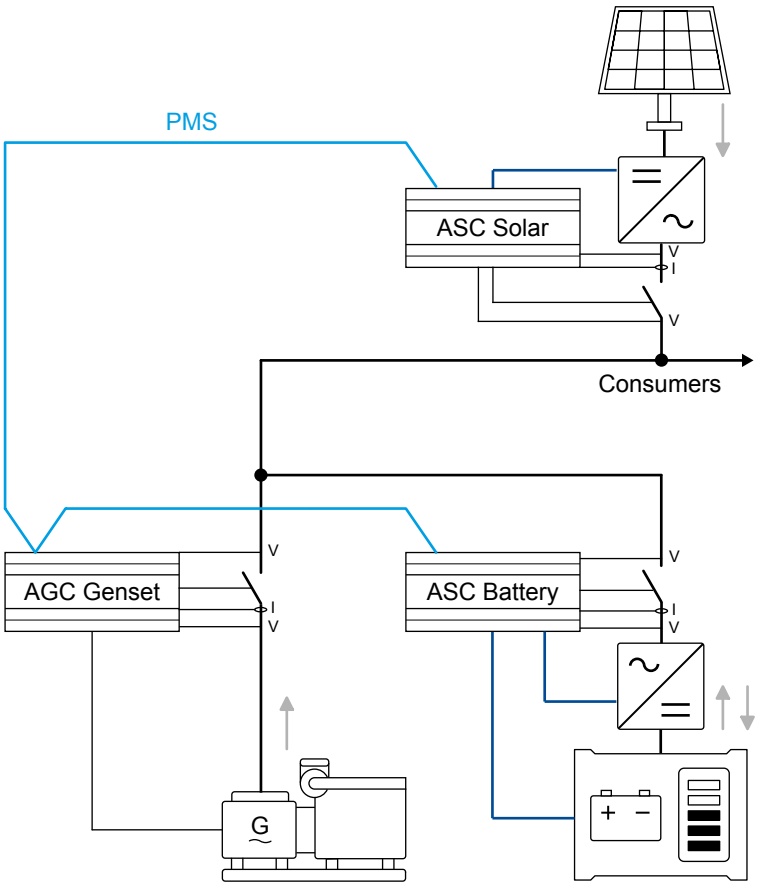
ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

AGC Genset 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

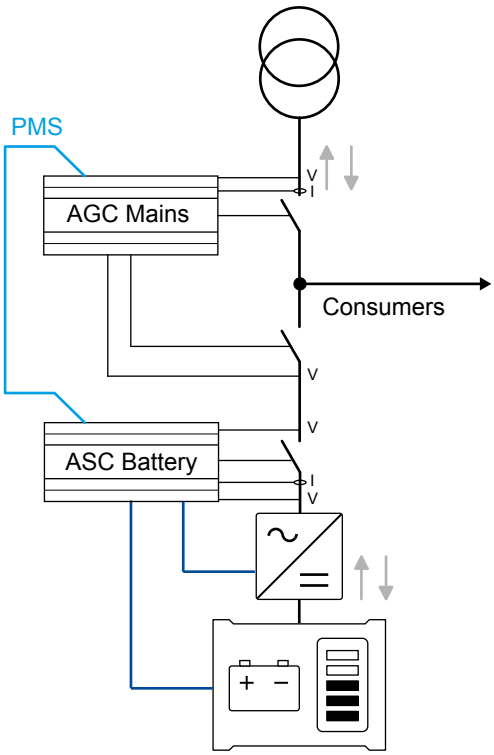
AGC Genset configuration

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 battery



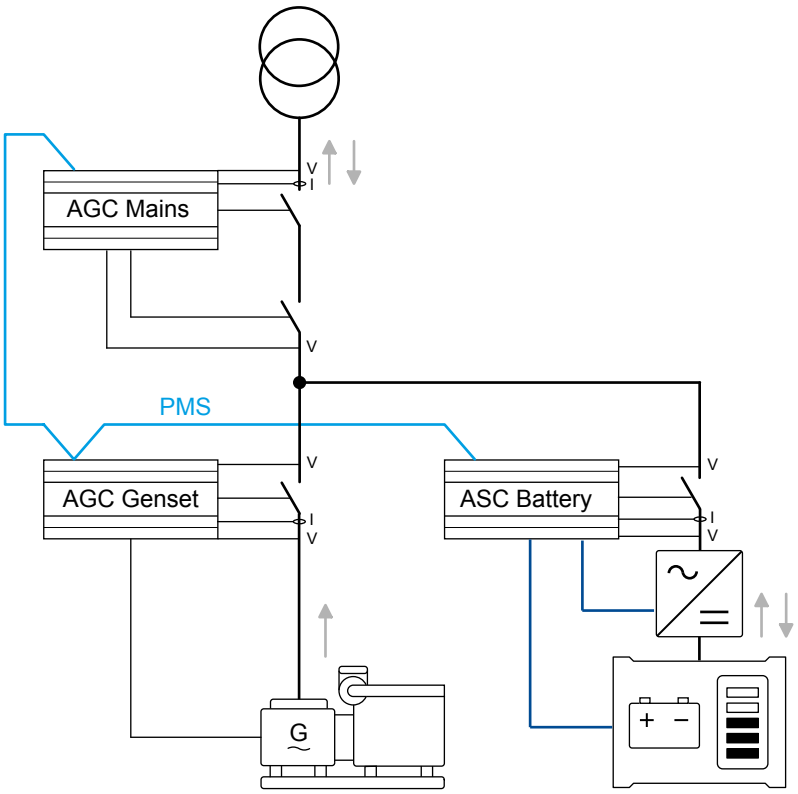
ASC Battery configuration

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 genset battery



ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

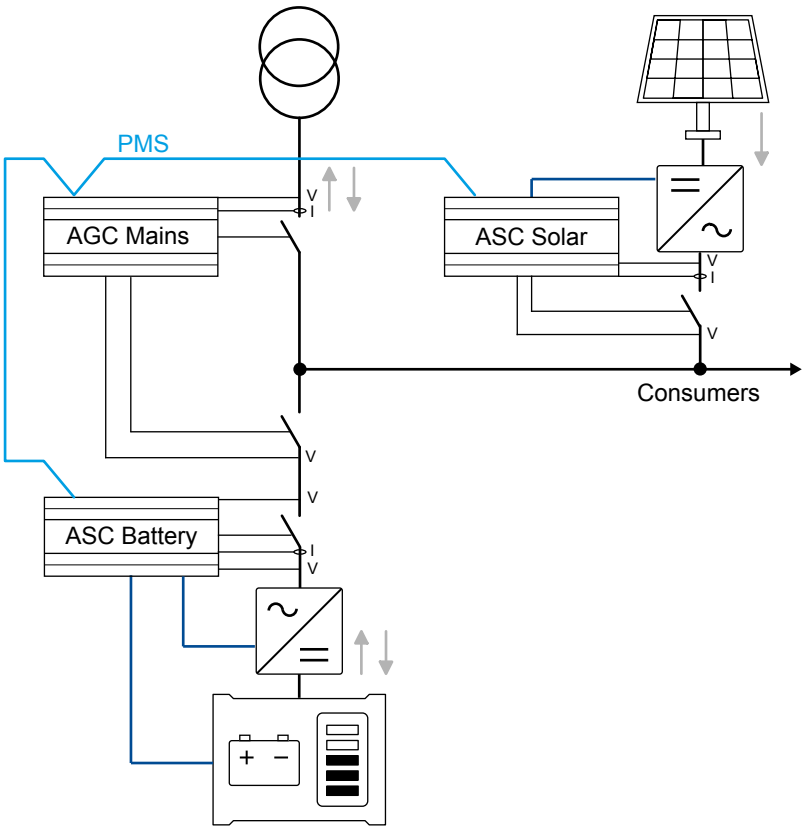
AGC Genset configuration

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.

5.6.3 Grid-tied hybrid solar-battery



ASC Battery configuration

Parameter	Name	Setting
6071	Operating mode	Power management

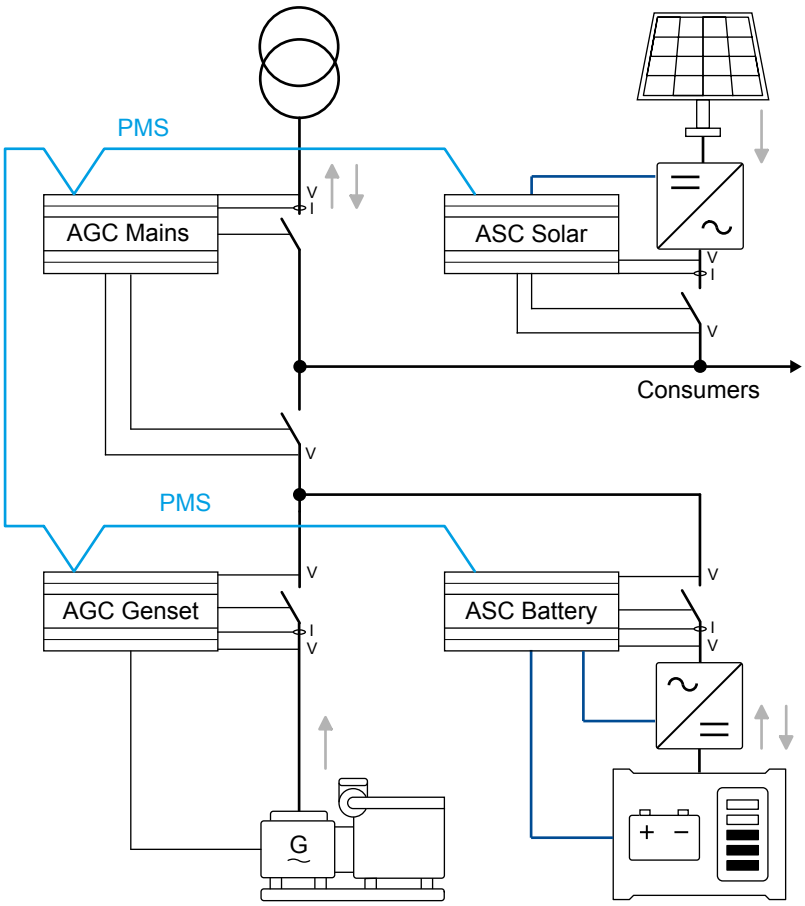
ASC Solar configuration

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.

5.6.4 Grid-tied hybrid solar-genset-battery



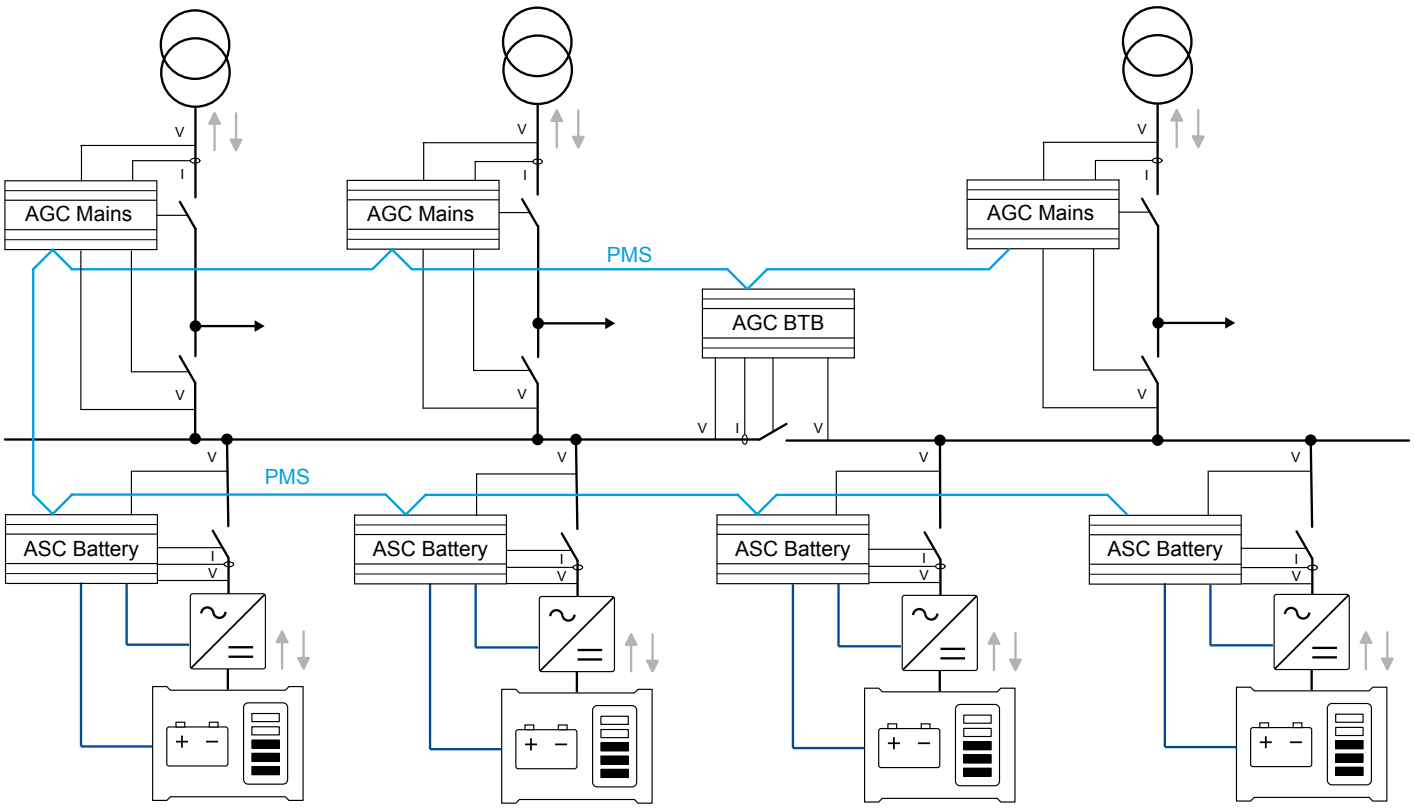
ASC Battery, ASC Solar, and AGC Genset configuration

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.

5.6.5 Multi-mains with battery



ASC Battery configuration

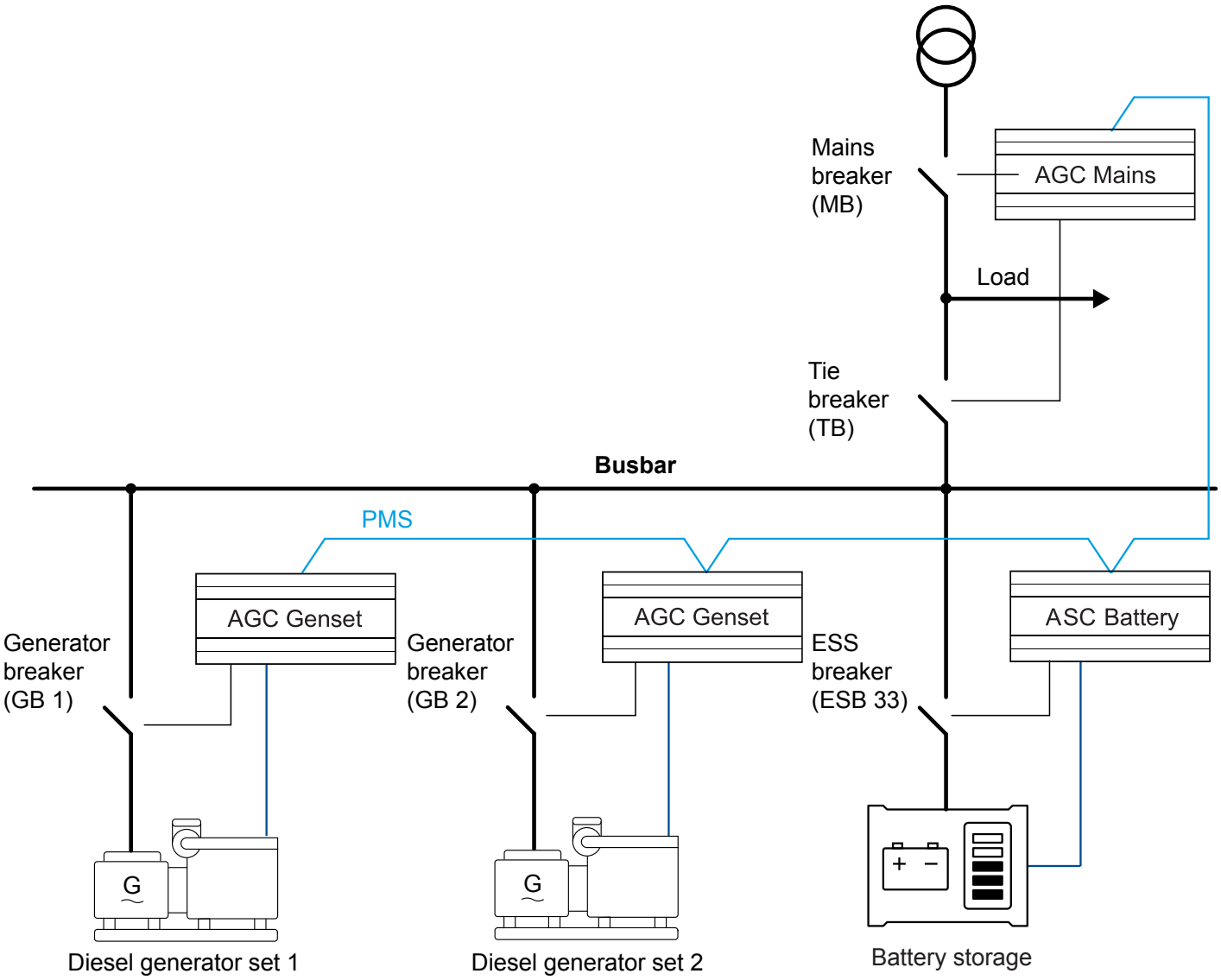
Parameter	Name	Setting
6071	Operating mode	Power management

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

ASC Battery 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 controller. When using ASC Battery, configure two sets of load-dependent start and stop parameters in each AGC Genset controller.

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

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

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

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 are shared parameters that ensure that all engines connected to the busbar do not go below the minimum load.

If the gensets are in frequency control mode, the energy storage system regulates the power. If the gensets are loaded more than the parameter set point, then the energy storage system is regulated up to take over load from the gensets and vice versa.

5.9 Spinning reserve

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

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

Available power

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

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

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

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

Spinning reserve

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

Spinning reserve = Genset available power + Battery generating capacity

To be included in the spinning reserve:

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

Parameters

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

Example: Off-grid genset and battery application

One battery and five gensets
Battery generating capacity = 0.4 MW
Nominal power for each genset = 1.5 MW
Spinning reserve required = 1.0 MW
Genset load-dependent start set point = 90 %
Genset load-dependent stop set point = 85 %

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

Example: Off-grid genset and energy storage system; half of storage capacity trips

Two 1 MW batteries, and ten gensets
Total battery generating capacity = 2 MW
Nominal power for each genset = 1.5 MW
Spinning reserve required = 3.5 MW

Genset load-dependent start set point = 90 %
Genset load-dependent stop set point = 70 %

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

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 Parallel to grid operation

Gensets that operate in parallel to the ESS are always loaded to at least their *Minimum Load*, to protect them.

The power management system uses the ESS according to the charge scheme, and starts and stops gensets as required while taking the minimum genset load into account.

5.12 ESS set point

The energy storage system gets a set point from the ASC controller. The ASC can transmit the set point. Alternatively, the energy storage system can read the set point from the ASC (DEIF Generic).

In grid-tied modes (for example, peak shaving or fixed power), the plant can be set up to stop all engines. For the AGC Genset controllers, configure the minimum number of gensets to run (multi-start) as **0**.

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

5.13 ASC Battery set points

5.13.1 Set points in multi-ASC applications

If more than one ASC is present, they 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 energy storage systems.

5.13.2 Reactive set points (kvar)

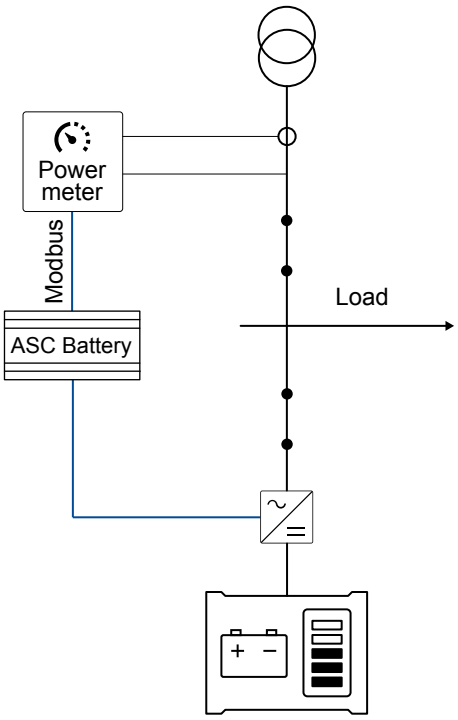
You can use a variety of reactive power regulation methods to regulate the reactive power from the energy storage system.

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 ESS 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 power converter uses the set point in this parameter.
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 power converter carries the remainder from 0.95 to 0.9.
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 power converter supplies all Q (under the assumption they support it).
7033	Q type off-grid	Off		●	If equal var sharing (in percent) is requested between the gensets and the power converter, equal kvar sharing can be enabled in this parameter. If var sharing is switched off, the settings in parameters 7031 or 7032 will be used.
7041	P/Q limit type	OFF	●	●	See the section below.
7042	P/Q cap limit %	95 %	●	●	See the section below.

7024, Method of var regulation

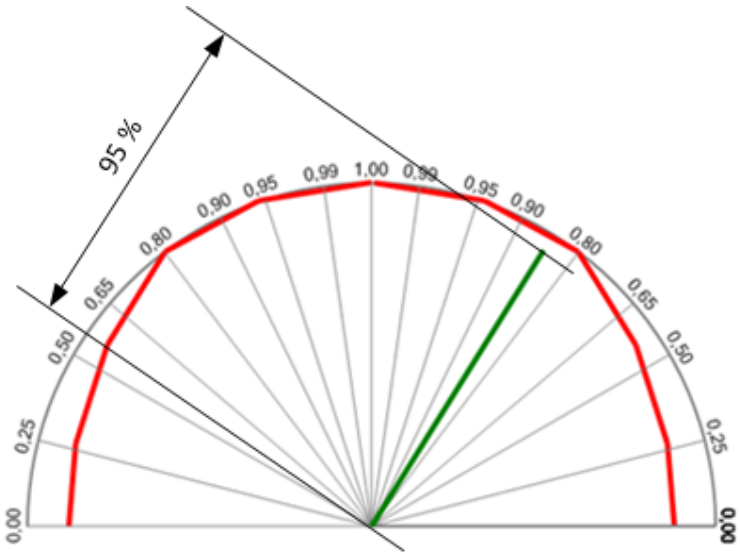
- **Off**: No Q control when the MB is closed or when fixed power mode is selected.
- **Cosphi fixed**: The power converter maintains a fixed cos phi (set in parameter 7021).
- **Cosphi imp/exp**: The power converter is regulated against a cos phi set point in parameter 7021.
  - **Measured at the point of connection**: A power meter or measurement transducers are needed to measure the reactive power imported to or exported from the plant. The power converter is 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 power converter is allowed to go. If set to 100 %, it is possible that the full area is used. If, for example, it is set to 95 %, the load level will not reach the limit of the capability curve.

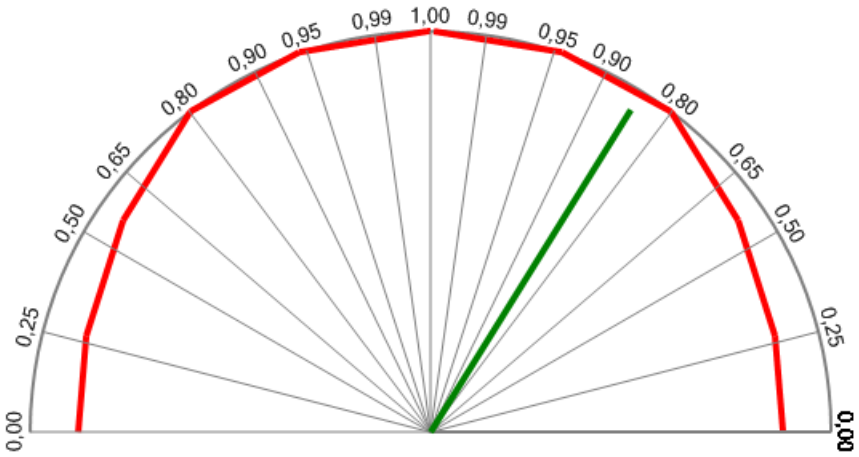


7041, use capability curve

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

Three selections are available:

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



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

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

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

5.13.3 Peak shaving charging limit

The peak shaving set point is configured in the AGC Mains controller. When this limit is enabled, if the power from the mains is above the peak shaving set point, the ESS cannot charge from the mains. Instead, the AGC Battery tries to use the remaining SOC to produce power, to get the mains power below the peak shaving set point.

Parameter				
8024	PS charging lim	Not enabled Enabled	Not enabled	To optimally charge the ESS in peak shaving operation, enable this parameter.
7011	Peak Shaving	-20000 to 20000 kW	750 kW	The peak shaving set point.

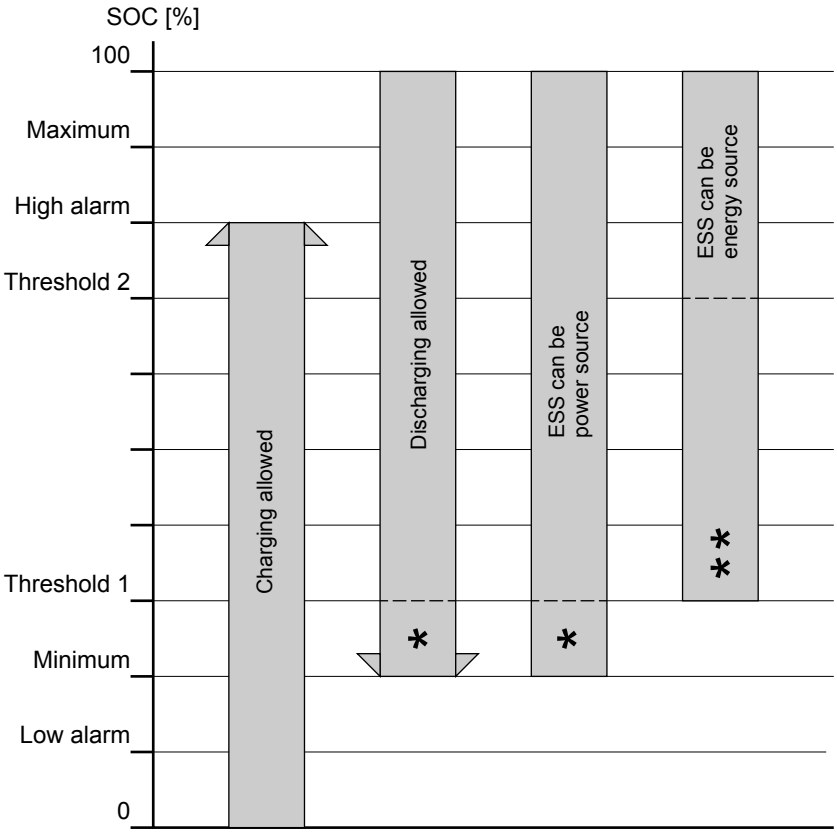
6. Battery controller functions

6.1 Managing charging and discharging

6.1.1 State of charge

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

State of charge conditions



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

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

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

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

State of charge parameters

Parameter	Name	Range	Default	Details
8055	SOC Settings	SOC Setting 1, 2, 3	SOC Setting 1	ASC Battery has three sets of state of charge parameters. This parameter selects which set to use.
7110	SOC Low	0 to 100 %	20 %	The SOC low alarm.

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

6.1.2 ESS charging source

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

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

ESS charging function parameters

Parameter	Name	Range	Default	Details
8022	Mains Charging	0 to 100 % of battery nominal power	100 %, Not enabled	If enabled, the ESS can recharge from mains. The set point is the maximum charging rate. If the ESS is running as an energy function, it will not recharge from mains.
8031	DG Charge pct	0 to 100 % of the connected genset(s) nominal power	100 %	The set point is the maximum charging rate from gensets in percent. This is only active if 8033 is enabled and set to *Percent*.
8032	DG Charge P	0 to 5000 kW	200 kW	This power must be available as spinning reserve while the ESS is recharging. This should be above the genset start limit. This is only active if 8033 is enabled and set to *Power*.
8033	DG Charge Mode	DG Charge in Percent DG Charge in Power	DG Charge in Percent, Not enabled	If enabled, the ESS can recharge from the gensets. This parameter determines whether parameter 8031 (Percent) or 8032 (Power) is used.
8041	PV Charging	0 to 100 % of the available surplus PV power	100 %, Not enabled	If enabled, the ESS can recharge from PV. The set point is the maximum charging rate.

Parameter	Name	Range	Default	Details
				If the PV system has no sensors (parameter 6301), the set point must be 100 %.

6.1.3 Charging the ESS

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

Charging rules

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

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

Maximum rate

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

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

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

6.1.4 Discharging from the ESS

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

Discharging rules

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

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

Maximum rate

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

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

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

6.1.5 Manually force dispatch

By default, the ASC determines the dispatch (battery discharging rate). You can use the following parameters to override the ASC, and force the ESS to supply fixed power.

Parameter	Name	Range	Default	Details
7061	Man. disp. Ref.	30 to 100 % of ESS nominal power	100 %	If enabled, the ASC uses this as the discharging rate. This discharging rate has first priority. The ASC can stop gensets to achieve this discharging rate.
7062	Man. disp. CMD	OFF ON	OFF	Enable parameter 7061.

6.1.6 Genset minimum load

For both single controller and energy management system applications, the ASC ensures that the load on the connected genset(s) does not fall below the minimum load.

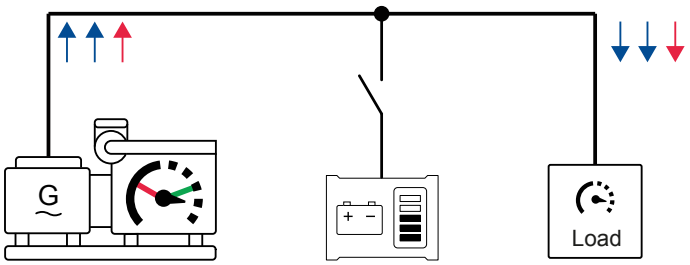
Parameter	Name	Range	Default	Description
8011	Min DG load 01	0 to 100 %	30 % of the genset's nominal power	The ASC calculates the ESS power set point to ensure that the load on the connected genset(s) does not fall below the minimum load.
8012	Min DG load 02	0 to 100 %	30 % of the genset's nominal power	
8013	Min DG load set	Min. DG load set 1 Min. DG load set 2	Min. DG load set 1	This determines whether the ASC uses the setting in parameter 8011 or 8012.

6.1.7 Genset optimum load

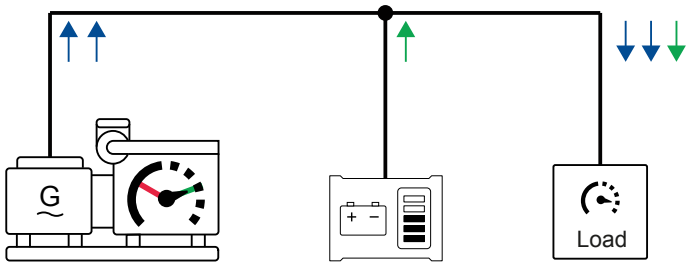
For both single controller and energy management system applications, the ASC ensures that (as far as possible), the connected genset(s) run at their optimum load.

Parameter	Name	Range	Default	Description
8014	Opt DG load 01	0 to 100 %	80 % of the genset's nominal power	The ASC calculates the ESS power set point to ensure that the load on the connected genset(s) is optimum.
8015	Opt DG load 02	0 to 100 %	70 % of the genset's nominal power	
8016	Opt DG load set	Optimal DG load set off Optimal DG load set pct 1 Optimal DG load set pct 2	Optimal DG load set off	This determines whether the ASC uses the optimal DG load function, or the setting in parameter 8014 or 8015.

Using battery discharging for optimum genset load (high power consumption)

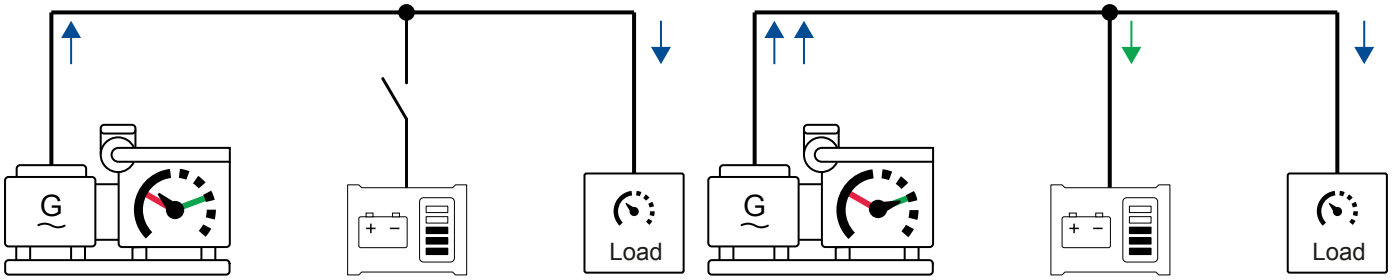


High power consumption, without battery



High power consumption, with battery discharging

Using battery charging for optimum genset load (low power consumption)



Low power consumption, without battery **Low power consumption, with battery charging**

NOTE The battery charging rate is governed by the set point for charging (parameter 8031). If this is the same as the optimal load point (parameter (8014), you will have the operation shown above.

6.2 Energy source or power source operation

The energy and power source functions determine the source priority. The source functions are not directly related to grid-forming and grid-following.

6.2.1 Energy source operation

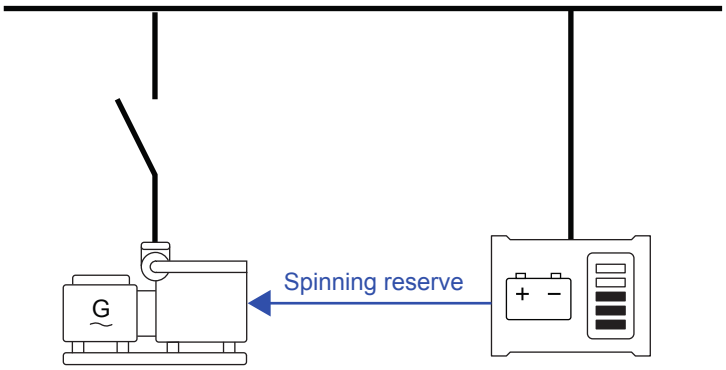
For energy source operation, the ASC-4 Battery controller prioritises battery power over genset power. As a result, the system uses as much battery power as possible before starting any genset.

Battery Energy Source operation

The ESS is designed to supply the load, and can be the only grid-forming source connected to the busbar. Selecting *Battery Energy Source* gives the ESS the higher priority (after PV, if this is present).

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

ESS acts as a battery energy source



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

NOTE For Battery Energy Source operation, the ESS must be able to do grid-forming operation.

6.2.2 Power source operation

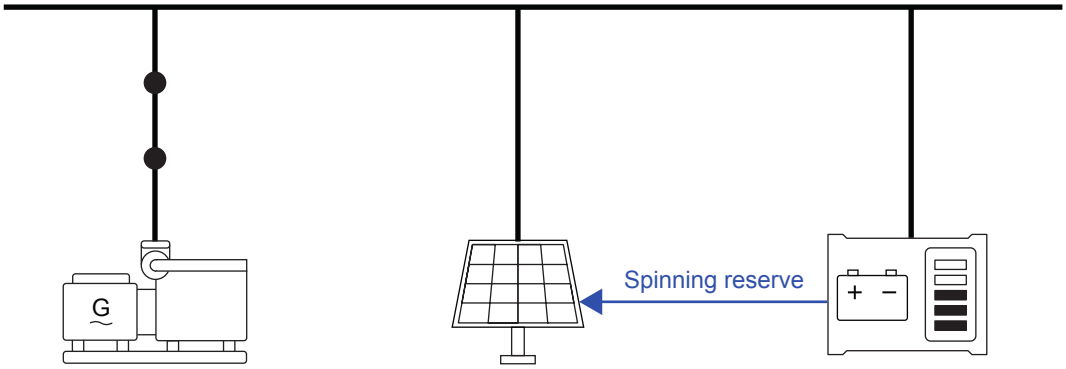
For power source operation, the ASC-4 Battery controller operates parallel to other sources. Genset power is prioritised over battery power. This mode is used to ensure that spinning reserve requirements are met

Battery Power Source operation

The ESS is used to supply peak loads while gensets are starting, and to improve power quality. The ESS is not designed to be the only grid-forming source connected to the busbar. Selecting *Battery Power Source* gives the gensets the higher priority (after PV, if this is present).

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

ESS acts as a battery power source



6.2.3 Energy or power source parameter

If PV is present, it is always the first priority source. You can configure whether the ESS is the next priority source.

Parameter	Name	Range	Default
8081	Operation mode	Battery Energy Source Battery Power Source	Battery Power Source

6.2.4 ESS black busbar start

If the energy source requirements are met, the ESS can start and supply the load alone. This includes a black busbar start. Other sources do not have to be connected.

6.2.5 ESS as the only energy source

If the energy source requirements are met, the ESS can supply the load alone. Other sources do not have to be connected.

If the ESS discharges so that the energy source requirements are not met, the controller changes to power source operation. The controller starts and connects another power source.

6.3 Grid-forming or grid-following

These modes are controlled by the ASC-4 Battery controller using the PCS and BCU.

Grid-forming

Grid-forming is also called island, or V/f mode. For grid-forming mode, the ASC-4 Battery controller can act as the only energy source. The battery can provide the grid-forming power in island operation, and work together with non-grid-forming sources, like solar and wind.

If the system includes gensets, these are stopped if the load level, battery capacity, and state of charge conditions are fulfilled. When the battery is discharged or the load increases beyond the battery capacity, the gensets are reconnected. The controller can also suppress genset starts from solar controller spinning reserve requests.

Grid-following

Grid-following is also called parallel, or P/Q mode. For grid-following mode, the ASC-4 Battery controller is always connected to another grid-forming source, like a mains or genset. The battery can be used as power buffer, providing spinning reserve and peak shaving. The battery can also be used for time of use (TOU) applications.

Droop mode/VSG mode

If the ESS supports this, the ASC-4 Battery controller can run the ESS in droop mode for both Grid-forming and Grid-following. The controller controls the storage charge and discharge using V/f or P/Q set points from the configured droop curve (that is, like a virtual synchronous generator (VSG)).

6.3.1 Battery droop

When the protocol selected in parameter 7561 supports droop, you can configure droop for the ASC battery controller. Adding droop to the battery regulation increases the system stability.

More information
See **DEIF hybrid controller compatibility** for the systems that support droop.

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

Power-frequency droop example

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

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

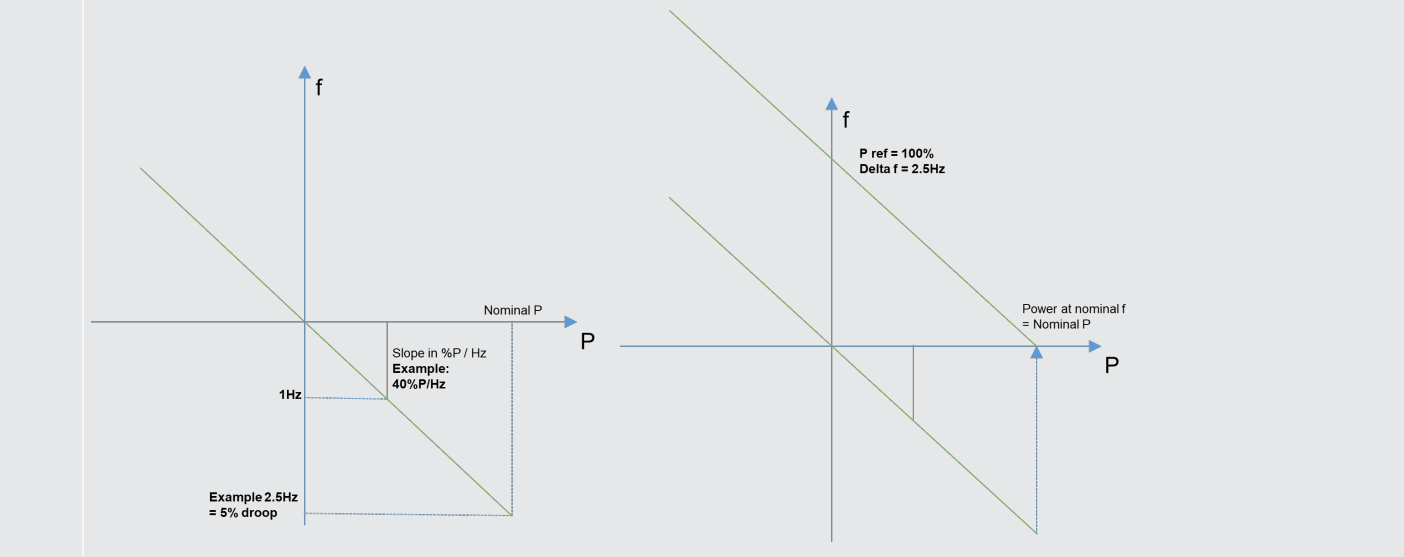
Reactive power-voltage droop example

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

Voltage offset = Reactive power reference / (Nominal reactive power x Droop slope) + Nominal voltage
Voltage offset = 100 kvar / (1000 kvar x 0.05 Q/Hz) + 400 V = 2 V + 400 V = 402 V

Droop curve example

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



6.3.2 Setting the mode

The controller dynamically changes the mode based on the configuration and operating conditions. You can override the mode from M-Logic. Under *Output, Battery*, you can select:

- **Set mode to Droop**: The ESS runs in droop mode.
- **Set mode to P/Q**: The ESS runs in grid-following mode.
- **Set mode to V/f**: The ESS runs in grid-forming mode.

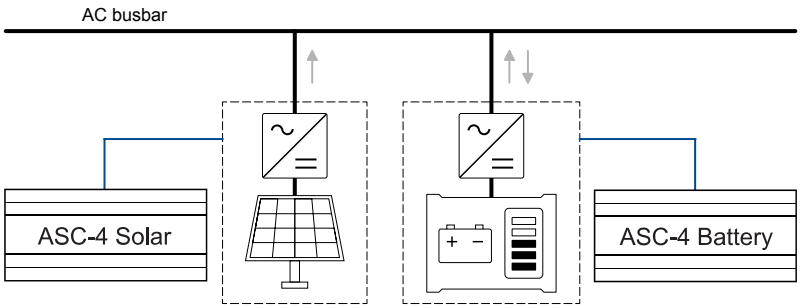
6.4 AC- or DC-coupled

6.4.1 AC-coupled connections

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

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

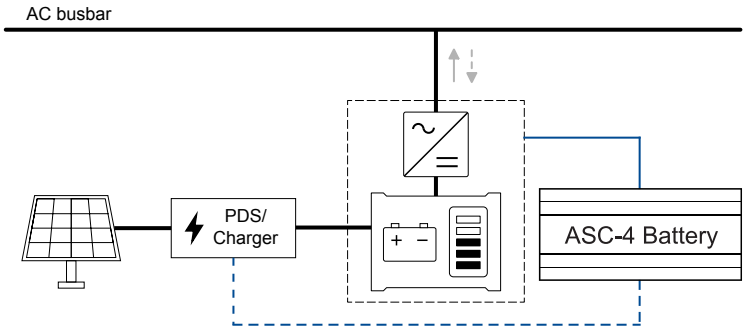
PV and ESS with separate AC connections to the busbar



6.4.2 DC-coupled connections

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

PV and ESS with one AC connection to the busbar



6.4.3 AC- or DC-coupled parameter

Parameter	Name	Range	Default	Description
8082	Operation mode	DC-Coupled Battery AC-Coupled Battery	AC-Coupled Battery	For DC-Coupled Battery, the PV is not connected to the busbar, but supplies the ESS directly. The ESS power is based on the ASC parameters. For example, if the ESS is charging from the busbar, then the current from the PDS is reduced.

6.4.4 PDS control

The ASC can communicate with a Power DC-DC System (PDS) in a DC-coupled system.

Parameter	Name	Range	Default	Description
7881	PDS comm. ID	1 to 247	5	Select the ID.
7882	PDS protocol	OFF SinExcel DC/DC PDS	OFF	Select the protocol for the PDS.
7890	PDS comm. error	0 to 100 s	3 s, Not enabled	**Enabled**: The ASC activates this alarm when there is a PDS communication error.
7900	PDS warning	0 to 100 s	0 s, Not enabled	**Enabled**: The ASC activates this alarm when there is a warning from the PDS.
7910	PDS shutdown	0 to 100 s	0 s, Not enabled	**Enabled**: The ASC activates this alarm when there is a PDS shutdown.

6.5 Ramps

6.5.1 Load ramps

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

Parameter	Name	Range	Default	Details
2611	P ramp up	0.1 to 20 %/s	2 %/s	Limits the rate of power increase from the battery.
2612	Island ramp	Enabled, Not enabled	Not enabled	**Not enabled**: The battery will always ramp up to the full load. **Enabled**: If the battery is in an island PMS and not other power sources are connected, it will take the full load immediately.
2621	P ramp down	0.1 to 20 %/s	2 %/s	Limits the rate of power decrease from the battery.

Parameter	Name	Range	Default	Details
2622	Ramp open point	1 to 20 %	5 %	The breaker cannot open after the ramp down until the load is below this point.
2641	Q ramp up	0.1 to 100 %/s	2 %/s	Limits the rate of reactive power increase from the battery.
2642	Q ramp lim. max	1 to 110 %	90 %	The controller ignores the ramp if the reactive power is above this limit.
2651	Q ramp down	0.1 to 100 %/s	2 %/s	Limits the rate of reactive power decrease from the battery.
2652	Q ramp lim. min	-20 to 50 %	-10 %	The controller ignores the ramp if the reactive power is below this limit.

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

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

6.5.2 Ramp override

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

Genset overload

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

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

Genset reverse power

The ASC overrides the set point ramp if the generator is running below a minimum load (parameters 8011 to 8013), or has reverse power.

6.6 Flowcharts

6.6.1 Functions

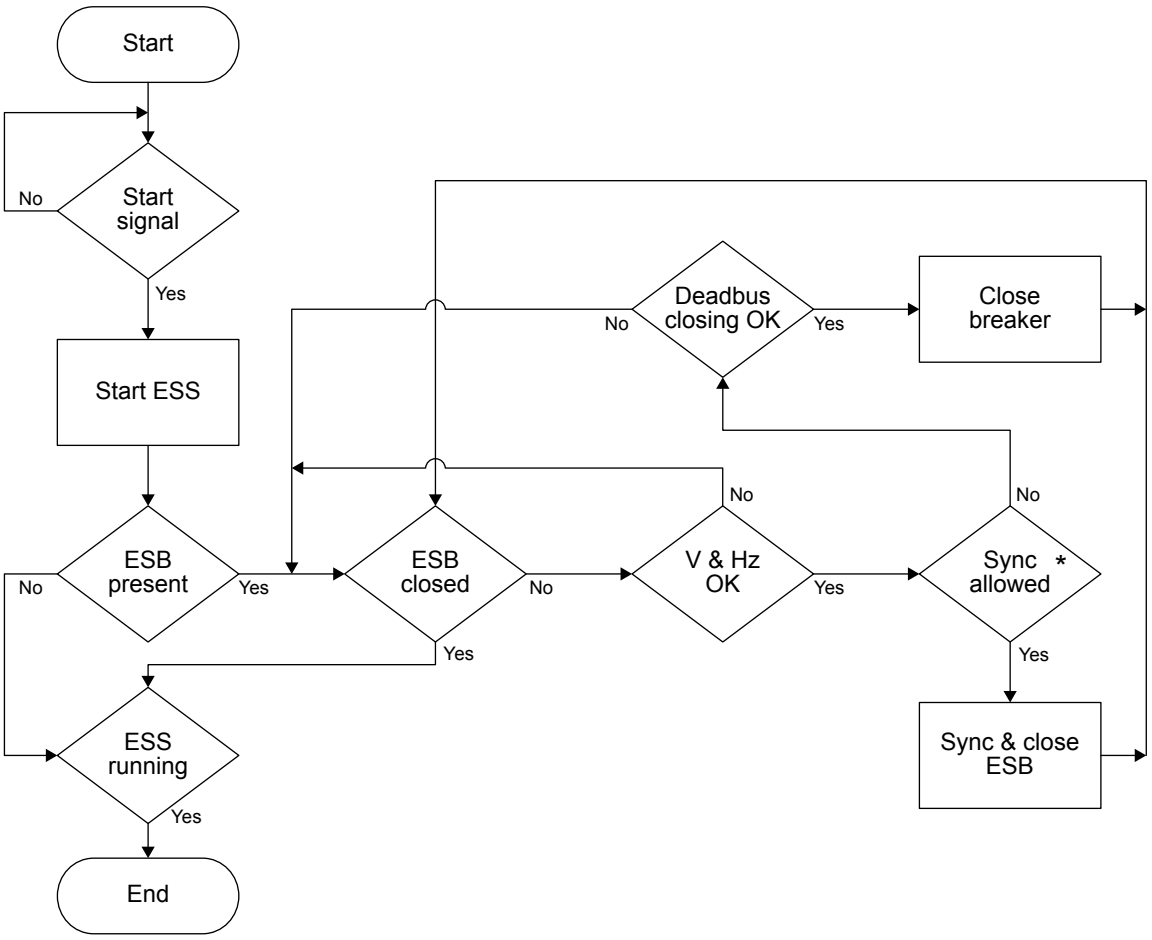
The following flowcharts show the most important function principles. The functions included are:

- Start sequence
- Stop sequence

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

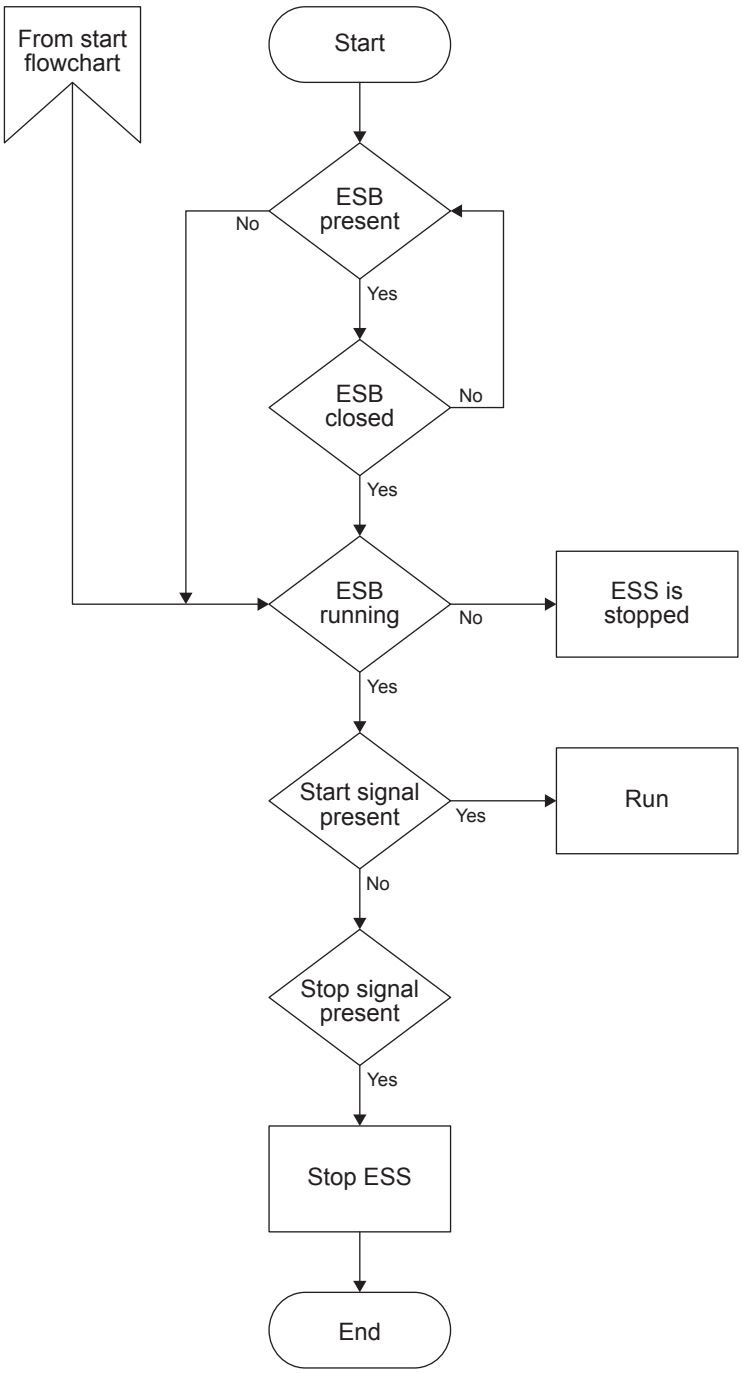
NOTE These simplified flowcharts are only for guidance.

6.6.2 Start sequence



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

6.6.3 Stop sequence



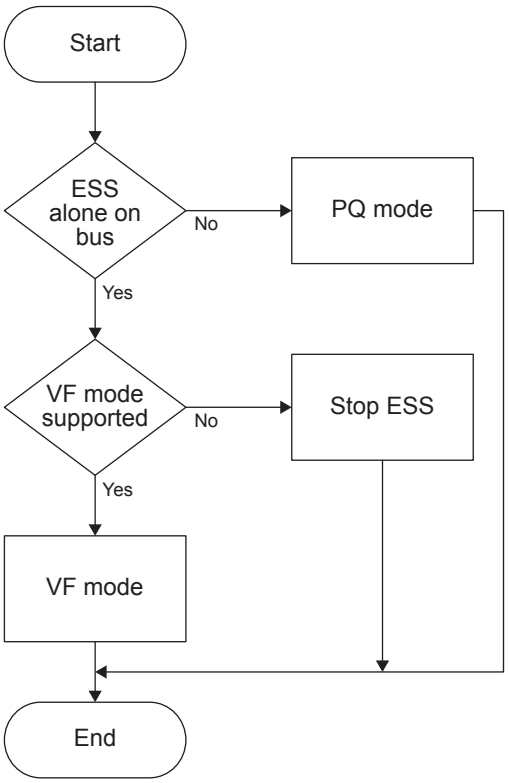
6.7 Modes of operation

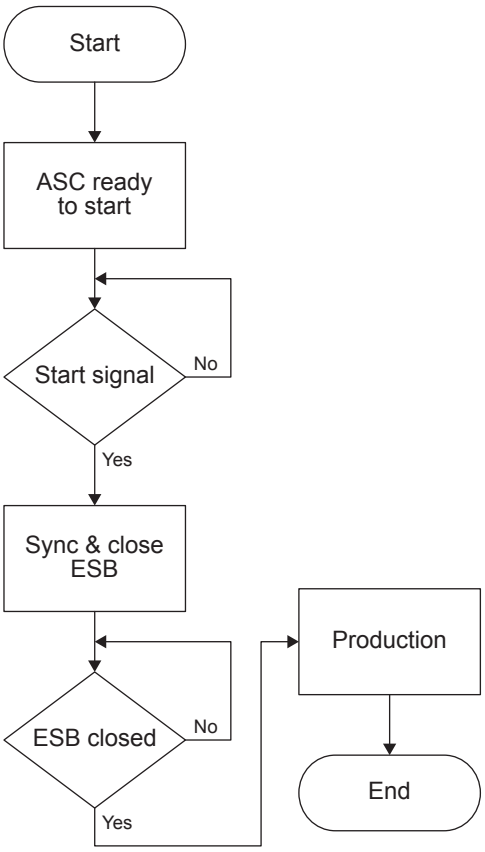
6.7.1 Automatic or semi-automatic mode

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

Rules for ESS operation:

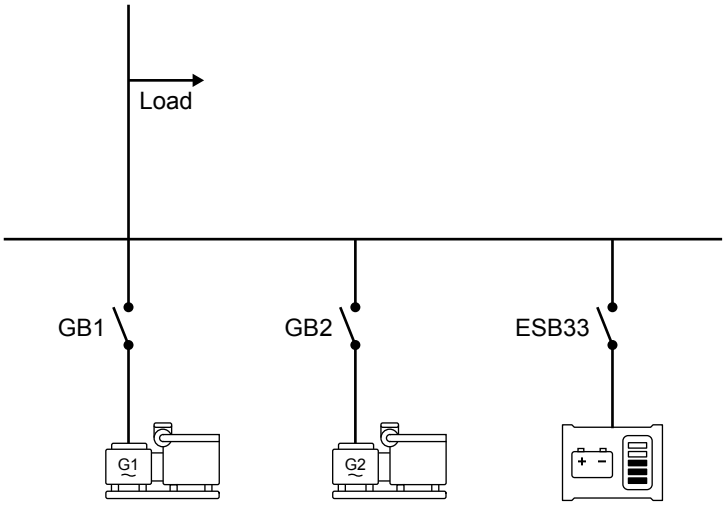
- The ESS can only be alone on the busbar if VF mode (voltage and frequency mode) is supported by the PCS.
- The ESB can only be closed if the busbar voltage and frequency are inside the defined window.
- If the ESB is open, the ESS is stopped.





6.7.2 Island start

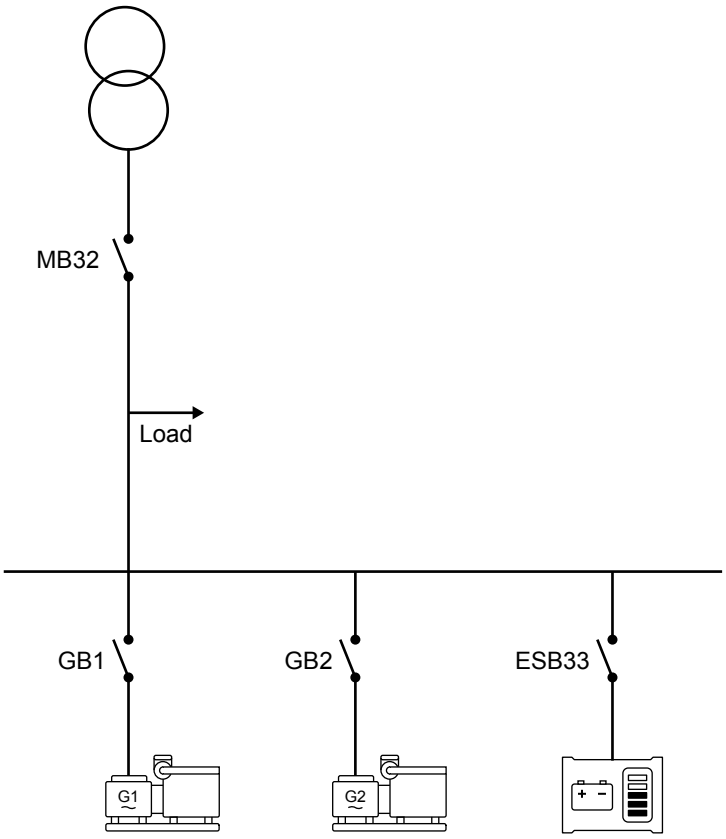
This is how the plant starts in island mode (with the controllers in AUTO and power management on).



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

6.7.3 Parallel mains start

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



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

6.8 Fail class

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

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

6.8.1 Energy storage system running

Fail class/action	Alarm horn relay	Alarm display	Trip ES breaker	Stop energy storage system
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 ES breaker immediately.
- The ASC stops the energy storage system immediately.
- The energy storage system cannot be started from the ASC (see next table).

6.8.2 Energy storage system stopped

Fail class/action	Alarm horn relay	Alarm display	Block energy storage system start	Block ESB sequence
Warning	•	•		
Shutdown	•	•	•	•

6.9 Alarm inhibit

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

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

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

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

6.10 Miscellaneous battery functions

6.10.1 Start and stop external gensets

You can configure the ASC Battery to activate an output to start or stop external gensets based on the system load and/or ESS SOC. You can use stops based on the system load to ensure that the genset minimum load requirement is met. You can use starts based on SOC to ensure that the ESS gets enough power to charge.

Start-stop output

On the *Inputs/Outputs* page in the USW, choose a relay to use as the output. Select the *Start/Stop Ext. DG* function.

SOC start-stop parameters (for a single controller or a power management system)

Parameter	Name	Range	Default	Description
7151	SOC DG start limit	0 to 100 %	30 %	When the SOC goes below the start limit (and the timer has run out), the ASC activates the output.

Parameter	Name	Range	Default	Description
		0 to 3200 s	10 s	
7153	SOC DG stop limit	0 to 100 % 5 to 3200 s	50 % 15 s	When the SOC goes above the stop limit (and the timer has run out), the ASC deactivates the output. If the SOC DG stop limit is higher than SOC threshold 2, the controller shows the warning *SOC STOP LIM > THR 2*. If the genset has been started by the SOC start limit, then the SOC DG stop limit overrules SOC threshold 2.
7155	SOC DG control	Enabled Not enabled	Not enabled	Select *Enable* to activate the SOC DG start function.

System power parameters (only for a single controller)

Parameter	Name	Range	Default	Description
7161	Sys P DG start limit	0 to 20000 % 0 to 3200 s	200 kW 10 s	When the system load* is above the start limit (and the timer has run out), the ASC activates the output.
7163	Sys P DG stop limit	0 to 20000 % 5 to 3200 s	50 kW 15 s	When the system load* is below the stop limit (and the timer has run out), the ASC deactivates the output.
7165	Sys P DG control	Enabled Not enabled	Not enabled	Select *Enable* to activate the Sys P DG start function.

NOTE * The system load is total load of the system, excluding the power used to charge the ESS.

External genset start/stop alarm

Parameter	Name	Range	Default	Description
7170	Ext. DG start error	1 to 1000 s	30 s	The alarm is activated if a genset start request is active, but the ASC has not received feedback from a genset. The alarm timer also starts running if the only genset connected to the busbar is disconnected.

Alternative setup using M-Logic

You can also activate the start and stop outputs by using M-Logic, for more flexibility. For example, the request to start the genset can be used in combination with the command timers. This enables scheduling of the genset start and stop. The request to stop the gensets from M-Logic overrules any start request from the SOC, system load, and M-Logic.

You can find the M-Logic functions under *Output, Command*:

- Request ext. DG to start
- Request ext. DG to stop

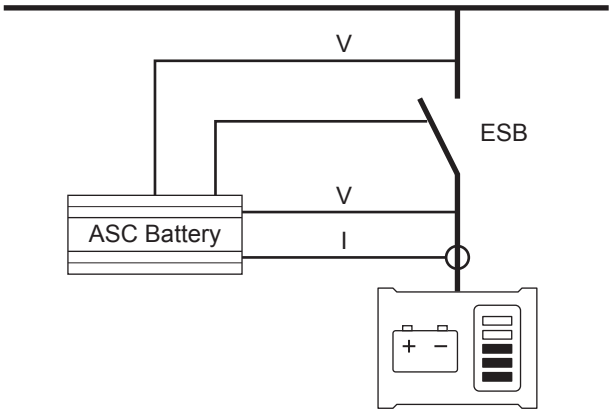
6.10.2 Busbar voltage and frequency reference

Parameter	Name	Range	Default	Description
2661	U ref. origin	Nominal value Busbar measurement	Nominal value	By default, the ASC uses the nominal voltage as the regulation voltage reference. To improve regulation and avoid high Q when closing the ESB, you can configure the ASC to use the busbar voltage measurement when the mains is connected.
2662	f ref. origin	Nominal value Busbar measurement	Nominal value	By default, the ASC uses the nominal frequency as the regulation frequency reference. To improve regulation and avoid high frequency when closing the ESB, you can configure the ASC to use the busbar frequency measurement when the mains is connected.

6.10.3 AC measurements

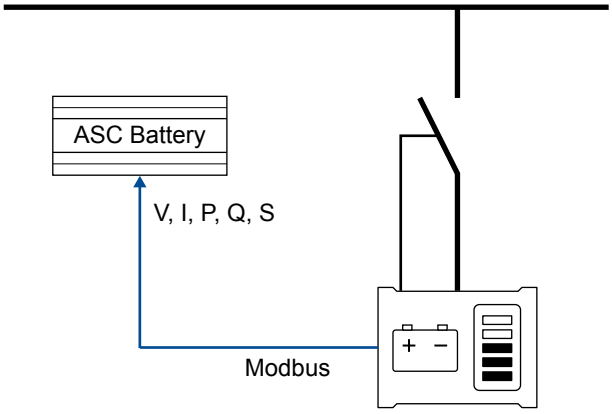
The ASC Battery terminals can be connected to measure the AC power from the ESS. This is the default configuration.

ASC Battery does the AC measurements



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

ASC Battery gets the AC measurements from the ESS



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

6.10.4 State of health

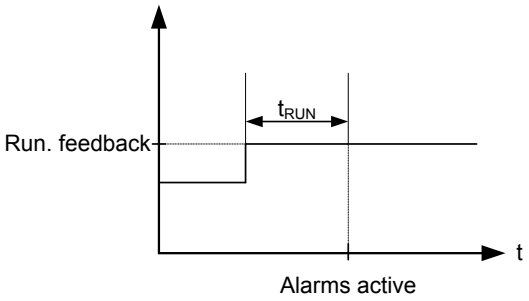
The ASC reads the state of health (SOH) from the ESS. The ASC activates an alarm if the SOH goes below the configured value.

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

6.10.5 Run status (6160)

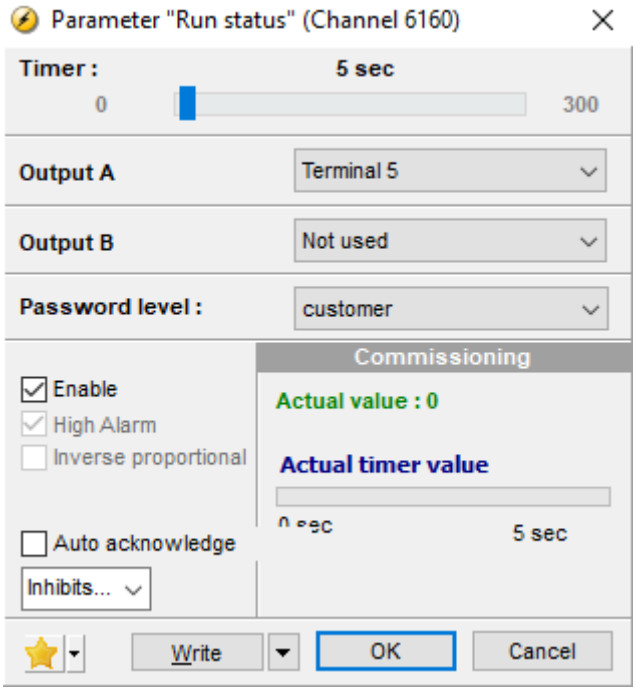
Alarms can be configured to activate when the running feedback is active and a time delay has expired.

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

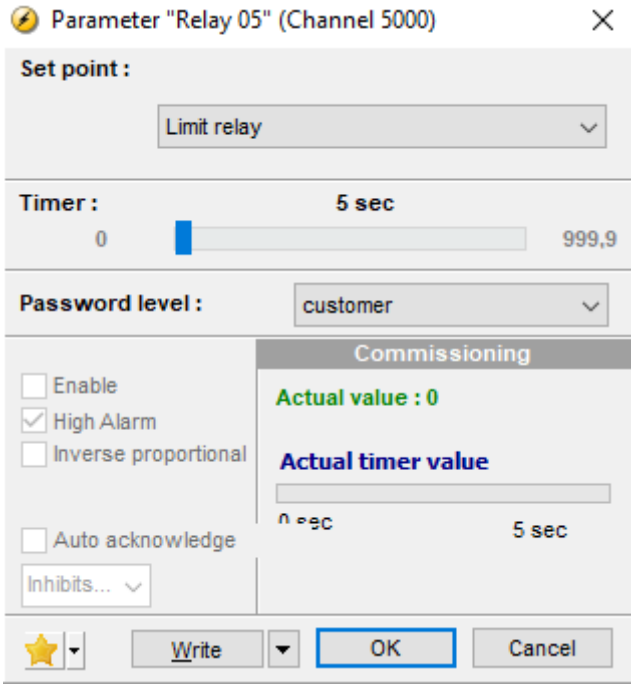


NOTE The timer is ignored if digital running feedback is used.

6.10.6 Running output



You can configure **6160 Run status** to activate a digital output when the ESS is running. Select the relay in *Output A*, and select *Enable*.



In the relay menu, change the relay set point to *Limit relay*. If the ESS is running, the relay activates, but an alarm is not activated.

If the relay function is not *Limit relay*, an alarm is activated whenever there is running feedback from the ESS.

6.10.7 Energy storage breaker control

Parameter	Name	Range	Default	Description
2360	Auto close cond	Default Auto start and running	Default	**Default**: The ESB can close when any of these conditions are met: • The BESS is running and an auto start signal is activated. • A mains is connected. • A genset in auto mode is connected. **Auto start and running**: The ESB can only close when the BESS is running and an auto start signal is activated.

6.10.8 Remote or local stop and start

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

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
- Push-buttons for start and stop
- Push-buttons for breaker operations
- Status texts

M-Logic

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

Miscellaneous

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

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. Press the JUMP push-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	ES 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. See "Switch between the nominal settings" for more information.

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

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

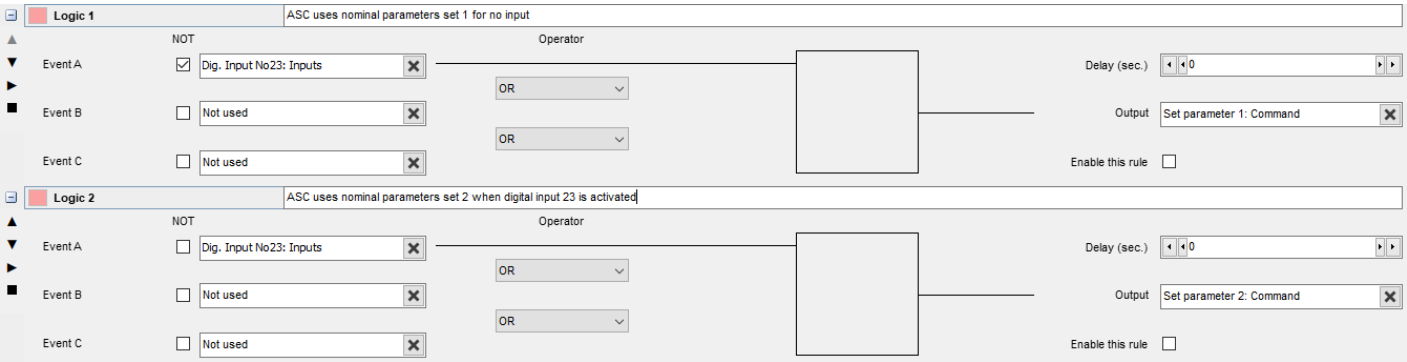
Switching between the nominal set points can be done in the following ways:

- 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 the push-button as the input event. Select the nominal settings in the outputs.

AOP Example

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

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

Parameter setting

Use parameter 6045 to select the nominal settings.

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

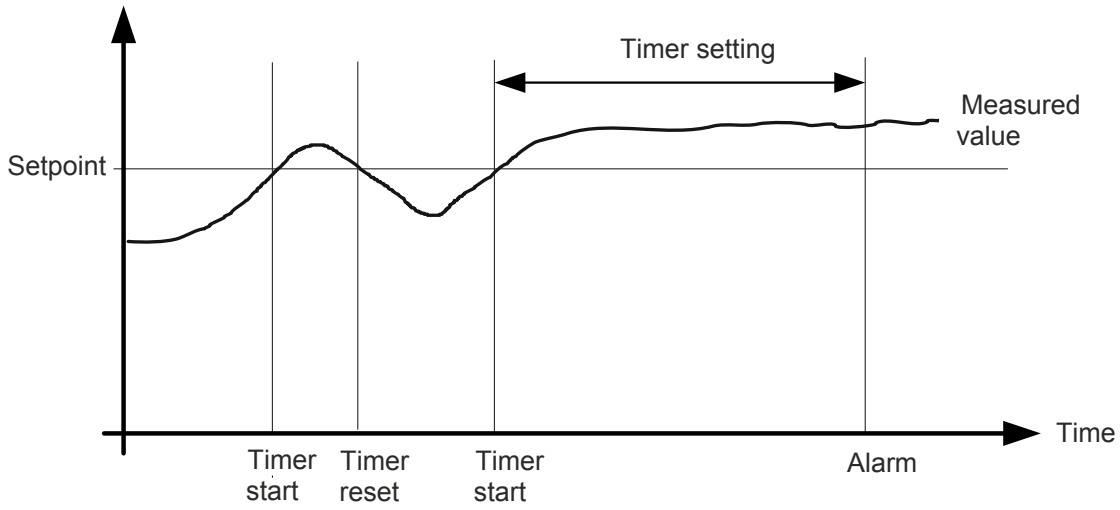
All nominal settings and the primary VT settings must be corrected after the scaling has been changed in parameter 9030.

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.

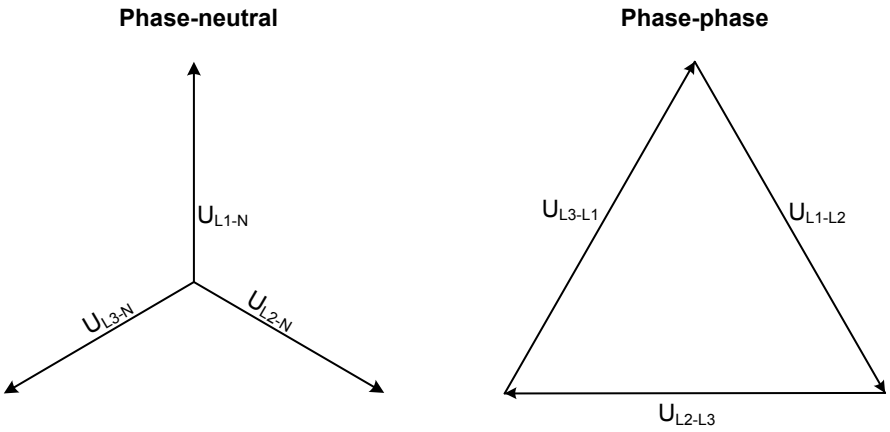


When the timer runs out, the output is activated. The total delay will be the delay setting + the reaction time.

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

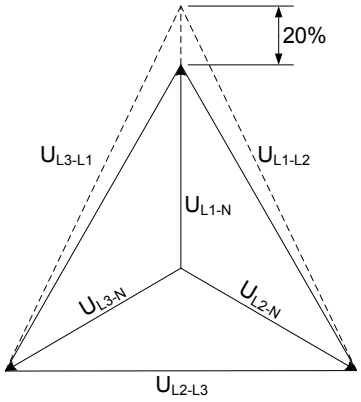
The below 400 V AC system shows that the phase-neutral voltage must change 20 %, when the phase-phase voltage changes 40 volts (10 %).

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 USW.

Event group	Description
Alarms	All ASC alarms and inputs are available as events.
Limits	These M-Logic events are activated when certain limits are reached. Limits can be used in alarm configurations to stop the alarm announcements in the display.
Events	The states in the ASC are available as events (for example, breaker open/close, the mode, the parameter selection).
Cmd Timers	Command timers. Use parameters to define the start and stop. These functions can then be used to activate commands.
CAN Input	16 CAN input active are available as events.
DG power meter inputs	16 power meters with 4 inputs each.
Mains power meter inputs	1 power meter with 4 inputs.
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 flip flop outputs. The event is active when the flip flop is set or toggled.

7.5.2 M-Logic outputs

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

Output group	Description
Redundancy	See Option T1.
Command	A variety of functions, including changing mode, breaker open and close, start, stop, and change parameters.
Virtual events	Activate up to 32 virtual events.
Relays	Activate the controller relays.
DG Ena/Dis	Enable and disable gensets.
Inhibits	Activate inhibits.
CAN Cmd	Activate CAN commands.
Display	Set primary display, and activate display views.
GB feedbacks	Activate GB feedbacks for the 16 gensets.
MB feedbacks	Activate MB feedback.
Battery	• Set and reset power and energy functions

Output group	Description
	• Set AC- or DC-coupling • Select state of charge settings • Set mode (power/energy source) • Request ESS to sync or open MB • Enable/Disable spinning reserve
Flip flops	16 outputs to set, reset, and toggle the flip flop state.

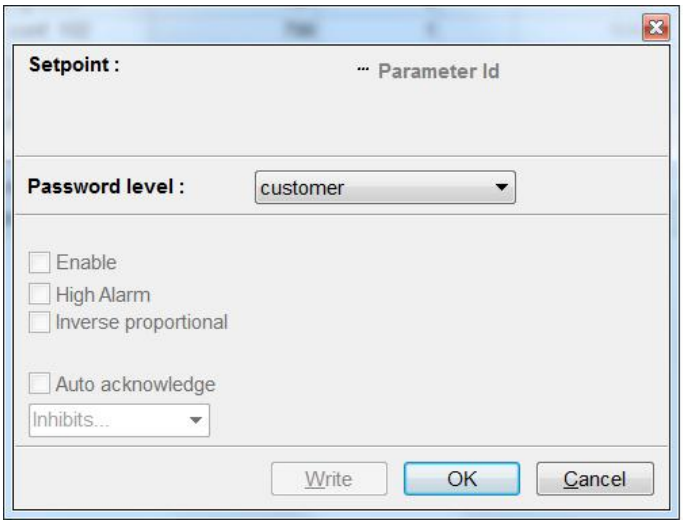
7.6 Language selection

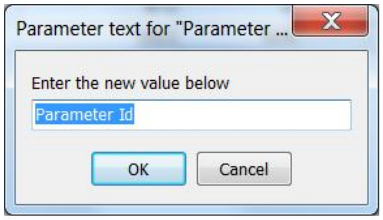
The unit has the possibility to display different languages. It is delivered with one master language which is English. This is the default language, and it cannot be changed. In addition to the master language, 4 different languages can be configured. This is done via the PC utility software. Four languages 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 an ESS breaker. Select the breaker type in the application configuration. The breaker (if present) can be configured to be one of three types:

Continuous NE

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

Pulse

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

Ext/ATS no control

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

7.9 Not in auto

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

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 push 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 takeover, mains power export and fixed power operation. Up to four command timers can be used for start and stop for instance. The command timers are available in M-Logic and can be used for other purposes than starting and stopping the genset automatically. Each command timer can be set for the following time periods:

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

NOTE To start in AUTO mode, the *Auto start/stop* command can be programmed in M-Logic or in the input settings.
NOTE The time-dependent commands are flags that are raised when the command timer is in the active period.

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	●

Type	Stored
Views configuration	●
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.

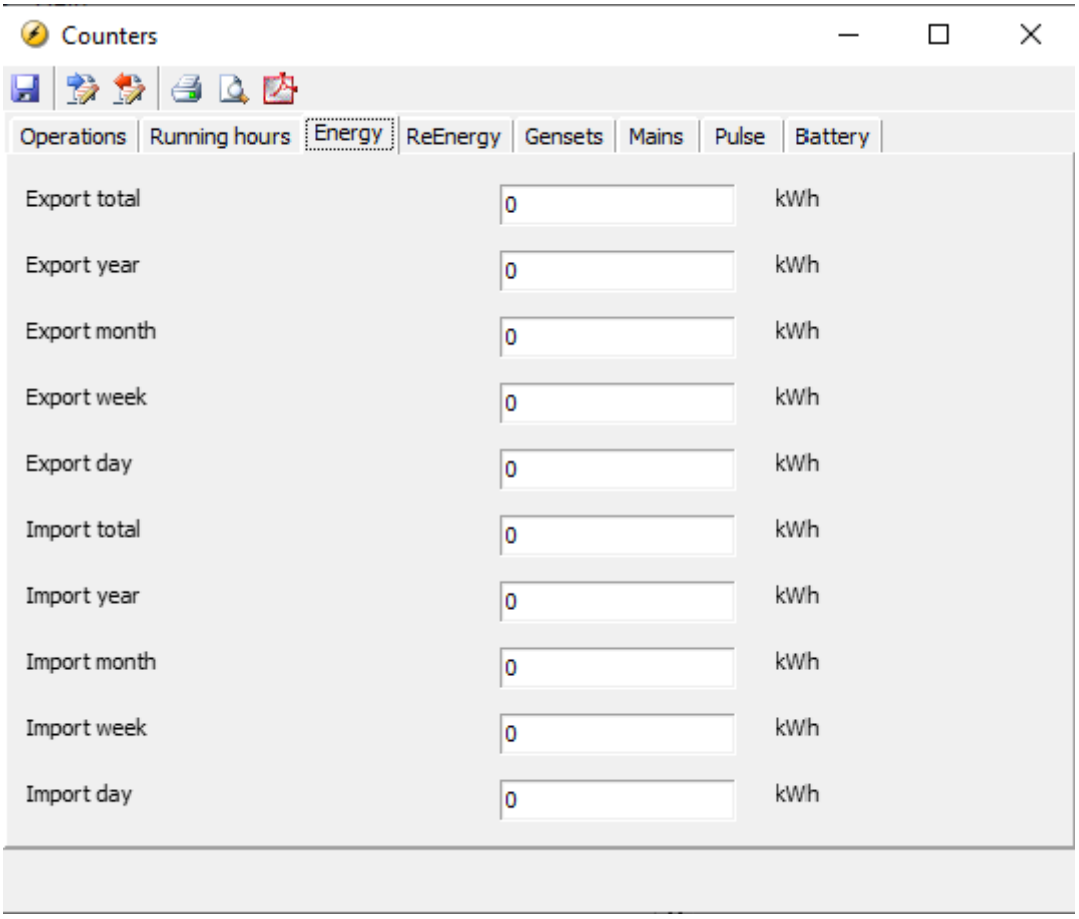
7.13 Counters

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 USW counters

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

ASC Battery counters example



The **Import** counters show the ESS charged energy, while the **Export** counters show the ESS discharged energy.

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.

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	2 not configurable if an ESB is present
Option M4	7	1 not configurable
Option M12 I/O extension	13	

Not configurable digital input functions

Function	Mode	Terminal	Input type	Details
MB pos. feedb. OFF*	Auto, Semi	24	Constant	The MSB is open. The ASC uses this feedback to confirm that the breaker is open.
MB pos. feedb. ON*	Auto, Semi	25	Constant	The MSB is closed. The ASC uses this feedback to confirm that the breaker is closed.
ESB pos. feedb. OFF	Auto, Semi	26	Constant	The ESB is open. The ASC uses this feedback to confirm that the breaker is open. The feedback is also used to detect a position failure (and activate an alarm).
ESB pos. feedb. ON	Auto, Semi	27	Constant	The ESB is closed. The ASC uses this feedback to confirm that the breaker is closed. The feedback is also used to detect a position failure (and activate an alarm).
Emergency stop	Auto, Semi	118	Constant	The ASC immediately opens the ESB and stops the ESS. 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 push-buttons. You can view measurements, alarms and the log.
Remote start	Semi	Pulse	Initiates the start sequence of the ESS when semi or manual mode is selected.
Remote stop	Semi	Pulse	Initiates the stop sequence of the ESS when semi or manual mode is selected.
Semi auto mode	Auto	Pulse	Changes the mode to semi-auto.
Auto mode	Semi	Pulse	Changes the mode to auto.
Remote ESB On	Semi	Pulse	Initiates the ESB ON sequence (to close the breaker).
Remote ESB Off	Semi	Pulse	Initiates the PSV/ESB OFF sequence (to open the breaker).

Function	Mode	Input type	Details
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 ESS when this input is activated. The ASC stops the ESS if the input is deactivated. The input can be used when the ASC is in island operation, fixed power, load takeover or mains power export, and the AUTO running mode is selected.
GB [1 to 16] on busbar	Auto, Semi	Constant	These inputs are activated when the generator breaker closes and the genset is connected to the busbar. The ASC needs this information for a 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 USW to configure how the set points correspond to the RRCR input patterns.

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

8.1.2 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.

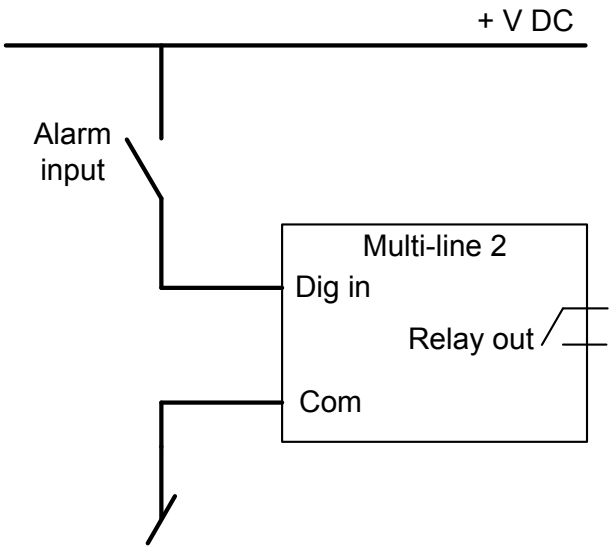
- **Normally closed (NC) alarm**

  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**.

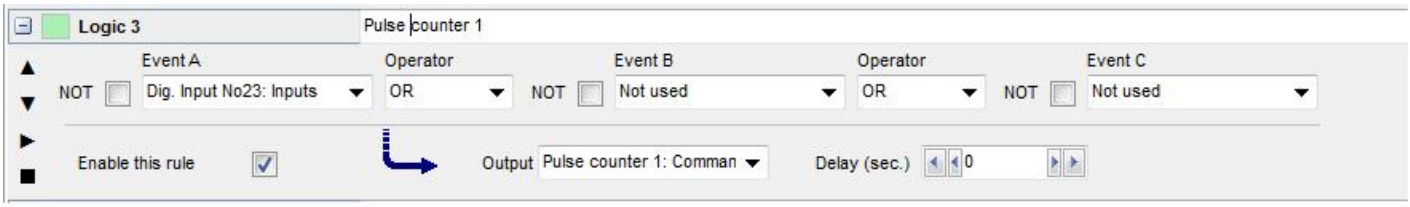
  The controller activates an alarm when the digital input is activated.



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

8.1.3 Pulse input counters

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



Pulse input counter parameters

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

Parameter	Name	Range	Default	Details
				If 6862 is set to *Pulse/unit*, then this parameter checks the amount of pulses in one unit.
6862	Pulse counter 2	Unit/pulse Pulse/unit	Unit/pulse	Sets the type of scaling performed for *Pulse counter 2*.
6863	Pulse counter 2	No decimals One decimal Two decimals Three decimal	No decimals	Adjusts the number of decimals seen in the display unit.

8.2 Digital outputs

8.2.1 DC 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	ESB OFF relay
Relay 17	5040	ESB 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 USW, 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.
Start/Stop Ext. DG	The ASC uses this relay to start or stop an external genset.

8.3 Analogue inputs

8.3.1 Multi-inputs

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

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

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

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

Input type	Multi-input 102	Multi-input 105	Multi-input 108
4 to 20 mA	4120/4130	4250/4260	4380/4390
0 to 40 V DC	4140/4150	4270/4280	4400/4410
Pt100/Pt1000	4160/4170	4290/4300	4420/4430
Digital*	3400	3410	3420

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

8.3.2 4 to 20 mA

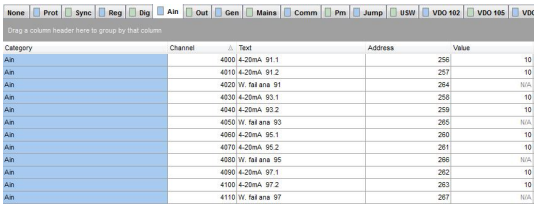
If one of the multi-inputs has been configured as 4 to 20 mA, the unit and range of the measured value corresponding to 4 to 20 mA can be changed in the PC utility software in order to get the correct reading in the display.

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.

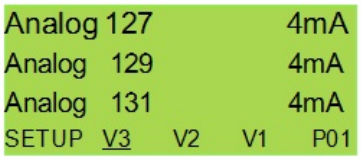


Setup with no decimals

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.



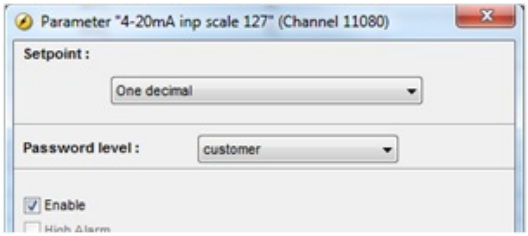
The display will show 0 to 5 [units] in the measuring range 4 to 20 mA.

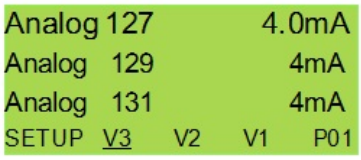
Setup with one decimal

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

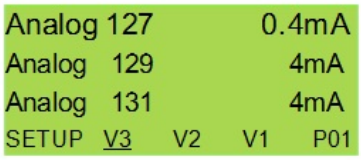
Decimals = 1

Auto scale = enable





Decimals = 1, AUTO SCALE = enabled



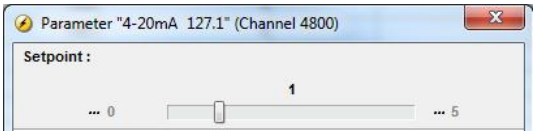
Decimals = 1, AUTO SCALE = disabled

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

Setting up the measuring range of the sensor

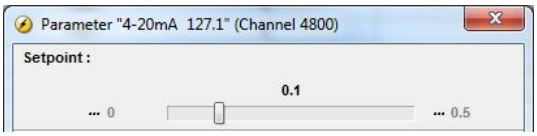
The measuring range of the multi-input is set up inside the actual alarm:

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

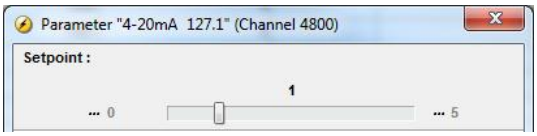


The display will then show 0 at 4 mA.

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



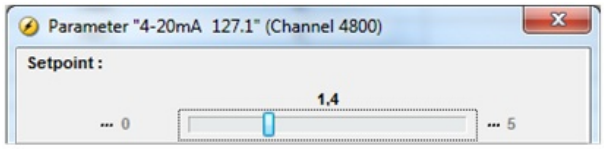
Change it to match the new selection of decimals.



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

Reload parameters

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



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

Save the parameter file

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

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

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

8.3.4 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.

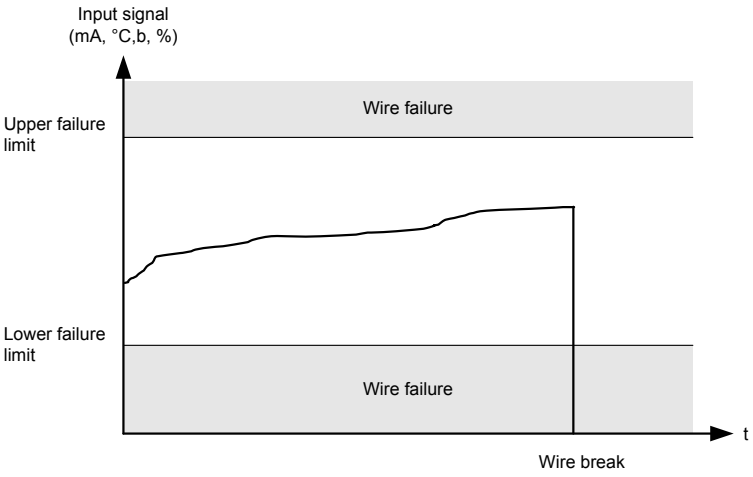
8.3.7 Wire fail detection

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

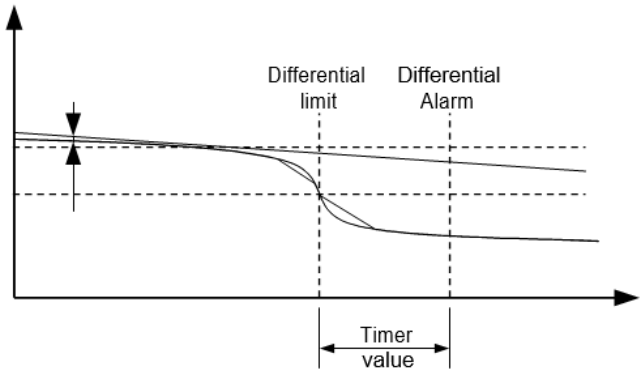
The illustration below shows that when the wire of the input breaks, the measured value will drop to zero. Then the alarm will occur.



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.



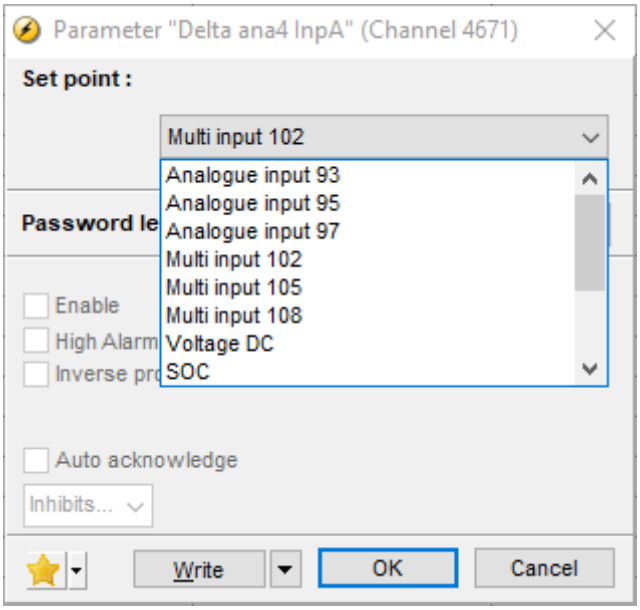
Six different differential measurements between two analogue input values can be configured.

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

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

Inputs are selected from the input list as shown below. The inputs include:

- Analogue inputs
- Multi-inputs
- Various ESS measurements



The alarm is configured using parameters 4610-4660 and 4680-4730. 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.

9. Small rental application (ESS-Genset) 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 Battery controller in a wide variety of applications. To help you to set up a single ASC-4 Battery controller quickly, this chapter here an example of a specific, simple, single controller application.

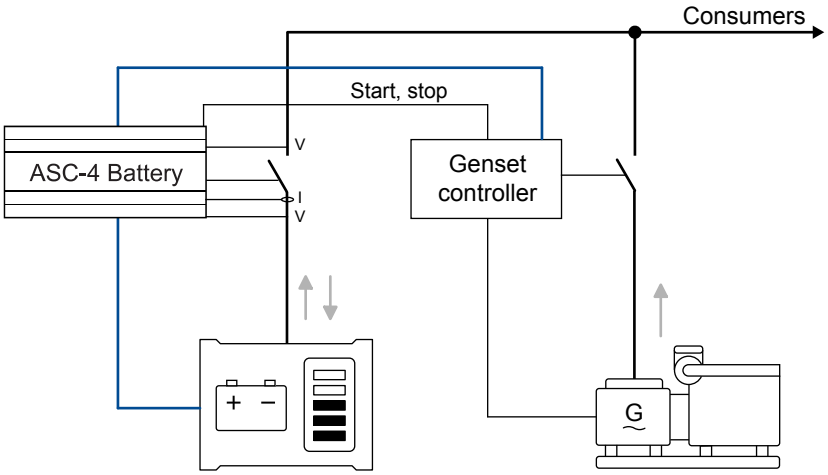
DANGER!

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

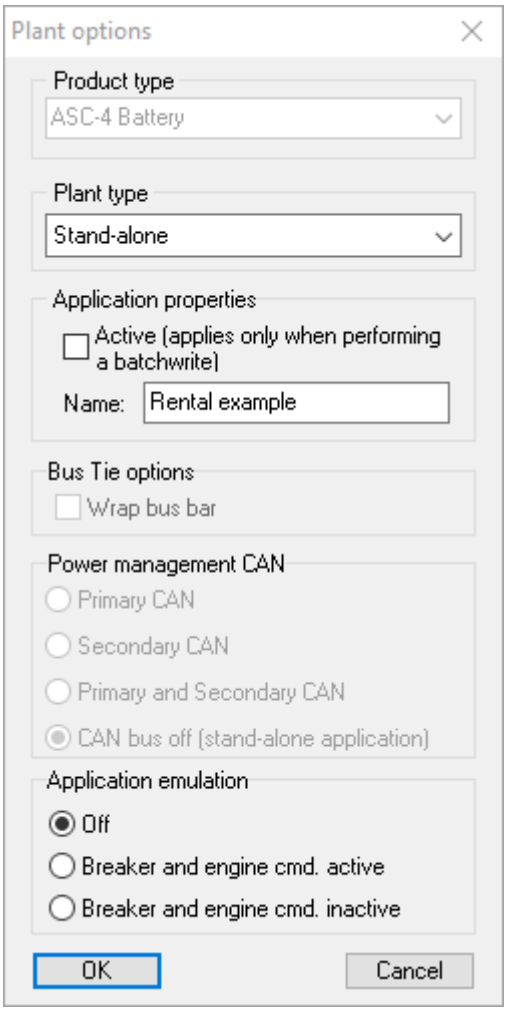


System information

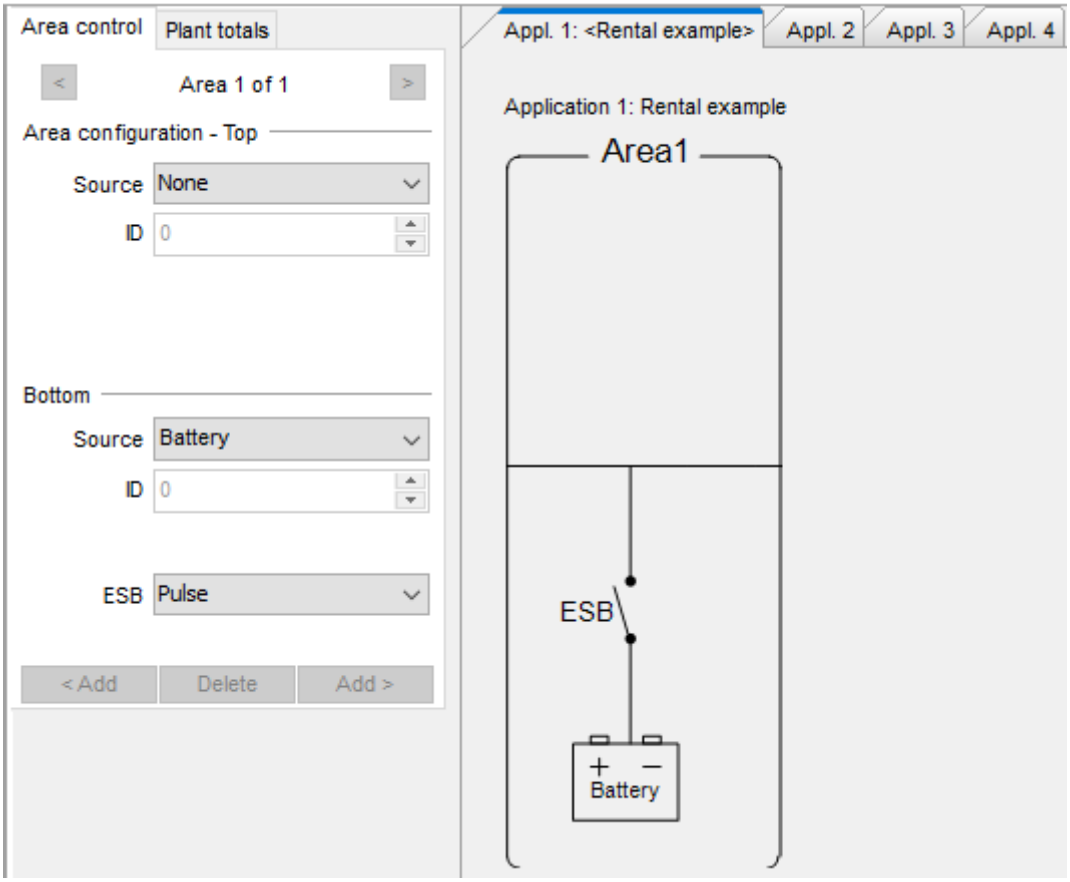
- The ASC-4 Battery must have hardware option H2.8.
- Three-phase system, 50 Hz, 400 V phase-phase
- Storage system: Enerflow, from H2 Inc., with Modbus TCP BCU communication
- Genset: 1500 kW, with a DSE 8xxx controller
- Application: Supply power at a building site on weekdays from 07h00 to 19h00:
  - During the day, the battery supplements the genset, and makes sure that the genset runs optimally.
  - At night, and over weekends, the battery supplies power for lighting and the security system. The genset is off.
- Operation strategy:
  - From 07h00 to 18h00, the state of charge parameters (set 1) ensure optimum genset operation.
  - From 18h00 to 19h00, the state of charge parameters (set 2) ensure that the battery is charged (to supply power through the night).
  - From 19h00, the state of charge parameters (set 3) allow the battery to run down (so that the genset does not have to start).

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.



2. Under *Area control*, remove Mains from the top area. Since the ASC-4 Battery controls the ESB in this example, add the ESB breaker type in the bottom area.

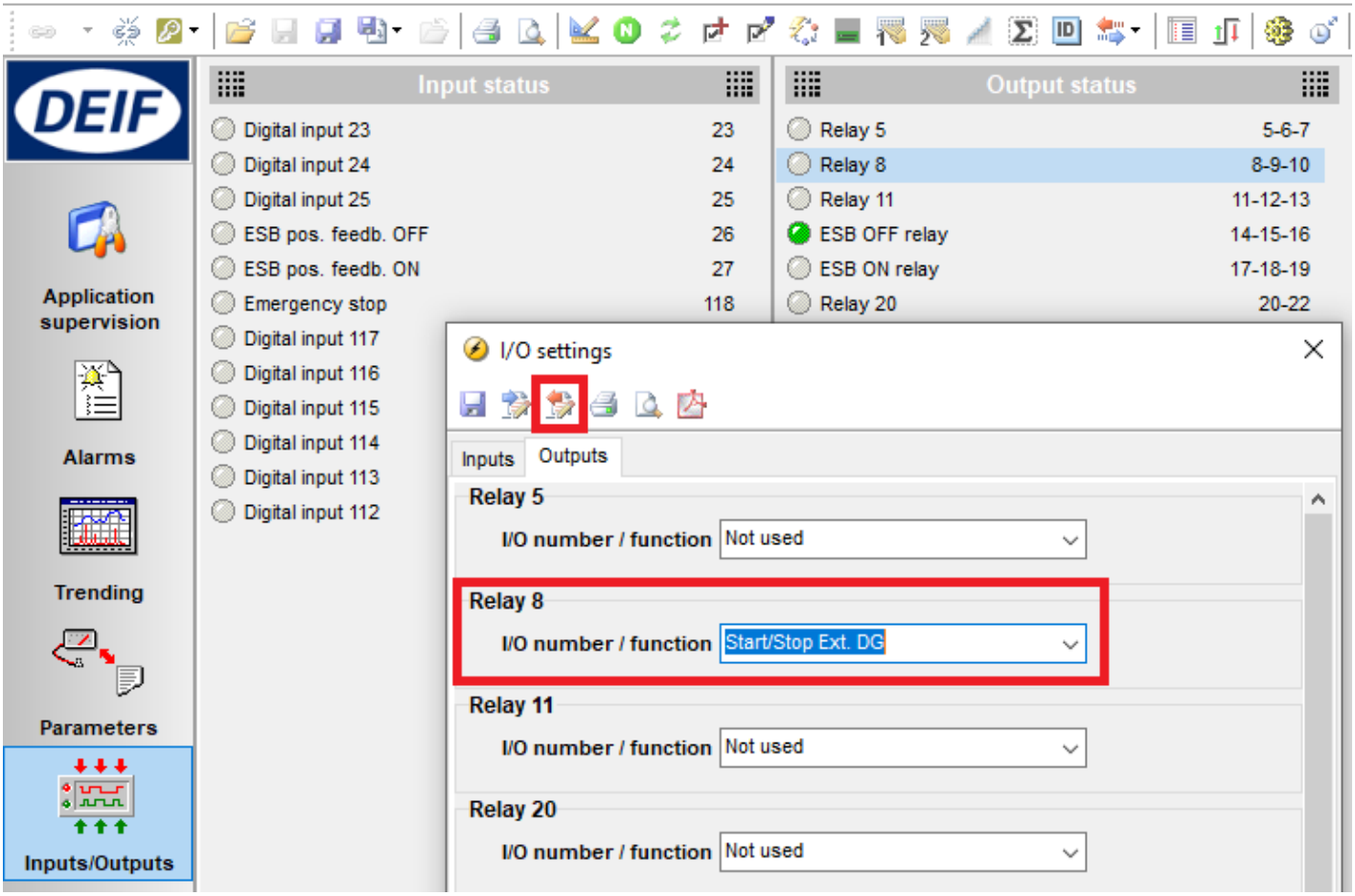


3. Use *Write plant configuration to the device* to write the configuration to the controller.

9.3 Inputs/Outputs

In the utility software, on the *Inputs/Outputs* page, double click any input/output.

In the *I/O settings* box, on the *Outputs* page, for *Relay 8*, select *Start/Stop Ext. DG*, then write to the controller.



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
8-9-10	Start-stop genset	Maximum 250 V AC/8 A relay. Connect these terminals to the genset controller. The genset must start when the relay is activated, and stop when the relay is deactivated.
14-15-16	Open ESS breaker	Maximum 250 V AC/8 A relay
17-18-19	Close ESS breaker	Maximum 250 V AC/8 A relay
26	ESS breaker open	ON: 8 to 36 V DC, OFF: <2 V DC
27	ESS breaker closed	
28	Common for 23-27	
29	Battery comm DATA + (A)	Connect these terminals to the RTU to TCP/IP converter. Connect the TCP/IP converter to the storage system.
31	Battery 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	

Terminal(s)	Function	Details
75	S1 (k) L2 AC current	Use an x/1 A or x/5 A current transformer.
76	S2 (l) L2 AC current	
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 ESS voltage	Maximum 690 V AC phase-phase
81	L2 ESS voltage	Maximum 690 V AC phase-phase
83	L3 ESS 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 comm DATA - (B)	Connect these terminals to the genset controller Modbus RTU terminals.
133	Genset 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. Irrelevant parameters are not included either.

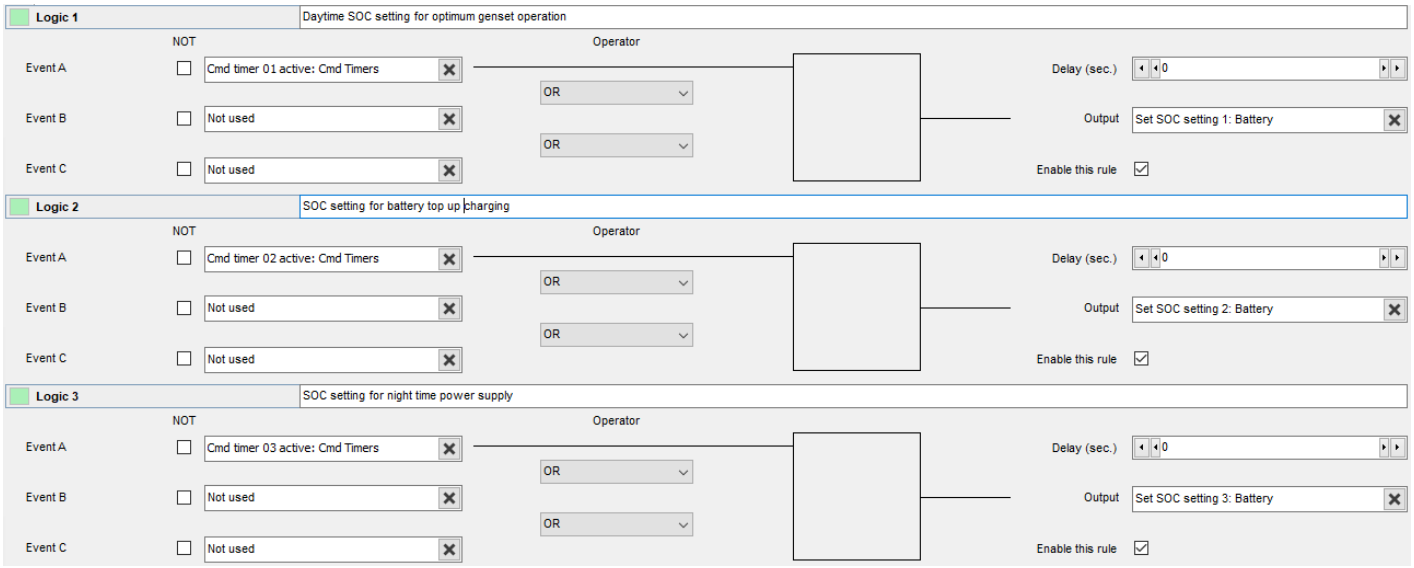
Parameter	Name	Description
5010	Relay 08	Select *Limit relay*
6001	Nom. f 1	Select *50 Hz*.
6002	Nom. P 1	Use the ESS information to configure the nominal power set point.
6003	Nom. I 1	Use the ESS information to configure the nominal current set point.
6004	Nom. U 1	Use the ESS information to configure the nominal voltage set point.
6005	Nom. Q 1	Use the ESS information to configure the nominal reactive power set point.
6006	Nom. S 1	Use the ESS information to configure the nominal apparent power set point.
6041	BA primary U	The ESS primary voltage. If necessary, adjust this set point.
6042	BA secondary U	The ESS secondary voltage. If necessary, adjust this set point.
6043	BA Primary I	The ESS primary current. If necessary, adjust this set point.
6044	BA Secondary I	The ESS secondary current. If necessary, adjust this set point.
6051	BB Primary U 1	The busbar primary voltage. If necessary, adjust this set point.
6052	BB second. U 1	The busbar secondary voltage. If necessary, adjust this set point.
6053	BB Nominal U 1	The busbar nominal voltage. If necessary, adjust this set point.
6071	Operation mode	Select *Island operation*
6961	Start timer 1	Select *MO-TU-WE-TH-FR*
6962	Start timer 1	Select *7 Hours*

Parameter	Name	Description
6964	Stop timer 1	Select *MO-TU-WE-TH-FR*
6965	Stop timer 1	Select *18 HOURS*
6971	Start timer 2	Select *MO-TU-WE-TH-FR*
6972	Start timer 2	Select *18 Hours*
6974	Stop timer 2	Select *MO-TU-WE-TH-FR*
6975	Stop timer 2	Select *19 HOURS*
6981	Start timer 3	Select *MO-TU-WE-TH-FR*
6982	Start timer 3	Select *19 Hours*
6984	Stop timer 3	Select *MO-TU-WE-TH-FR*
6985	Stop timer 3	Select *7 HOURS*
7110	SOC Low	If necessary, adjust this set point.
7120	SOC High	If necessary, adjust this set point.
7151	SOC DG start limit	If necessary, adjust this set point.
7153	SOC DG stop limit	If necessary, adjust this set point.
7155	SOC DG control	Select *Enable*.
7161	Sys P DG start limit	If necessary, adjust this set point.
7163	Sys P DG stop limit	If necessary, adjust this set point.
7165	Sys P DG control	Select *Enable*.
7331	DG1 nom. power	Select the genset nominal power.
7333	DG1 P input	Select *Power meter comm. 01*.
7335	DG1 Q input	Select *Power meter comm. 01*.
7561	ESS protocol	Select *Enerflow*.
7680	BMS comm. ID	If necessary, adjust this set point.
7701	DG meter ID	If necessary, adjust this set point.
7721	DG meter prot.	Select *DSE 8xxx, 7xxx, 6xxx and 4xxx*
8011	Min DG load 01	If necessary, adjust this set point.
8014	Opt. DG load pct 01	If necessary, adjust this set point.
8031	DG Charge pct	If necessary, adjust this set point.
8032	DG Charge P	If necessary, adjust this set point.
8033	DG Charge Mode	As relevant, select percent or power.
8051	SOC. Minimum 1	If necessary, adjust this set point.
8052	SOC. Maximum 1	If necessary, adjust this set point.
8053	SOC. Thr. 1.1	If necessary, adjust this set point.
8054	SOC. Thr. 2.1	If necessary, adjust this set point.
8061	SOC. Minimum 2	Adjust this set point to make sure that the battery is charged up.
8062	SOC. Maximum 2	Adjust this set point to make sure that the battery is charged up.
8063	SOC. Thr. 1.2	Adjust this set point to make sure that the battery is charged up.
8064	SOC. Thr. 2.2	Adjust this set point to make sure that the battery is charged up.
8071	SOC. Minimum 3	Adjust this set point to allow the battery to discharge as it supplies power through the night.

Parameter	Name	Description
8072	SOC. Maximum 3	Adjust this set point to allow the battery to discharge as it supplies power through the night.
8073	SOC. Thr. 1.3	Adjust this set point to allow the battery to discharge as it supplies power through the night.
8074	SOC. Thr. 2.3	Adjust this set point to allow the battery to discharge as it supplies power through the night.
8081	Operation mode	Select *Battery Energy Source*, so that the ESS can supply energy when the genset is not running.
8091	Start/stop	Select *Local*, so that the operator can start the ESS from the ASC-4 display.

9.6 Timer logic

The utility software screenshot below shows simple logic to change the state of charge parameter set based on the command timers.



You can also create more complex logic. For example, you can configure a switch to override the timers.

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 ESS and the genset controller.

9.8 Operation

Press MODE on the display unit, then select AUTO.

The controller automatically ensures that the ESS runs according to its charge scheme, and supplies the required power.

At 07h00, the controller changes to state of charge parameter set 1. If necessary, the controller automatically starts the genset. The controller changes the ESS set point to ensure that the genset never runs below its minimum load. As far as possible, the controller ensures that the genset runs at its optimum load.

At 18h00, the controller changes to state of charge parameter set 2. If necessary, the controller automatically starts the genset to top up the battery charge for the night.

At 19h00, the controller changes to state of charge parameter set 3. The battery is allowed to run down as it supplies a small amount of power for security and lighting.