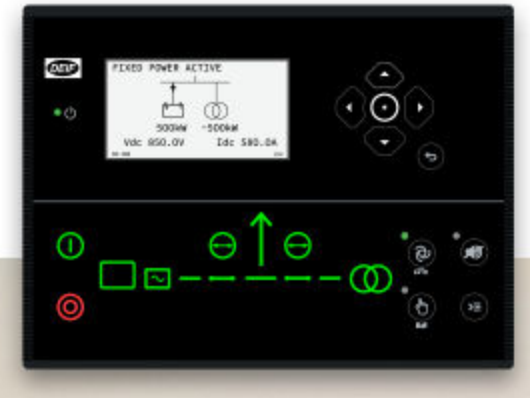
iE 150 Battery

4921240693-D

Data sheet

Improve Tomorrow





1. iE 150 Battery

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1. iE 150 Battery

1.1 About the controller

The iE 150 Battery controller is a fully flexible controller to control and protect an energy storage system (ESS) with communication to a BMS, BCU, and/or a PCS. Use the battery controller to add storage to an existing or new site. You can have up to 16 battery controllers working together.

Use the battery controller as a single controller to add storage and a mains connection (optional) to an existing site.

In an energy management system, use the battery controller for seamless integration of electrical storage with other power sources (including PV, gensets and/or mains). You can prioritise the energy sources for supplying the load, and recharging the battery. The battery controller includes a configurable charge scheme (charge/discharge levels).

For sites with genset controllers and/or mains controllers from other suppliers, use the battery controller with open PMS to add solar, battery and/or mains controllers.

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). There is also a 4th current measurement that can be used to measure mains power. The controller can receive power measurements from power meters, genset communication, and/or transducers.

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

Grid-forming or grid-following

These modes are controlled by the battery controller using the PCS and BCU.

- **Grid-forming**
  Grid-forming is also called island, or V/f mode. For grid-forming (V/f mode) the battery 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 (P/Q mode), the battery 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.
- **Droop mode**
  If the ESS supports this, the battery controller can run the ESS in droop mode for both Grid-forming and Grid-following. The controller controls the battery charge and discharge using V/f or P/Q set points from the configured droop curve (that is, like a virtual synchronous generator (VSG)).

Energy source or power source

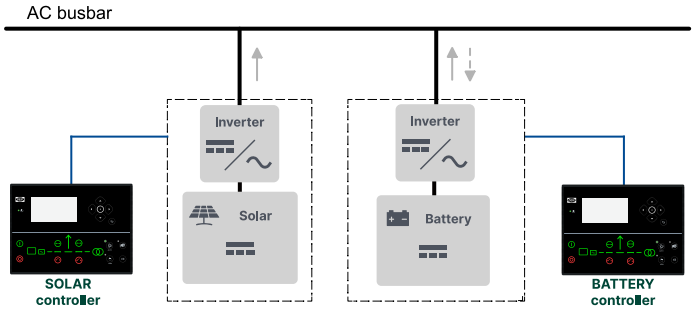
The energy and power source functions determine the source priority. The source functions are not directly related to grid-forming and grid-following.

- **Energy source**
  For the energy source function (plant-leading), the battery controller prioritises battery power over genset power. As a result, the system uses as much battery power as possible before starting any genset.
- **Power source**
  For the power source function (plant assist), the 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.

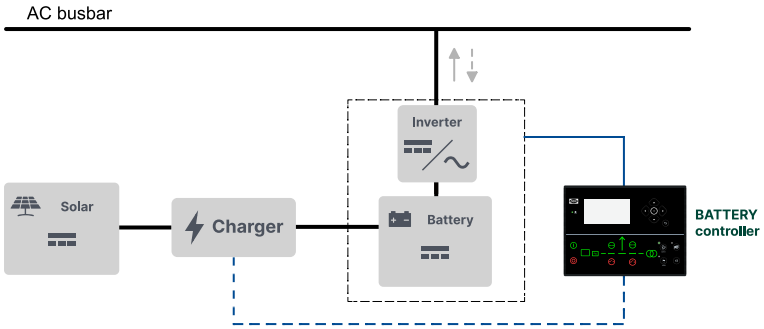
AC- or DC-coupled

The battery controller can be used for both AC- and DC-coupled ESS applications.

For AC-coupled systems, you can define battery charging and discharging scheme. Using the charge scheme, in DEIF power management, you'll also be able to define the energy sources (gensets, PV or mains) that you allow for charging purposes.



For DC-coupled systems, the battery is charged by its own PV bus. Depending on the PV-Battery system and supplier, the battery controller can communicate with the PV inverter, and limit the current from the PV to the battery.



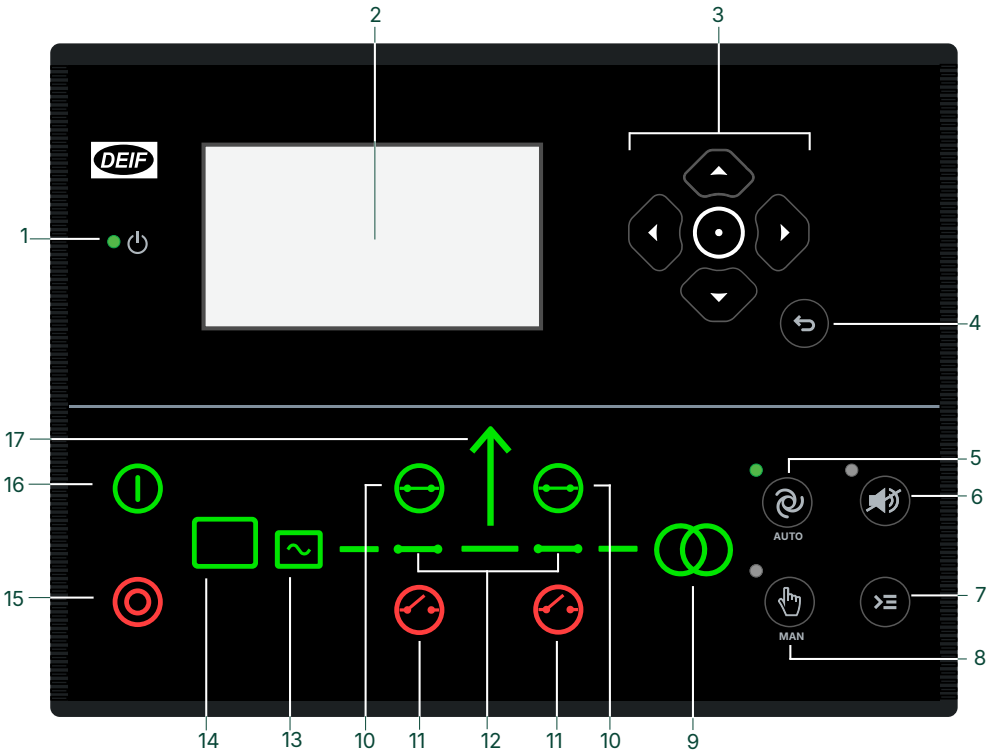
1.1.1 Software versions

The information in this document relates to software version:

Software	Details	Version
iE 150	Controller application	1.38.0

The controller must have the **Premium** software package.

1.1.2 Display layout



No.	Name	Function
1	Power	Green: The controller power is ON. OFF: The controller power is OFF.
2	Display screen*	Resolution: 240 x 128 px. Viewing area: 88.50 x 51.40 mm. Six lines, each with 25 characters.
3	Navigation buttons	Move the selector up, down, left and right on the screen.
	Enter button	Confirms the selection.
4	Back button	Go to the previous page.
5	AUTO mode	The controller automatically starts and stops (and connects and disconnects) the battery system. The controller automatically controls the power to and from the battery system. No operator actions are needed.
6	Silence horn	Stops an alarm horn (if configured) and enters the Alarm menu.
7	Shortcut menu	Access the Jump menu, Mode selection, Test, Lamp test, and Battery.
8	Manual mode	The operator or an external signal can also start or stop, and open and close the battery breaker. Automatic controller actions are not possible. The controller automatically synchronises before closing a breaker, and automatically de-loads before opening a breaker.
9	Mains symbol	Green: Mains/busbar voltage and frequency are OK. The controller can synchronise and close the breaker. Red: Mains/busbar voltage failure.
10	Close breaker	Push to close the breaker.

No.	Name	Function
11	Open breaker	Push to open the breaker.
12	Breaker symbol	Green: Breaker is closed. Green flashing: Synchronising or de-loading. Red: Breaker failure.
13	Power converter	Green: Power converter voltage and frequency are OK. The controller can synchronise and close the breaker. Green flashing: The power converter voltage and frequency are OK, but the V&Hz OK timer is still running. The controller cannot close the breaker. Red: The power converter voltage is too low to measure.
14	Battery management system	Green: There is battery system available feedback. Green flashing: The battery system is getting ready. Red: The battery system is not running, or there is no availability feedback.
15	Stop	Stops the power converter if manual is selected.
16	Start	Starts the power converter if manual is selected.
17	Load symbol	OFF: Power management application Green: The supply voltage and frequency are OK. Red: Supply voltage/frequency failure.

NOTE * You can use the display to monitor the battery operation.

The controller can use the voltage and frequency measurements from the ESS. If communication with the ESS then fails, an alarm is activated. On the display folio, the ESS icon, mains icon, and load lines LEDs flash yellow, red and green.

1.1.3 Emulation

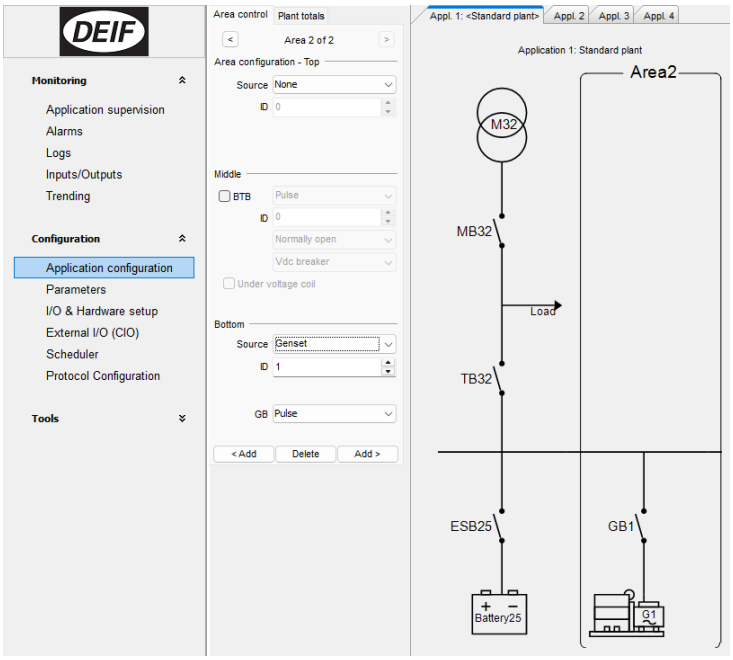
The controller includes an emulation tool to verify and test the functionality of the application, for example plant modes and logics, breaker handling, power management, and battery charging and discharging.

Application emulation is useful for training, customising plant requirements and for testing basic functionality that needs to be set up or verified.

1.1.4 Easy configuration with the utility software

Set up an application easily with a PC and the utility software.

You can also use the utility software to quickly configure the inputs, outputs, parameters, and settings.



1.2 Functions and features

1.2.1 Battery functions

Battery functions	Premium
Energy storage breaker (ESB) control	●
Energy usage monitoring	●
Power management	●
Reactive power control	●
Configurable dynamic power offset for the battery power reference (optional)	●
Configurable battery-specific PID control (optional)	6
Hotel load	●
Power DC-DC system (PDS): DC-coupled solar or DC-charger, current limitation, spinning reserve for the DC-busbar	●

Battery management system functions	Premium
BMS communication	●
Derate based on BMS state	●
Temperature-dependent derate	●
Energy usage monitoring	●
Maintenance alarms	●
Maintenance charge	●
DC breaker control	●

Power converter functions	Premium
PCS and BCU communication	●
Derate power converter output based on BMS maximum charge/discharge and state of charge (SOC)	●
Power ramp up and down control • Parameters to force ramp, override ramp, and adjust ramp change intervals	●
SOC balancing between parallel batteries (optional)	●
Off-grid isochronous master for reactive power regulation (optional)	●
Reactive power limitation	●
Customise and prioritise reactive power load sharing	●
Maintenance alarms	●
Configurable start signal	●
Analogue output power converter control (optional): • Analogue output from the controller • Analogue output from an external module (IOM 230)	 ● ●

Protection packages	Premium
BMS protection	●
Inverter protection	●

Power management functions	Premium
Command schedulers	●
Generator priority selection: • Fuel optimisation • Genset starts automatically for low state of charge	 ● ●
Optimal load point for the genset(s) • Dynamic genset start/stop	●

NOTE If you need to use redundant controllers (option T1), use an ASC-4 Battery controller.

1.2.2 General controller functions

AC functions	Premium
Sets of nominal settings	4
Select the AC configuration: • 3-phase/3-wire • 3-phase/4-wire • 2-phase/3wire (L1/L2/N or L1/L3/N) • 1-phase/2-wire L1	 ● ● ● ●
100 to 690 V AC (selectable)	●
CT -/1 or -/5 (selectable)	●
4th current measurement: Power from a Mains, Genset, or PV	●

General functions	Premium
Emulation for testing and front load commissioning	●
Built-in test sequences (Simple test, Load test, Full test, and Auxiliary supply test)	●
PLC logic (M-Logic)	80 lines
Counters, including: • Breaker operations • kWh meter (day, week, month, total) • kvarh meter (day, week, month, total)	● ● ● ●
General purpose PID regulators (2 × built-in analogue outputs can use these PID regulator references)	6
4 additional analogue outputs (using 2 × IOM 230)	●
Simple load shedding and adding	●
Changeable controller type	●

Setting and parameter functions	Premium
EasyConnect (Quick setup)	●
User permission level	●
Password-protected setup	●
Trending on USW	●
Event logs with password, up to 500 entries	●

Display and language functions	Premium
Supports multiple languages (including Chinese, Russian, and other languages with special characters)	●
20 configurable graphical screens	●
Graphical display with six lines	●
Parameters can be changed on the display unit	●

Modbus functions	Premium
Modbus RS-485	●
Modbus TCP/IP	●
Configurable Modbus area	●

1.2.3 BMS, BCU, and PCS communication

The controller supports a wide range of BMS, BCU, and PCS protocols. The controller also supports BMS and ESS CAN bus protocols.

Implementing new protocols

Since new systems are launched every year, DEIF developers continuously implement new protocols. If your system is not listed, please contact DEIF. We can work with you to quickly implement the required protocol. Alternatively, you can use the utility software to create a simple communication protocol.

More information
See **Application note, DEIF hybrid controller compatibility** for a list of the supported protocols. See **Application note, iE 150 ASC 150 Protocol configuration** for information about creating your own communication protocol.

1.3 Alarms and protections

Protections	Alarms	ANSI	Operate time
Fast over-current	2	50P	<40 ms
Over-current	4	50TD	<200 ms
Voltage-dependent over-current	1	50V	
Over-voltage	2	59	<200 ms
Under-voltage	3	27P	<200 ms
Over-frequency	3	81O	<300 ms
Under-frequency	3	81U	<300 ms
Unbalance voltage	1	47	<200 ms
Unbalance current	1	46	<200 ms
Under-excitation or reactive power import	1	32RV	<200 ms
Over-excitation or reactive power export	1	32FV	<200 ms
Overload*	5	32F	<200 ms
IEC/IEEE inverse time over-current	1	51	-
Neutral inverse time over-current	1	50N	-
Earth inverse time over-current	1	50G	-
Busbar over-voltage	3	59P	<50 ms

Protections	Alarms	ANSI	Operate time
Busbar under-voltage	4	27P	<50 ms
Busbar over-frequency	3	81O	<50 ms
Busbar under-frequency	4	81U	<50 ms
Emergency stop	1		<200 ms
Low auxiliary supply	1	27DC	
High auxiliary supply	1	59DC	
ES breaker external trip	1		
Synchronisation failure alarms	1/breaker		
Breaker open failure	1/breaker	52BF	
Breaker close failure	1/breaker	52BF	
Breaker position failure	1/breaker	52BF	
Phase sequence error	1	47	
De-load error	1		
Hz/V failure	1		
Not in Auto	1		
Vector shift	1	78	<40 ms
ROCOF (df/dt)	1	81R	<130 ms

NOTE * You can configure these protections for overload or reverse power.

1.4 Applications

1.4.1 Power management

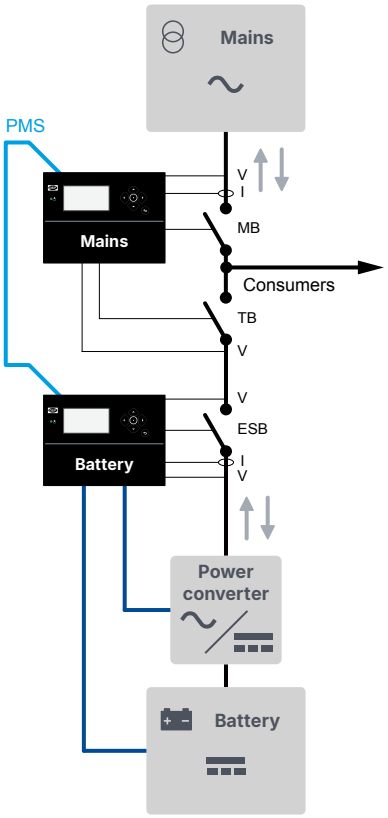
1.4.1.1 Grid-tied

The battery controllers can integrate seamlessly into grid-tied applications. This includes power management applications with other DEIF controllers using CAN bus communication.

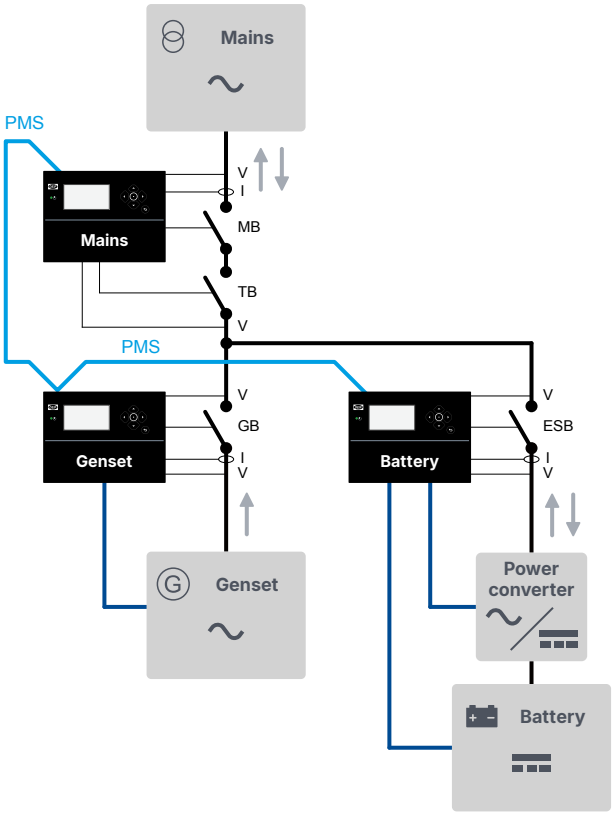
The battery controller can control an ESS to take peak loads, provide mains power export, provide fixed power. If there is a mains failure, the controller can run in island mode. The battery controller can also provide the spinning reserve for a PV plant, thereby improving the green energy penetration to the grid.

These controller configurations can be used in greenfield applications. To use these configurations in brownfield applications, all the genset, mains, battery and solar controllers must be replaced with DEIF controllers. The DEIF system can treat existing BTB controllers as externally controlled BTBs.

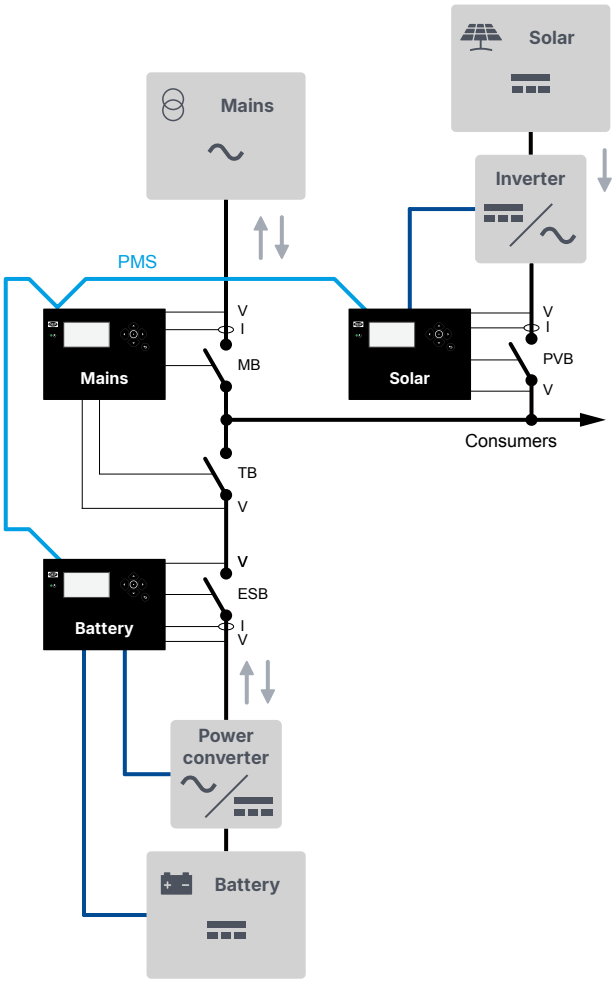
Grid-tied battery



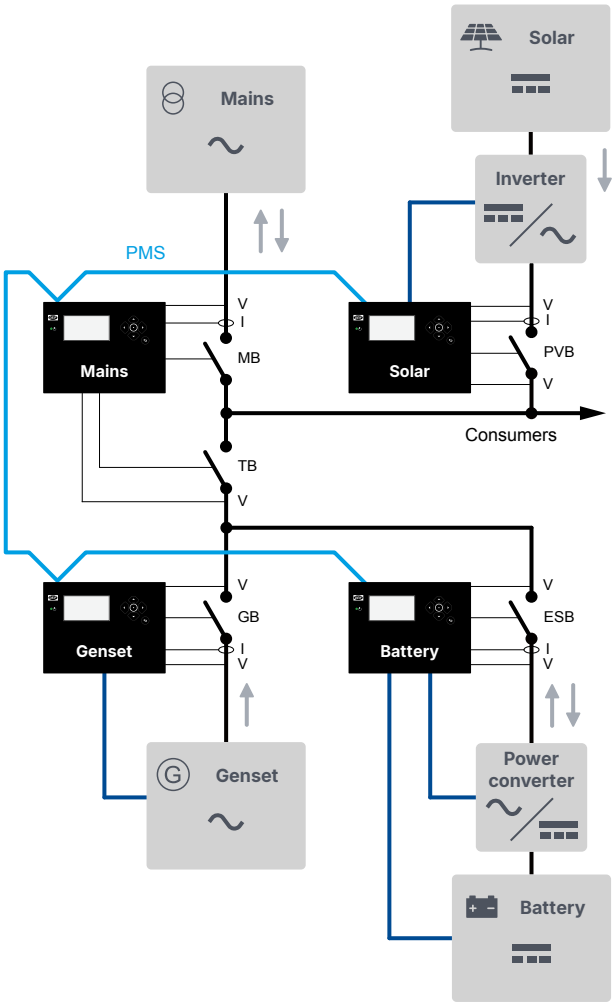
Grid-tied hybrid genset-battery



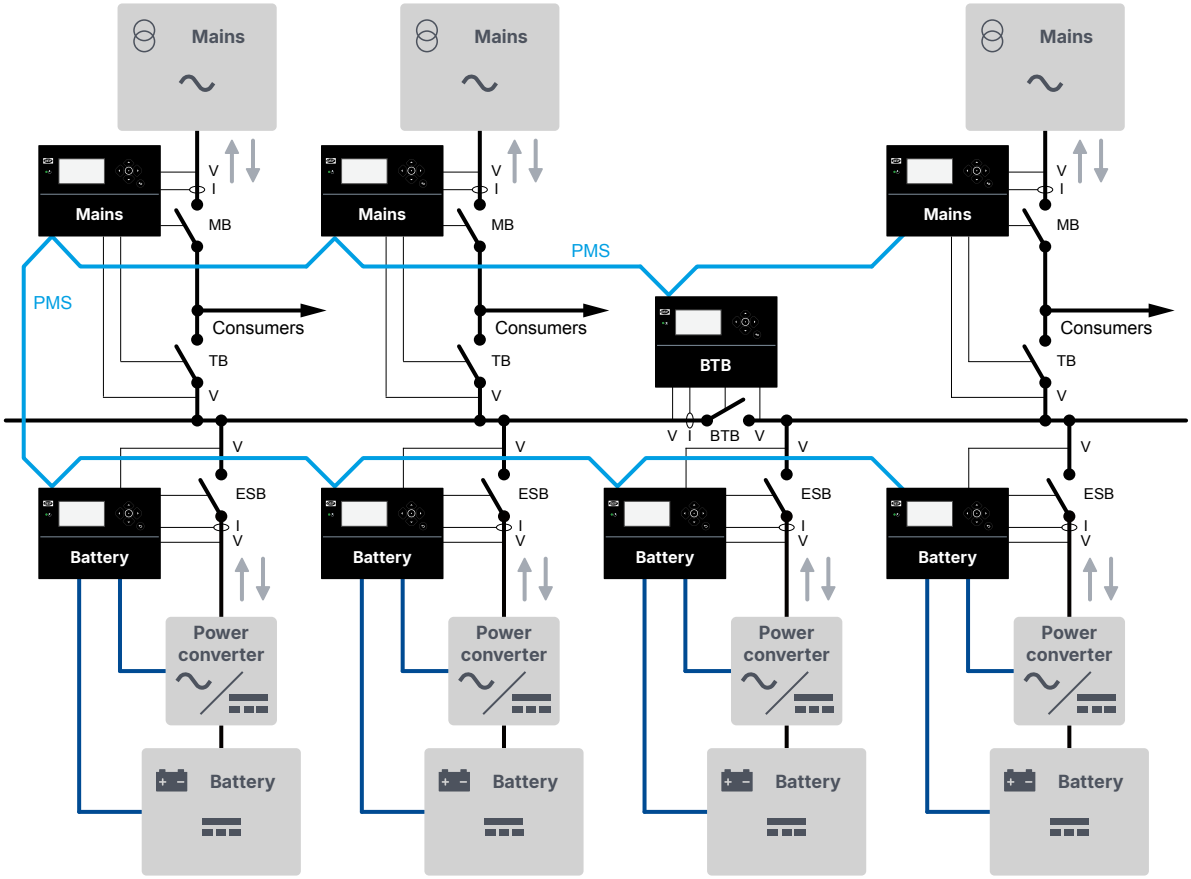
Grid-tied hybrid solar-battery



Grid-tied hybrid solar-genset-battery



Multi-mains with battery

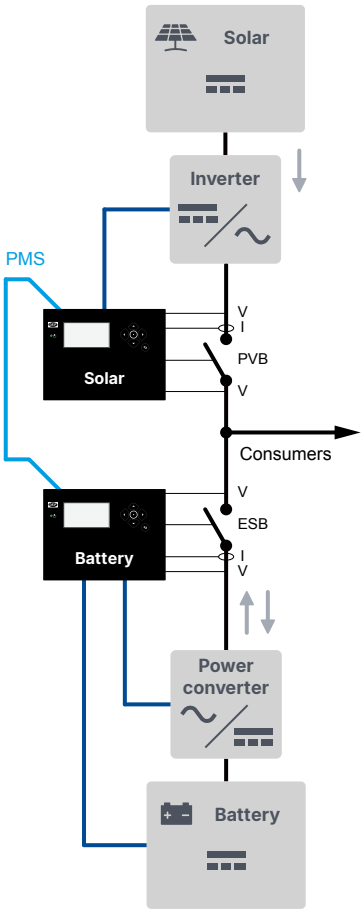


1.4.1.2 Off-grid

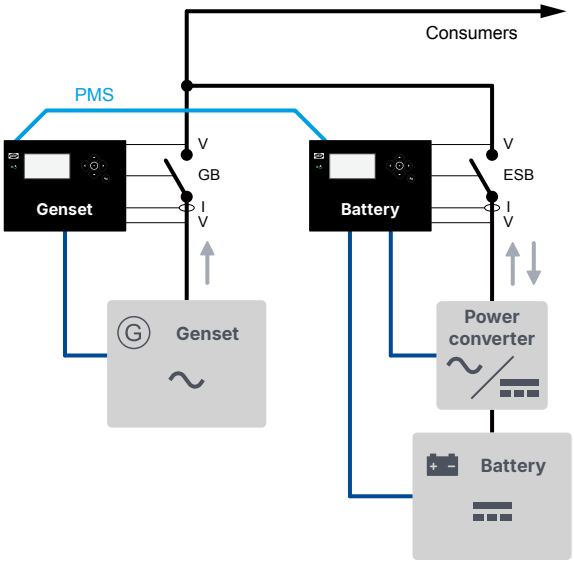
The battery controllers provide flexibility for off-grid applications.

These controller configurations can be used in greenfield applications. To use these configurations in brownfield applications, all the genset, mains, battery and solar controllers must be replaced with DEIF controllers. Existing BTB controllers can be replaced, or treated as externally controlled BTBs.

Off-grid with solar and battery

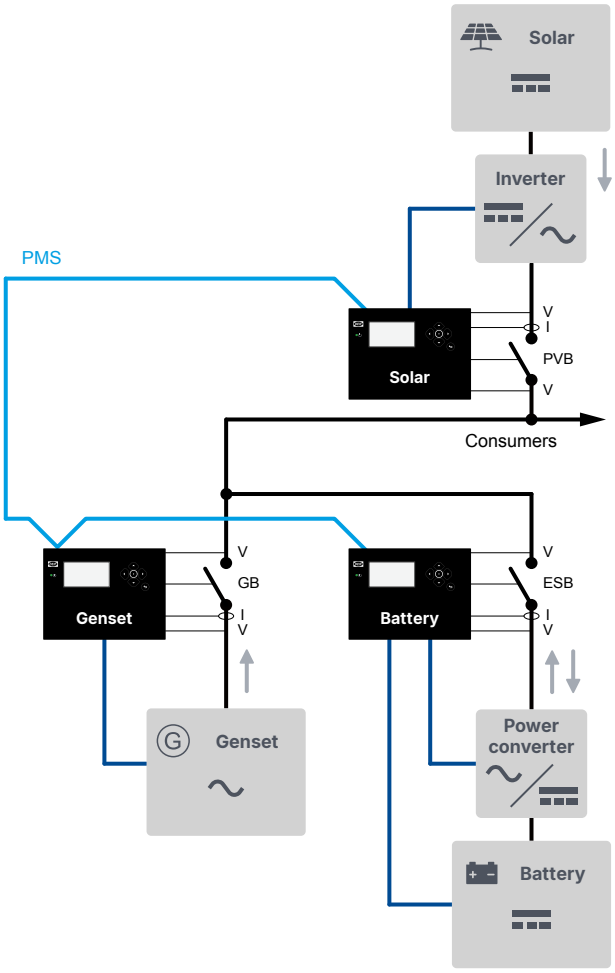


Off-grid with genset(s) and battery



To improve power quality, the battery controller can supply peak loads while gensets start. The 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.

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

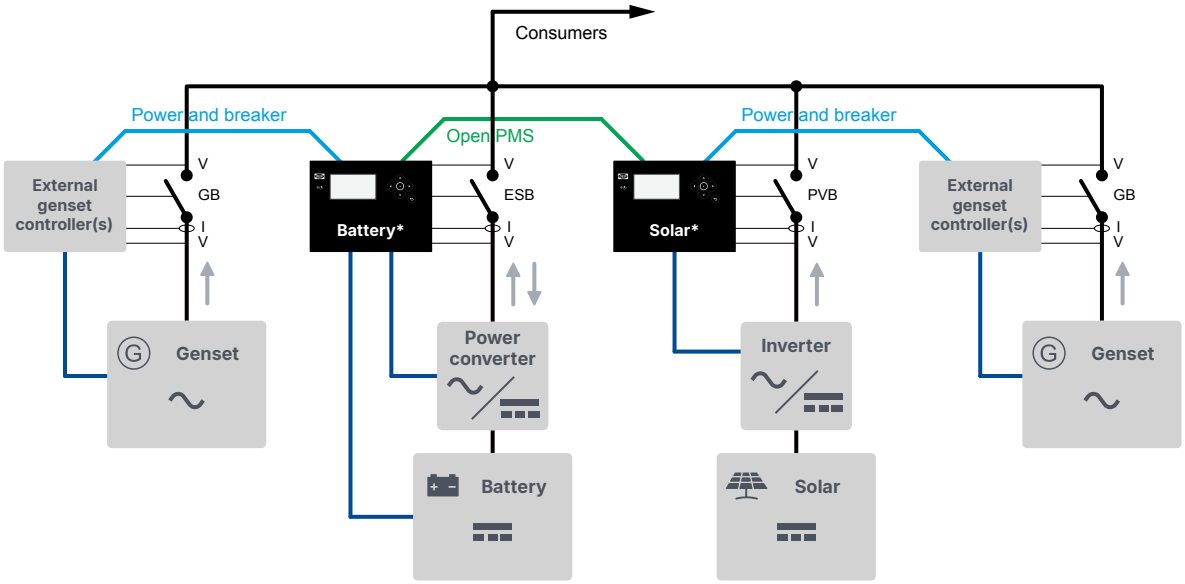


1.4.2 Open PMS

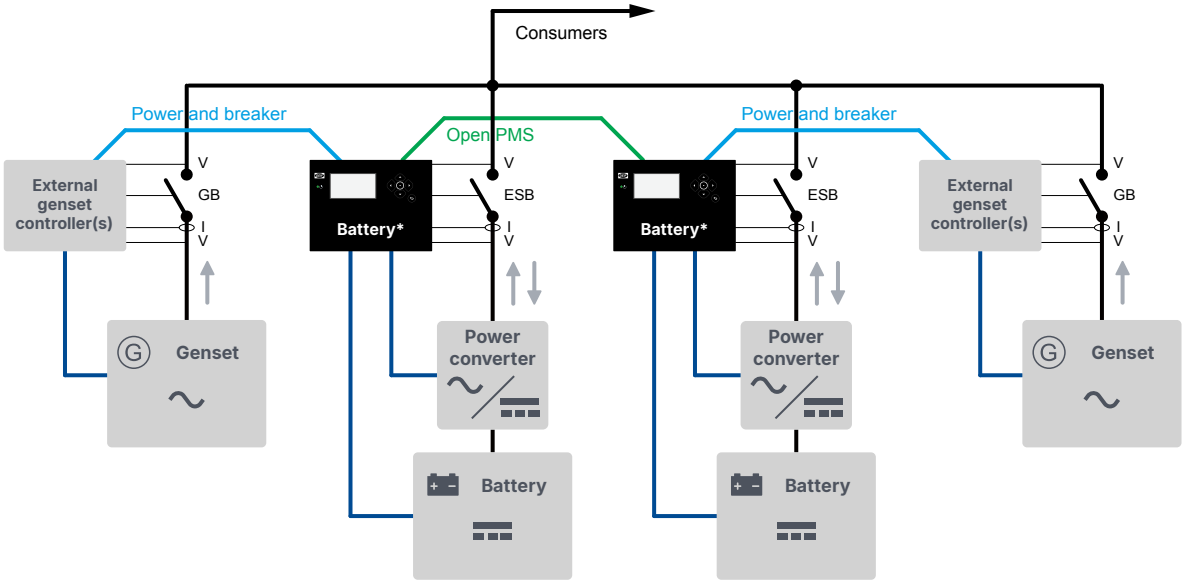
In an open power management system (PMS) the battery and/or solar controller(s) get power measurements from the externally controlled power source(s). You can therefore use open PMS to add power management to a brownfield application with third party gensets.

1.4.2.1 Off-grid open PMS

Off-grid solar, battery and external genset(s)



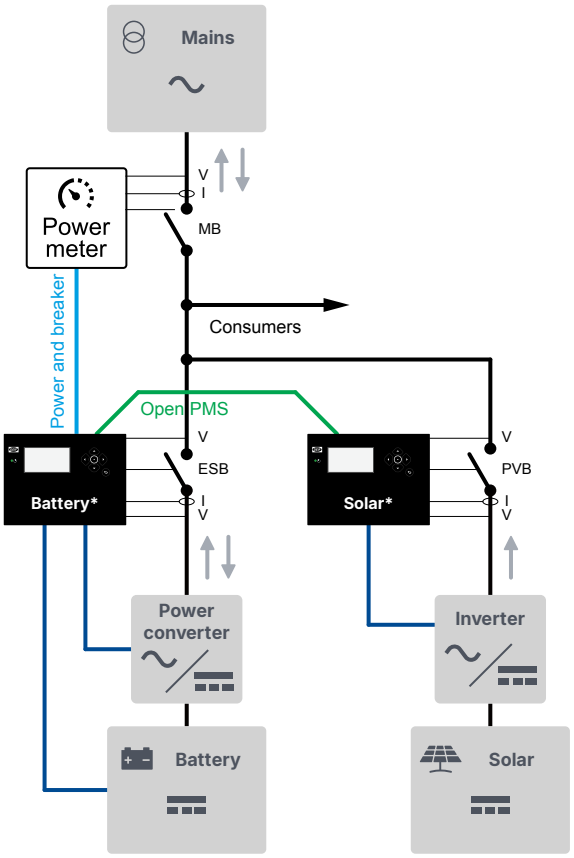
Off-grid battery(s) and external genset(s)



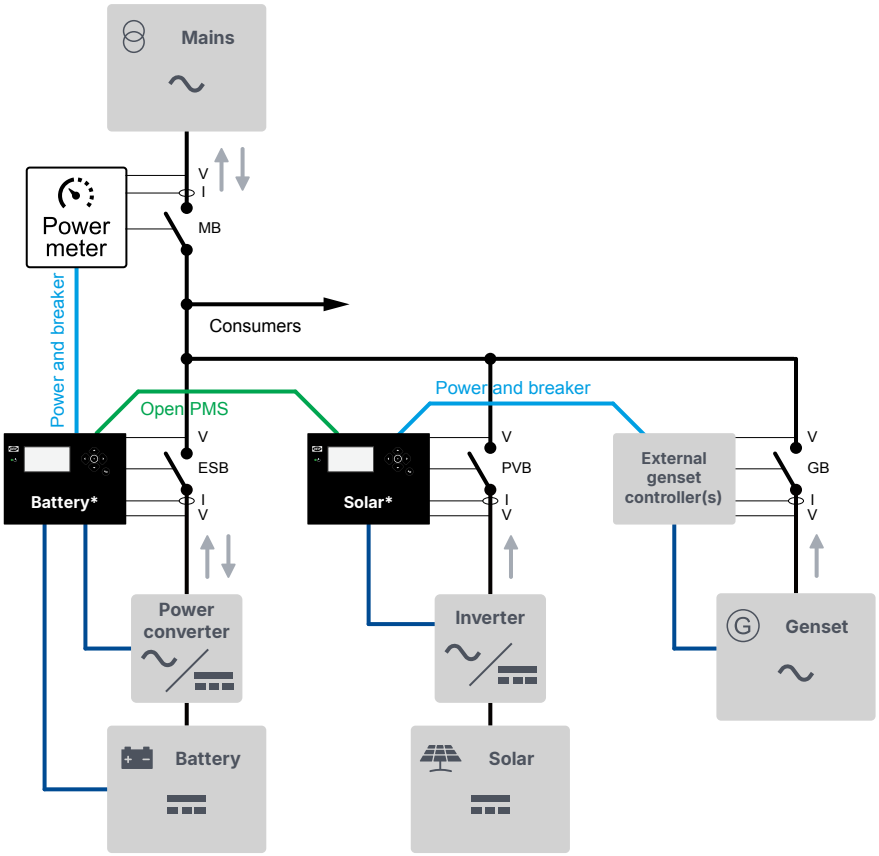
NOTE * You can use multiple controllers in the application. Power measurements can be connected to the closest solar or battery controller.

1.4.2.2 Grid-tied open PMS

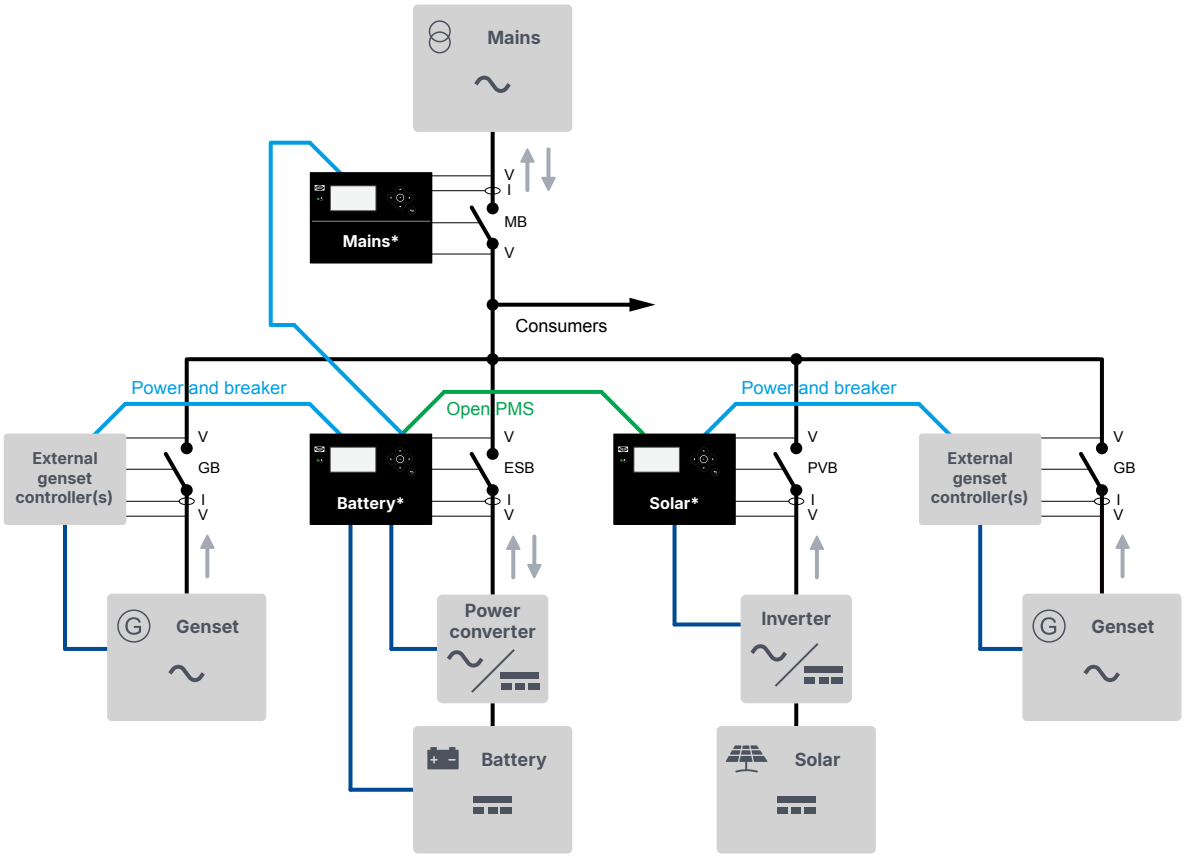
Grid-tied solar, battery and external mains



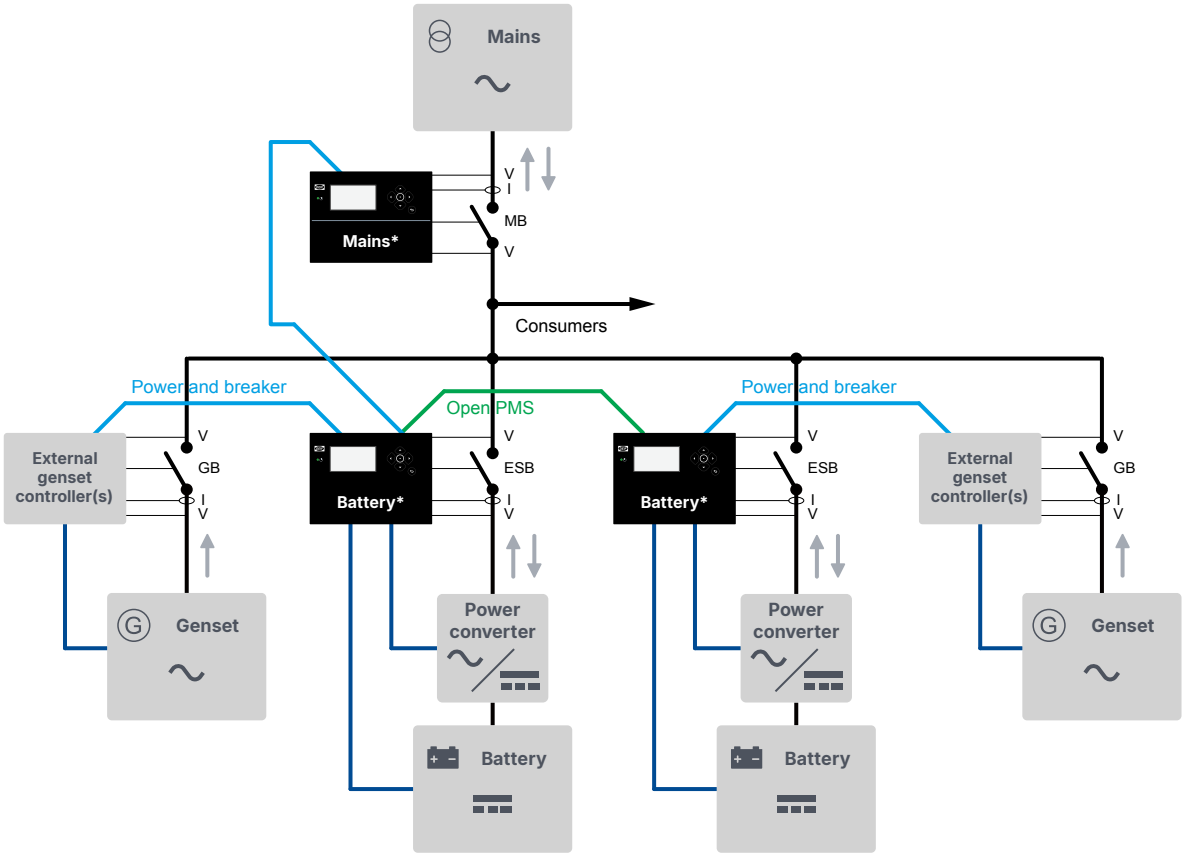
Grid-tied solar, battery, external genset(s) and external mains



Grid-tied solar, battery, mains and external genset(s)



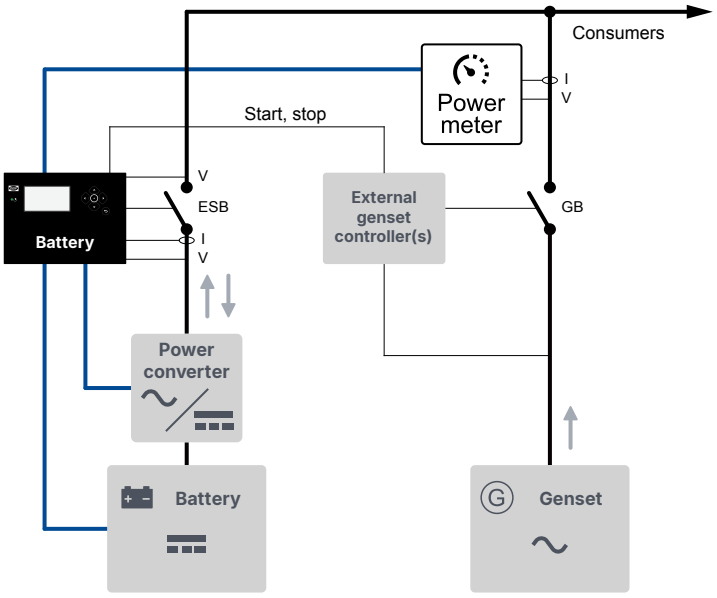
Grid-tied battery(s), mains and external genset(s)



NOTE * You can use multiple controllers in the application. Power measurements can be connected to the closest battery or solar controller.

1.4.3 Single battery controller

Single battery controller with genset(s)

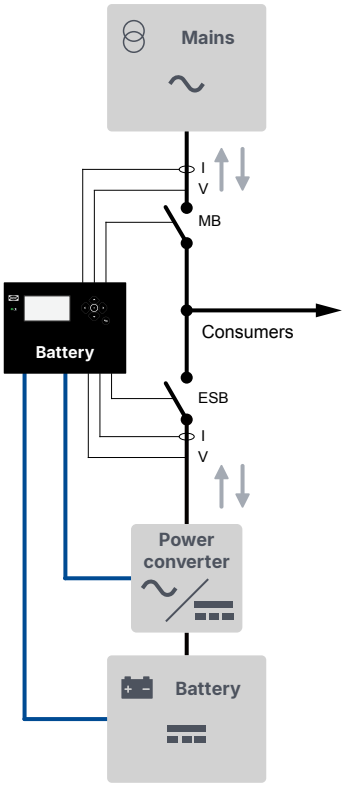


The battery controller can support the load, so that the genset can run at its optimal load point.

Ideal for ESS rental applications

You can use the battery single controller for emission-free power rental solutions with a single ESS. The controller provides full communication with the ESS. The controller can communicate with a BCU (battery control unit) or directly with a BMS (battery management system) and PCS (power control system) over Modbus. You can use the battery controller with a wide range of energy storage systems (ESS), and in any rental application.

Single battery controller with one mains



- **Peak shaving**: The battery supplies the peak load demand and runs parallel to mains.

- **Load take-over**: The load is moved from mains to battery, for example, during peak demand periods or periods with a risk of power outages.
- **Mains power export**: The battery produces a fixed kW set point (excluding increasing load).
- **Automatic mains failure**: If there is a significant loss of mains power or a total blackout, the controller automatically changes the supply so that the battery supplies the load.

1.5 Power management

1.5.1 Introduction

The power management system automatically supplies the power that is necessary for the load efficiently, safely and reliably.

The power management system:
- Automatically charges and discharges the ESS
- Automatically uses the ESS as spinning reserve for PV and microgrids
- Automatically starts and stops generators
- Automatically closes and opens breakers
- Optimises the diesel genset load for high efficiency and low carbon footprint
- Optimises the fuel consumption
- Balances the loads in the system
- Deploys plant logic
- Makes sure that the system is safe

You can monitor the complete power management system from a graphical supervision page in the utility software. You can also see running status, hours in operation, breaker status, the condition of the mains and busbars, fuel consumption, and so on.

Multi-master system

The power management system is a multi-master system, for increased reliability. In a multi-master system all vital data is transmitted between the controllers, so that all the controller know the power management status (calculations and position) in the application. As a result, the application does not have a single master controller.

Busbar sections

The plant can be divided by one to eight bus tie breakers. This makes it possible to run different sections of the plant in different plant modes. For example, you can use this to test a section, or to divide the load into primary and secondary loads.

1.5.2 Power management plant modes

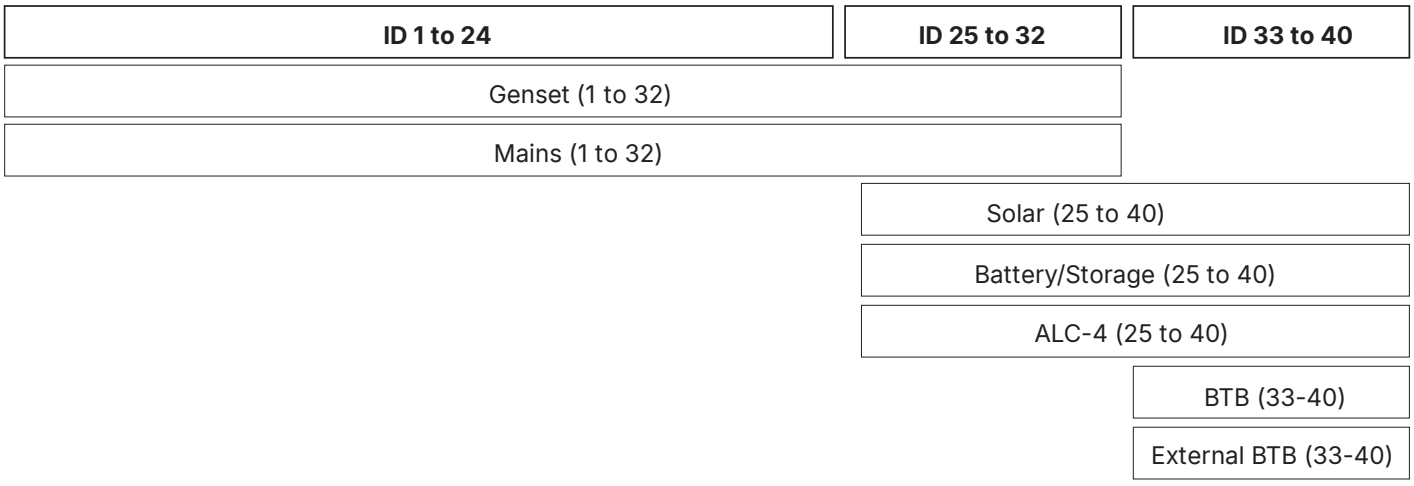
The plant modes are configurable and can be changed at any time. All modes can be combined with Automatic Mains Failure mode (AMF). You can use the controllers for the following applications:

Standard plant modes	Applications
Island mode	Power plant with synchronising generators.
Automatic Mains Failure	Critical power/emergency standby plants, black start generator.
Fixed power	Power plant with fixed kW set point (including building load).
Peak shaving	Power plant in which the generator supplies the peak load demand while operating in parallel with the mains.
Load take-over	Plant mode where the load is moved from mains to generator. For example, peak demand periods, or periods with a risk of power outages.
Mains power export	Power plant with fixed kW set point (excluding building load).

1.5.3 Power management features

Power management features	Premium
Power management operation*: • Number of generator controllers • Number of mains controllers • Number of BTB controllers • Number of solar controllers • Number of battery/storage (BESS) controllers • Number of load controllers (ALC-4)	 32 32 8 16 16 8
Hybrid ready (compatible with battery/storage and solar controllers)	●
Genset and battery/storage controllers: Ground relay management	●
Load controller support (compatible with ALC-4)	●
Genset load-dependent start and stop	●
EasyConnect	●
Asymmetrical genset load sharing	●
N + X (Secured mode)	●
Genset priority selection: • Manual • Running hours • Fuel optimisation	 ● ● ●
Safety stop of genset	●

***Restrictions on controllers**



1.5.4 Open PMS

Open PMS is a power management system that consists of battery and/or solar controllers. Open PMS can also include a mains controller. The battery and/or solar controller(s) get power measurements from the externally controlled power source(s). You can therefore use open PMS to add power management to a brownfield application with third party gensets.

Open PMS automatically supplies the power that is necessary for the load efficiently, safely and reliably:

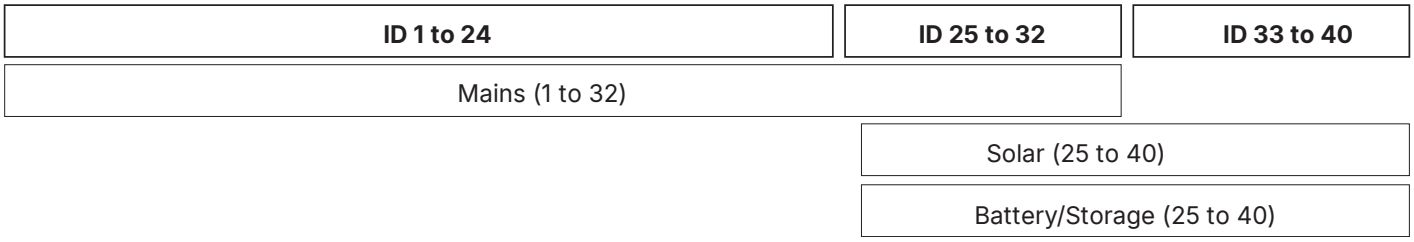
- Automatically maximises PV power
- Automatically optimises ESS power
- Automatically closes and opens breakers
- Balances the loads in the system
- Deploys logic

The open PMS operating data can be shown graphically on the controller display. You can also monitor open PMS from a graphical supervision page in the utility software.

Open PMS features

Open PMS features	Premium
Power management operation limits: • External generator controllers per battery/solar controller • Mains controllers* • External mains connections • Battery/storage (BESS) controllers* • Solar controllers*	 16 32 1 16 16
EasyConnect	●
External sources included in the available power: • Supply the busbar load • Charge batteries • Minimum and optimal genset load	● ● ● ●
Global or local start of external genset(s)	●

*Restrictions on controllers



Plant modes with a mains controller

With a mains controller, open PMS supports:

- Configurable mains power set point
- Configurable mains operating mode
- Auto-start signal for the application to the mains controller
- Standard mains controller PMS features, including cos phi set points, and mains breaker control

Standard plant modes	Applications
Island mode	Power plant with synchronising generators.
Automatic Mains Failure	Critical power/emergency standby plants, black start generator.
Fixed power	Power plant with fixed kW set point (including building load).
Peak shaving	Power plant where generator supplies peak load demand paralleled to the mains.
Load take-over	Plant mode where the load is moved from mains to generator. For example, peak demand periods, or periods with a risk of power outages.
Mains power export	Power plant with fixed kW set point (excluding building load).

Plant modes with an external mains

The battery or solar controller that is connected to the external mains operates as a *Mains lite* controller and controls the mains mode.

Standard plant modes	Applications
Fixed power	Power plant with fixed kW set point (including building load).
Peak shaving	Power plant where generator supplies peak load demand paralleled to the mains.
Mains power export	Power plant with fixed kW set point (excluding building load).

NOTE For an open external mains breaker, open PMS cannot synchronise so that the mains breaker can close. That is, open PMS runs in island mode and cannot back sync.

1.6 Single battery controller

The battery controller can operate as a single controller, that is, without power management communication to other controllers. Single controllers are particularly useful for brownfield applications. 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.

- **Only one other power source**: You can use the controller's 4th current transformer terminals to measure the power.
- **Multiple other power sources**: You must use genset communication, power meters, or transducers.

The 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 battery
- The power readings from the other power source(s)
- The breaker position(s) of the other power source(s)

Software variants

Single battery controller	Premium
External gensets	16
External mains	16
Energy storage breaker (ESB) control	●
Mains breaker control (paralleling)	●
External power source (for example, genset) start and stop by an external relay, based on: • State of charge (SOC) • System load	●
Optimal load point for the genset(s)	●

1.7 Compatible products

1.7.1 Touch display unit: TDU

TDU is a pre-programmed touch screen display (www.deif.com/products/tdu-series). The TDU can be used for these controllers:

- iE 150 Generator, Mains, BTB, Battery, and Solar *
- AGC 150 Generator, Mains, and BTB *
- ASC 150 Solar and Storage *
- AGC-4 Mk II Generator, Mains, and BTB
- ASC-4 Solar and Battery

- AGC-4 Generator, Mains, and BTB

NOTE * These controllers must have **Premium** software.

1.7.2 Power meters

Power measurements are required in single controller applications, as well as in open PMS applications. The controller can receive measurements from a number of power meters, including these DEIF power meters:

- **MIB 8000C** (www.deif.com/products/mib-8000c)
- **MIC-2 MKII** (www.deif.com/products/mic-2-mkii)
- **MTR-4** (www.deif.com/products/mtr-4)

More information
See **Application note, DEIF hybrid controller compatibility** for supported power meters and controllers from other suppliers.

NOTE Alternatively, you can use the USW to set up the controller to use Modbus to read values from your power meter. The controller can read P, Q, and up to four digital inputs.

1.7.3 Power measurements from gensets

Power measurements are required in single controller applications, as well as in open PMS applications. The controller can receive measurements from these DEIF genset controllers:

- **iE 150 Generator** (www.deif.com/products/ie-150/)
- **AGC 150 Generator** (www.deif.com/products/agc-150-generator)
- **AGC-4 Mk II Genset** (www.deif.com/products/agc-4-mk-ii)
- **AGC-4 Genset** (www.deif.com/products/agc-4)
- **CGC 400** (www.deif.com/products/cgc-400)

More information
See **Application note, DEIF hybrid controller compatibility** for supported power measurements from other genset suppliers.

1.7.4 Power management

You can use these controllers together in a power management system:

- **iE 150 Generator, Mains, BTB, Battery, and Solar** (www.deif.com/products/ie-150)
- **AGC 150 Generator** (www.deif.com/products/agc-150-generator)
- **AGC 150 Mains** (www.deif.com/products/agc-150-mains)
- **AGC 150 BTB** (www.deif.com/products/agc-150-btb)
- **ASC 150 Solar** (www.deif.com/products/asc-150-solar)
- **ASC 150 Storage** (www.deif.com/products/asc-150-storage)
- **AGC-4 Mk II Genset, Mains, BTB, Group, and Plant** (www.deif.com/products/agc-4-mk-ii)
- **AGC-4 Genset, Mains, BTB, Group, and Plant** (www.deif.com/products/agc-4)
- **ASC-4 Solar** (www.deif.com/products/asc-4-solar)
- **ASC-4 Battery** (www.deif.com/products/asc-4-battery)
- **ALC-4 (Automatic Load Controller)** (www.deif.com/products/alc-4)

1.7.5 Open PMS

You can use these controllers together in an open power management system:

- **iE 150 Battery, Solar, Mains** (www.deif.com/products/ie-150)
- **ASC 150 Solar** (www.deif.com/products/asc-150-solar)
- **ASC 150 Storage** (www.deif.com/products/asc-150-storage)
- **AGC 150 Mains** (www.deif.com/products/agc-150-mains)
- **ASC-4 Solar** (www.deif.com/products/asc-4-solar)
- **ASC-4 Battery** (www.deif.com/products/asc-4-battery)
- **AGC-4 Mk II Mains** (www.deif.com/products/agc-4-mk-ii)

You can also use **iE 150 Generator**, **AGC 150 Generator**, **AGC-4 Mk II Genset**, **AGC-4 Genset**, and/or third-party genset controllers as external gensets. That is, the genset controllers are not part of the open PMS. They can send their power measurements to the open PMS controllers over CAN bus.

1.7.6 Remote monitoring service: Insight

Insight is a responsive remote monitoring service (www.deif.com/products/insight). It includes real-time genset data, a customisable dashboard, GPS tracking, equipment and user management, email and/or SMS alerts, and cloud data management.

1.7.7 Additional inputs and outputs

The controller uses CAN bus communication with these:

- **CIO 116** is a remote input expansion module (www.deif.com/products/cio-116).
- **CIO 208** is a remote output expansion module (www.deif.com/products/cio-208).
- **CIO 308** is a remote I/O module (www.deif.com/products/cio-308).
- **IOM 220** and **IOM 230** each have two analogue outputs. These can be used for general PID control.

1.7.8 Additional operator panel, AOP-2

The controller uses CAN bus communication to the additional operator panel (AOP-2). Configure the controller using M-Logic. On the AOP-2, the operator can then:

- Use the buttons to send commands to the controller.
- See LEDs light up to show statuses and/or alarms.

You can configure and connect two AOP-2s if the controller has the premium software package.

1.7.9 Other equipment

DEIF has a wide variety of other equipment that is compatible. Here are some examples:

- **Synchroscopes**
  - **CSQ-3** (www.deif.com/products/csq-3)
- **Battery chargers/power supplies**
  - **DBC-1** (www.deif.com/products/dbc-1)
- **Current transformers**
  - **ASK** (www.deif.com/products/ask-asr)
  - **KBU** (www.deif.com/products/kbu)
- **Transducers**
  - **MTR-4** (www.deif.com/products/mtr-4)

1.7.10 Controller types

Parameter	Setting	Controller type	Minimum software
9101	Genset unit	Non-sync generator controller	Core
	Genset unit	Generator controller	Sync
	Mains unit	Mains controller	Sync
	Bus Tie Breaker unit	BTB controller	Sync
	Genset Hybrid unit	Hybrid Genset-Solar controller	Core
	Engine Drive unit	Engine drive controller	Core
	Remote display unit	Remote display	None
	Battery unit	Battery storage controller	Premium
	Solar unit	Solar controller	Premium
	ATS unit	Automatic transfer switch (open transition)	Core
	ATS unit	Automatic transfer switch (closed transition)	Sync
	Genset PMS lite unit	PMS lite controller	Sync

Software packages and controller types

The controller software package determines which functions the controller can use.

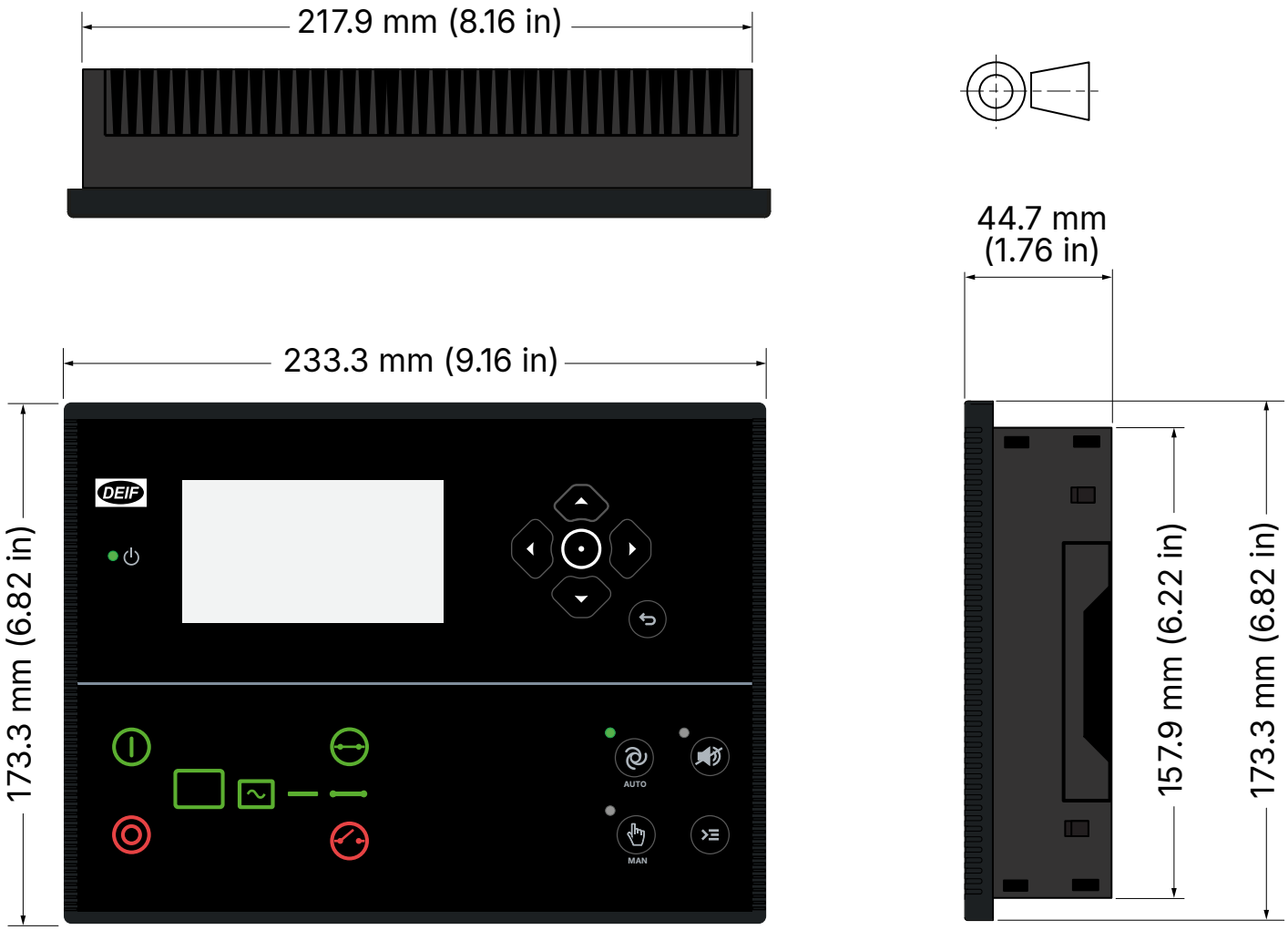
- **Core**
  - You can change the controller type to any other controller that uses **Core**.
  - **Core** software only supports non-synchronisation applications.
- **Sync**
  - You cannot change the controller type.
  - **Sync** software supports synchronisation applications.
- **PM** (power management)
  - You cannot change the controller type.
- **Premium**
  - You can change the controller type to any other controller type.
  - All functions are supported.

You can select the controller type under `Basic settings > Controller settings > Type`.

NOTE For the iE 150 Marine controllers, see www.deif.com/products/ie-150-marine.

2. Technical specifications

2.1 Dimensions



Dimensions and weight	
Dimensions	Length: 233.3 mm (9.16 in) Height: 173.3 mm (6.82 in) Depth: 44.7 mm (1.76 in)
Panel cutout	Length: 218.5 mm (8.60 in) Height: 158.5 mm (6.24 in) Tolerance: ± 0.3 mm (0.01 in)
Max. panel thickness	4.5 mm (0.18 in)
Mounting	UL/cUL Listed: Type complete device, open type 1 UL/cUL Listed: For use on a flat surface of a type 1 enclosure
Weight	0.79 kg (1.7 lb)

2.2 Mechanical specifications

Operation conditions	
Vibration	Response: • 10 to 58.1 Hz, 0.15 mmpp

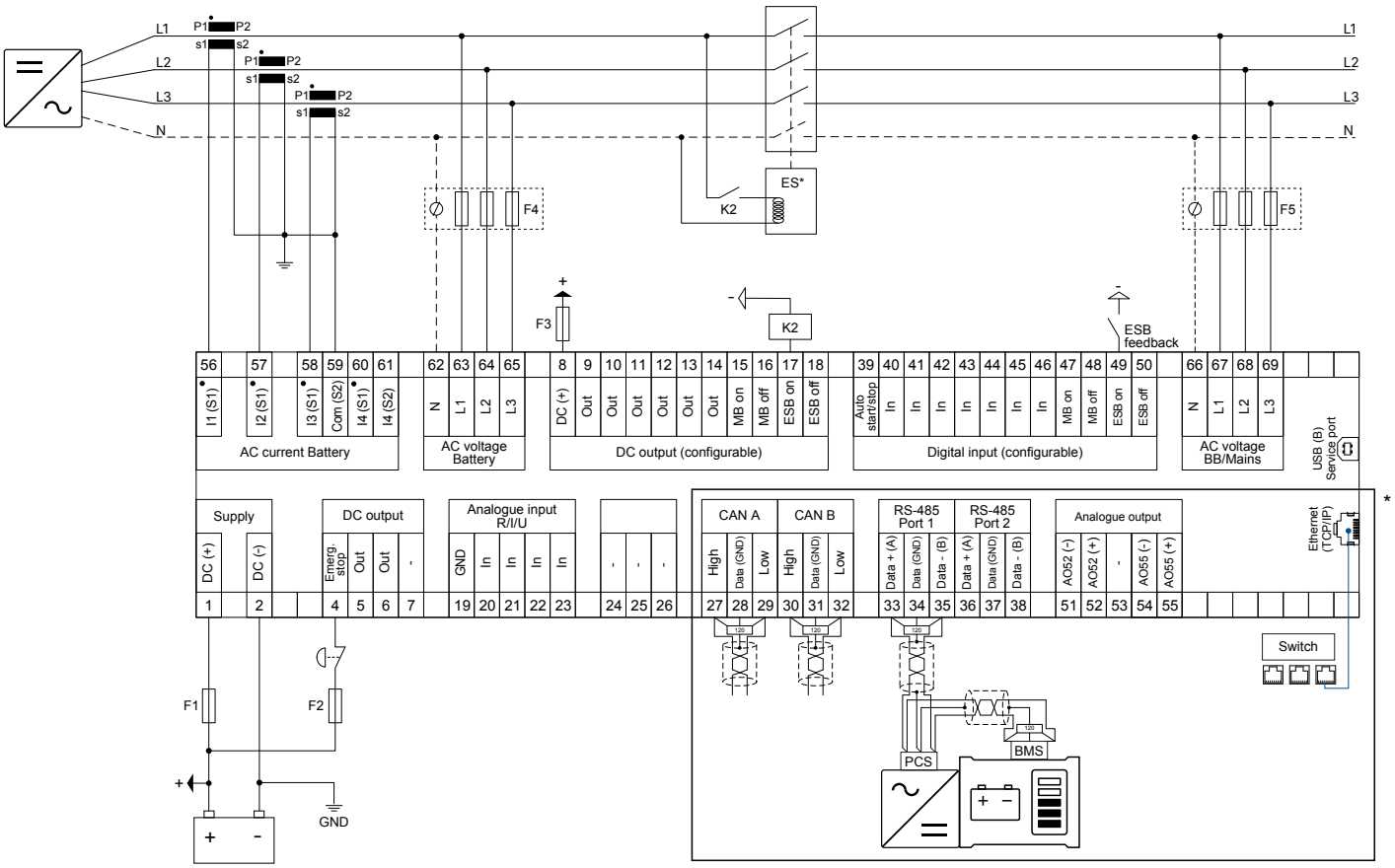
Operation conditions	
	• 58.1 to 150 Hz, 1 *g*. To IEC 60255-21-1 (Class 2) Endurance: • 10 to 150 Hz, 2 *g*. To IEC 60255-21-1 (Class 2) Seismic vibration: • 3 to 8.15 Hz, 15 mmpp • 8.15 to 35 Hz, 2 *g*. To IEC 60255-21-3 (Class 2)
Shock	10 *g*, 11 ms, half sine. To IEC 60255-21-2 Response (Class 2) 30 *g*, 11 ms, half sine. To IEC 60255-21-2 Withstand (Class 2) 50 *g*, 11 ms, half sine. To IEC 60068-2-27, test Ea Tested with three impacts in each direction in three axes (total of 18 impacts per test)
Bump	20 *g*, 16 ms, half sine IEC 60255-21-2 (Class 2) Tested with 1000 impacts in each direction on three axes (total of 6000 impacts per test)
Galvanic separation	CAN port 2 (CAN B): 550 V, 50 Hz, 1 minute RS-485 port 1: 550 V, 50 Hz, 1 minute Ethernet: 550 V, 50 Hz, 1 minute Analogue output 51-52 (GOV): 550 V, 50 Hz, 1 minute Analogue output 54-55 (AVR): 3000 V, 50 Hz, 1 minute Note: No galvanic separation on CAN port 1 (CAN A) and RS-485 port 2
Safety	Installation CAT. III 600 V Pollution degree 2 IEC/EN 60255-27
Flammability	All plastic parts are self-extinguishing to UL94-V0
EMC	IEC/EN 60255-26

2.3 Environmental specifications

Operation conditions	
Operating temperature (incl. display screen)	-40 to +70 °C (-40 to +158 °F)
Storage temperature (incl. display screen)	-40 to +85 °C (-40 to +185 °F)
Accuracy and temperature	Temperature coefficient: 0.2 % of full scale per 10 °C
Operating altitude	0 to 4000 m with derating
Operating humidity	Damp Heat Cyclic, 20/55 °C at 97 % relative humidity, 144 hours. To IEC 60255-1 Damp Heat Steady State, 40 °C at 93 % relative humidity, 240 hours. To IEC 60255-1
Change of temperature	70 to -40 °C, 1 °C / minute, 5 cycles. To IEC 60255-1
Protection degree	IEC/EN 60529 • IP65 (front of module when installed into the control panel with the supplied sealing gasket) • IP20 on terminal side

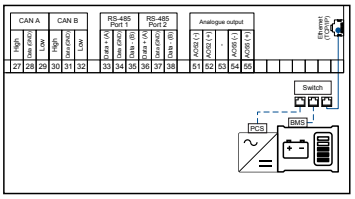
2.4 Controller

2.4.1 Typical wiring for battery controller

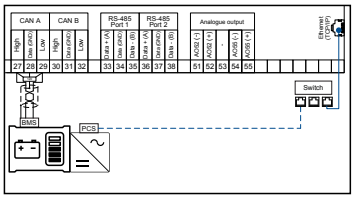


* Other examples:

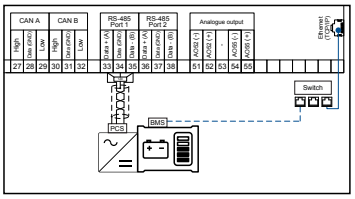
Ethernet connections



CAN connection (CAN A or CAN B)



Mixed connections



NOTE * ES: Optional ES breaker.
* BMS and PCS: The controller can use RS-485 or Ethernet communication. The RS-485 communication can be daisy chained from one port.

NOTE RS-485 port 1 has galvanic isolation, and RS-485 port 2 does not have galvanic isolation.

Fuses:

- F1: 2 A DC max. time-delay fuse/MCB, c-curve
- F2: 6 A DC max. time-delay fuse/MCB, c-curve
- F3: 4 A DC max. time-delay fuse/MCB, b-curve
- F4, F5: 2 A AC max. time-delay fuse/MCB, c-curve

2.4.2 Electrical specifications

Power supply	
Power supply range	Nominal voltage: 12 V DC or 24 V DC

Power supply	
	Operating range: 6.5 to 36 V DC
Voltage withstand	Reverse polarity
Power supply drop-out immunity	0 V DC for 50 ms (coming from min. 6 V DC)
Power supply load dump protection	Load dump protected according to ISO16750-2 test A
Power consumption	5 W typical 12 W max.
RTC clock	Time and date backup

Supply voltage monitoring	
Measuring range	0 V to 36 V DC Max. continuous operating voltage: 36 V DC
Resolution	0.1 V
Accuracy	±0.35 V

Voltage measurement	
Voltage range	Nominal range: 100 to 690 V phase-to-phase (above 2000 m derate to max. 480 V)
Voltage withstand	U_n +35 % continuously, U_n +45 % for 10 seconds Measuring range of nominal: 10 to 135 % Low range, nominal 100 to 260 V: 10 to 351 V AC phase-to-phase High range, nominal 261 to 690 V: 26 to 932 V AC phase-to-phase
Voltage accuracy	±1 % of nominal within 10 to 75 Hz +1/-4 % of nominal within 3.5 to 10 Hz
Frequency range	3.5 to 75 Hz
Frequency accuracy	±0.01 Hz within 60 to 135 % of nominal voltage ±0.05 Hz within 10 to 60 % of nominal voltage
Input impedance	4 MΩ/phase-to-ground, and 600 kΩ phase/neutral

Current measurement	
Current range	Nominal: -/1 A and -/5 A Range: 2 to 300 %
Number of CT input	4
Max. measured current	3 A (-/1 A) 15 A (-/5 A)
Current withstand	7 A continuous 20 A for 10 seconds 40 A for 1 second
Current accuracy	From 10 to 75 Hz: • ±1 % of nominal from 2 to 100% current • ±1 % of measured current from 100 to 300 % current From 3.5 to 10 Hz: • +1/-4 % of nominal from 2 to 100 % current • +1/-4 % of measured current from 100 to 300 % current
Burden	Max. 0.5 VA

Power measurement	
Accuracy power	±1 % of nominal within 35 to 75 Hz
Accuracy power factor	±1 % of nominal within 35 to 75 Hz

Digital inputs	
Number of inputs	12 x digital inputs Negative switching
Maximum input voltage	+36 V DC with respect to plant supply negative
Minimum input voltage	-24 V DC with respect to plant supply negative
Current source (contact cleaning)	Initial 10 mA, continuous 2 mA

DC outputs	
Number of 3 A outputs	2 x outputs 15 A DC inrush and 3 A continuous, supply voltage 0 to 36 V DC Endurance tested according to UL/ULC6200:2019 1.ed: 24 V, 3 A, 100000 cycles (with an external freewheeling diode)
Number of 0.5 A outputs	10 x outputs 2 A DC inrush and 0.5 A continuous, supply voltage 4.5 to 36 V DC
Common	12/24 V DC

Analogue inputs	
Number of inputs	4 x analogue inputs
Electrical range	Configurable as: • Negative switching digital input • 0 V to 10 V sensor • 4 mA to 20 mA sensor • 0 Ω to 2.5 kΩ sensor
Accuracy	Current: • Accuracy: ±20 uA ±1.00 % rdg Voltage: • Range: 0 to 10 V DC • Accuracy: ±20 mV ±1.00 % rdg RMI 2-wire LOW: • Range: 0 to 800 Ω • Accuracy: ±2 Ω ±1.00 % rdg RMI 2-wire HIGH: • Range: 0 to 2500 Ω • Accuracy: ±5 Ω ±1.00 % rdg

Analogue outputs	
Output type	Isolated DC voltage output
Voltage range	-10 to +10 V DC
Resolution	Less than 1 mV
Maximum voltage	Output 52: ±550 V Output 55: ±3 kV

Analogue outputs	
Minimum load	500 Ω
Accuracy	±1 % of setting value

Display unit	
Type	Graphical display screen (monochrome)
Resolution	240 x 128 pixels
Navigation	Five-key menu navigation
Log book	Data log and trending function
Language	Multi-language display

2.4.3 Communication

Communication	
CAN A	You can connect some combinations* of these: • CIO 116, CIO 208, and CIO 308* • IOM 220, and IOM 230* • AOP2* • ESS CAN protocol • BMS CAN protocol Data connection 2-wire + common, or 3-wire Not isolated External termination required (120 Ω + matching cable)
CAN B	You can connect some combinations* of these: • CIO 116, CIO 208, and CIO 308* • IOM 220, and IOM 230* • AOP2* • Power management • ESS CAN protocol • BMS CAN protocol Data connection 2-wire + common, or 3-wire Isolated External termination required (120 Ω + matching cable) PMS 125 kbit and 250 kbit
RS-485 Port 1	Used for: • Modbus master to PCS/BCU, BMS and PDS • Power meters • Modbus RTU, PLC, SCADA, Remote monitoring (Insight) Data connection 2-wire + common, or 3-wire Isolated External termination required (120 Ω + matching cable) 9600 to 115200
RS-485 Port 2	Used for: • Modbus master to PCS/BCU, BMS and PDS • Power meters • Modbus RTU, PLC, SCADA, Remote monitoring (Insight) Data connection 2-wire + common, or 3-wire Not isolated External termination required (120 Ω + matching cable)

Communication	
	9600 to 115200
RJ45 Ethernet	Used for: • Modbus master to PCS/BCU, BMS and PDS • Modbus to PLC, SCADA, and so on • NTP time synchronisation with NTP servers • Power management system (PMS) communication between iE 150, AGC 150, and ASC 150 controllers • PC utility software Isolated Auto detecting 10/100 Mbit Ethernet port
USB	Service port (USB-B)

NOTE * These can be daisy chained and connected to the same CAN port. However, when Power management, the ESS CAN protocol, or the BMS CAN protocol is selected, the port is used exclusively for that (any other use is not possible).

2.5 Approvals

Standards
CE
UL/ULC Listed to UL6200:2019 1st edition controllers for use in Power Production

NOTE Refer to www.deif.com for the most recent approvals.

2.5.1 UL/cUL Listed

Requirements	
Installation	To be installed in accordance with the NEC (US) or the CEC (Canada)
Enclosure	A suitable type 1 (flat surface) enclosure is required Unventilated/ventilated with filters for controlled/pollution degree 2 environment
Mounting	Flat surface mounting
Connections	Use 90 °C copper conductors only
Wire size	AWG 30-12
Terminals	Tightening torque: 5-7 lb-in.
Current transformers	Use Listed or Recognized isolating current transformers
Communication circuits	Only connect to communication circuits of a listed system/equipment

2.6 Spare parts and accessories

Name	Details	Included with controller
Connector kit	A set of terminal blocks.	●
Fixing clamps	Clamps for mounting the controller.	●
J4	PC Ethernet cable crossed, 3 m. UL94 (V1) approved. Weight 0.2 kg (0.4 lbs).	
J7	PC cable for utility software (USB), 3 m. UL94 (V1) approved. Weight 0.2 kg (0.4 lbs).	

3. Legal information

3.1 Trademarks

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