DATA SHEET

ASC-4

Automatic Sustainable Controller

1. ASC-4 Solar

2. ASC-4 Battery

3. Applications

4. Technical information

5. Hardware and software

6. Ordering information

1. ASC-4 Solar

1.1 Overview

The ASC-4 Solar controller is designed to combine photovoltaic power with other power sources.

Spinning reserve

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

Ideal for self-consumption applications

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

Genset load management

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

This is to secure a certain amount of load on the gensets, eliminating the risk of reverse power, as well as impure combustion and exhaust problems.

Key features

- PV integration
- Self-consumption & IPP applications
- PV-Genset-Mains-ESS (energy storage system) applications
- Minimum genset load requirement
- Spinning reserve generation
- Green & brown field applications
- Power meter interfacing (only used for stand-alone)
- Inverter interfacing
  - Monitor and troubleshoot the Modbus communication from the ASC-4 display unit
- SunSpec support
- Forecast system interfacing
- Meteorological data representation
- Compatible with ASC-4 Battery, AGC-4 Mk II, AGC-4, AGC 150, and ALC-4
- Scalable & flexible
- Easy setup with free PC tool
- Plug & play HMI

Hardware

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

2. ASC-4 Battery

2.1 Overview

The ASC-4 Battery controller is designed to combine electrical storage with other power sources. It features a configurable charge scheme to determine charge/discharge levels as well as sources of energy which can be used for re-charging the battery.

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.

Grid forming or grid following

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

- **Grid forming**

  Grid forming is also called island, or V/f mode. For grid forming (V/f 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 ASC-4 Solar controller spinning reserve requests.

- **Grid following**

  Grid following is also called parallel, or P/Q mode. For grid following (P/Q 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.

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, 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.

- **Power source**

  For the power source function, the ASC-4 Battery operates parallel to other sources. Genset power is prioritised over battery power.

AC- or DC-coupled

The ASC Battery is ideal for AC- as well as DC-coupled applications.

For AC-coupled systems, you can define battery charging and discharging scheme. Using the charge scheme, 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 and the controller is only responsible for the discharging scheme. Depending on the PV-Battery system and supplier, the ASC Battery can communicate with the PV inverter, and limit the current from the PV to the battery.

Key features

- Electrical storage integration
- Grid-tied and off-grid applications
- Micro-grid applications
- Grid-following (P/Q), and grid-forming (V/f) mode
- Battery droop (power-frequency, and reactive power-voltage)
- AC- and DC-charged systems
- Configurable charge scheme
- Spinning reserve provider
- BCU, BMS and/or PCS interfacing
  - Monitor and troubleshoot the Modbus communication from the ASC-4 display unit
- Compatible with ASC-4 Solar, AGC-4 Mk II, AGC-4, AGC 150, and ALC-4
- Scalable & flexible
- Frequency response
- Easy setup with free PC tool

Hardware

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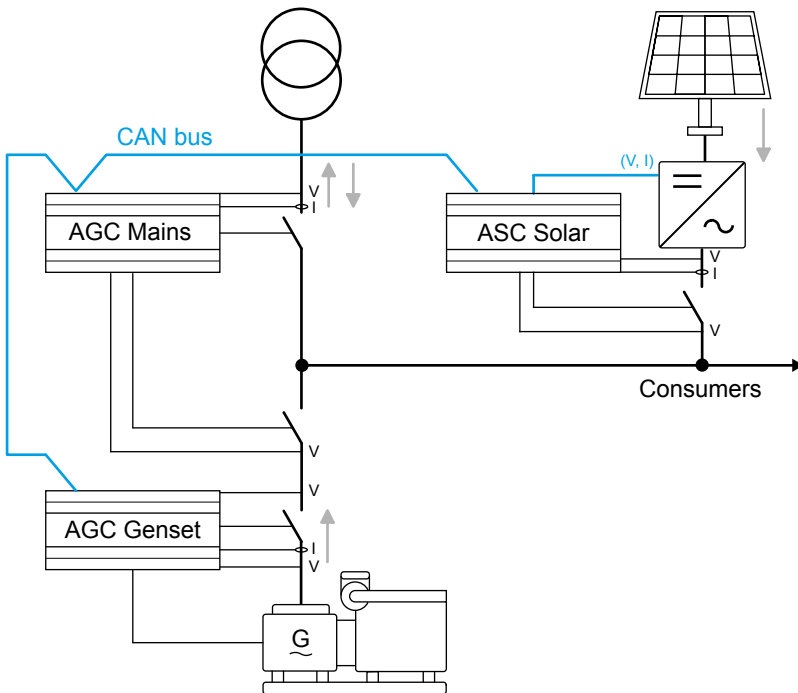
3. Applications

3.1 Grid-tied

The ASC-4 Solar and ASC-4 Battery controllers can integrate seamlessly into grid-tied applications. This includes power management applications with other DEIF controllers using CAN bus communication.

The ASC-4 Solar can feed surplus PV energy to the grid, or charge the energy storage system (ESS). Alternatively, the ASC-4 Solar can regulate the PV production to match the self-consumption, thereby preventing any feed-in of PV power to the grid.

The ASC-4 Battery can control an ESS to take peak loads, provide mains power export, provide fixed power, or run in island mode. The ASC-4 Battery can also provide the spinning reserve for a PV-plant, thereby improving the green energy penetration to the grid.
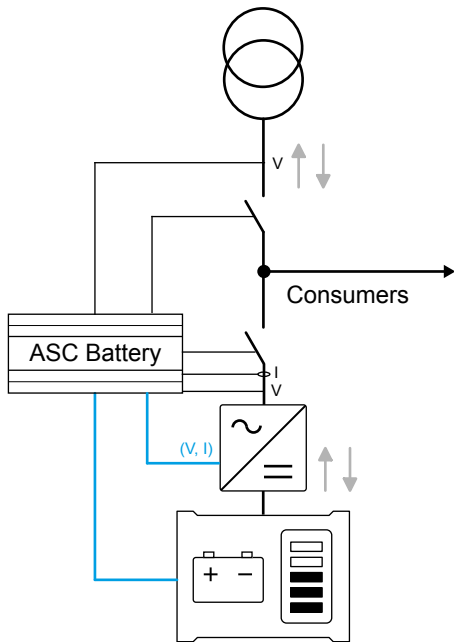
Hybrid solar-genset grid-tied application (greenfield)

Hybrid solar-genset-battery grid-tied application (greenfield)
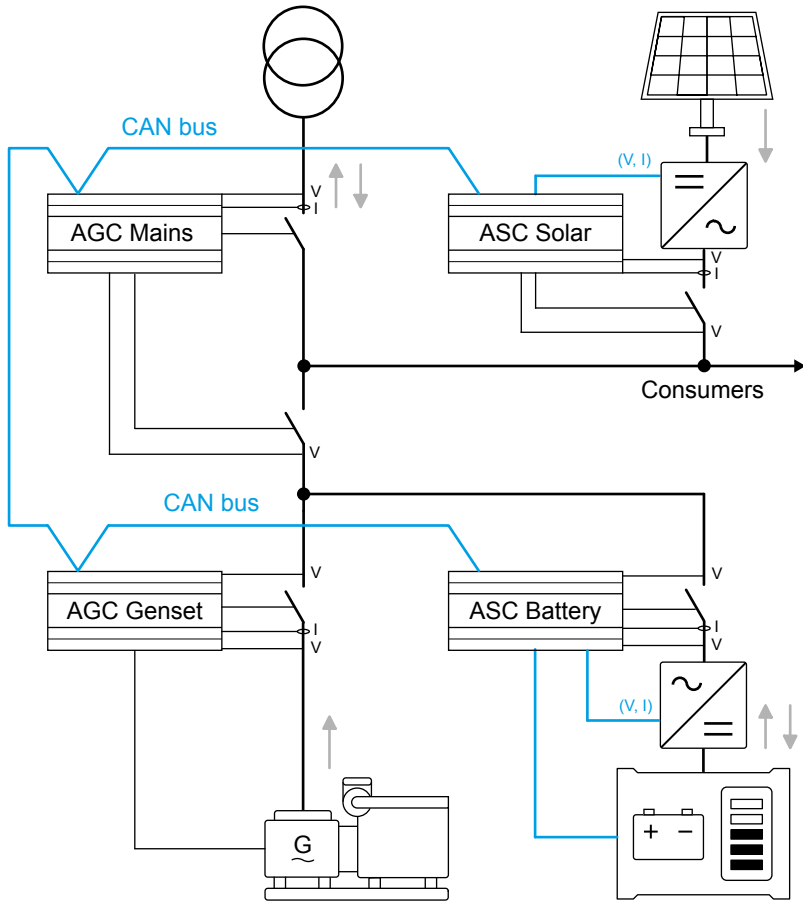
Grid-tied battery stand-alone application (brownfield or greenfield)

Grid-tied battery in a simple power management application (greenfield)

CAN bus

AGC Mains

Consumers

ASC Battery

(V, I)
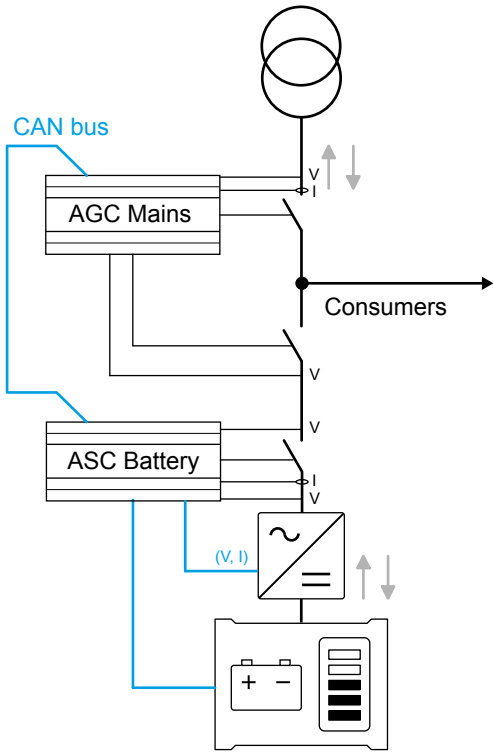
Battery controllers in a multi-mains application (greenfield)

AGC Mains

AGC Mains

CAN bus

AGC BTB

AGC Mains

CAN bus

ASC Battery

ASC Battery

ASC Battery

ASC Battery

(V, I)

(V, I)

(V, I)

(V, I)

Hybrid solar-battery grid-tied application (greenfield)
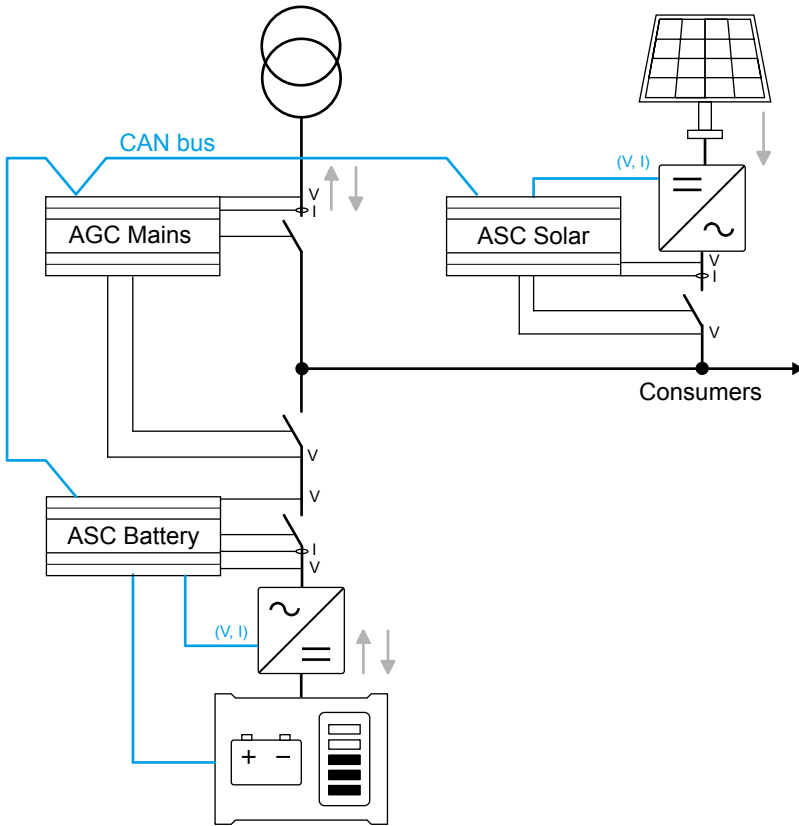
3.2 Off-grid

The ASC-4 Solar and ASC-4 Battery controllers provide flexibility for off-grid applications.
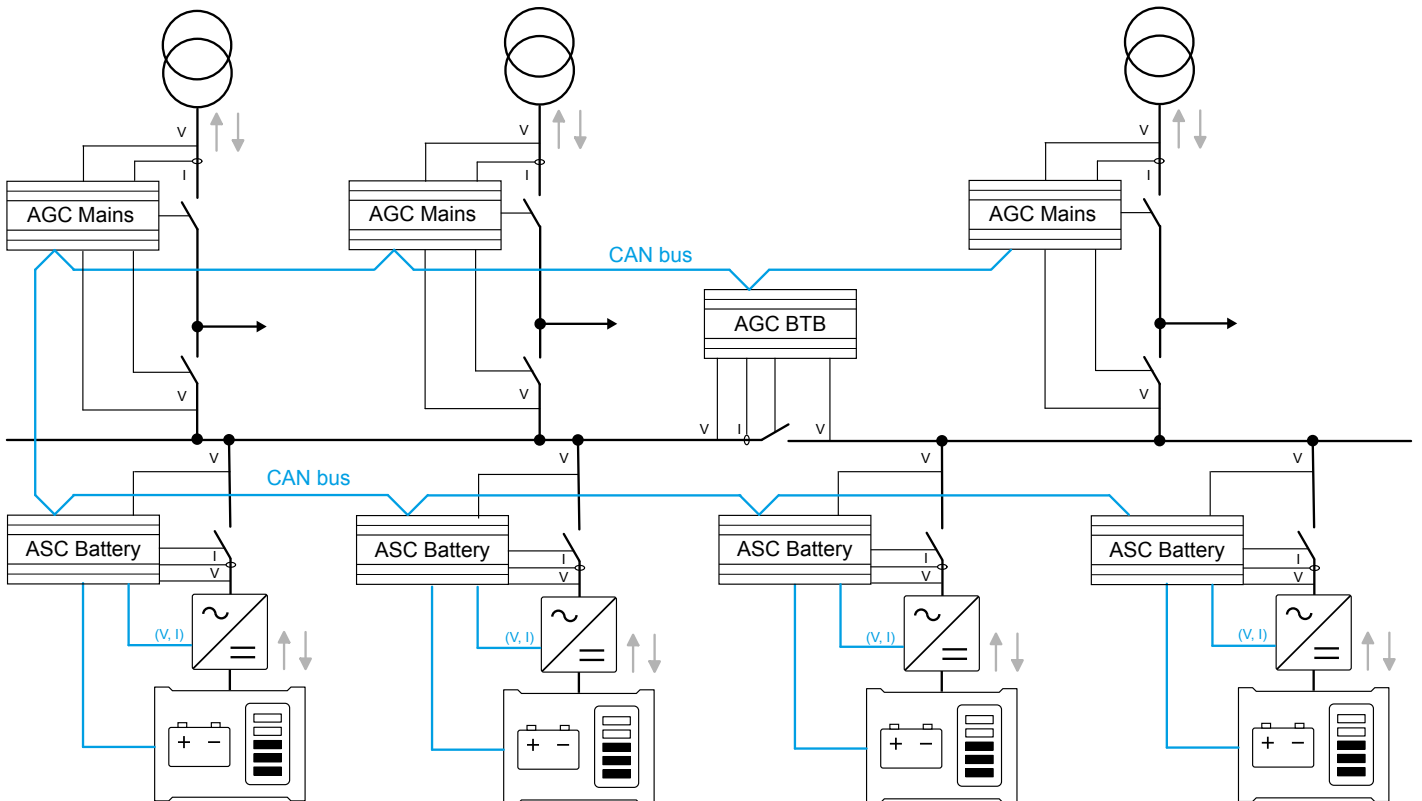
The ASC-4 Solar can work with AGC controllers to combine a PV power plant with a genset power plant. Alternatively the ASC-4 Solar can be stand-alone controller that calculates the power set points for the PV power plant based on power readings and breaker positions.

The ASC-4 Battery can supply peak loads while gensets start to improve power quality. If the ESS is designed to supply the busbar load, the ASC-4 Battery can work with AGC controllers to allow the ESS to be the only source connected to the busbar.

Stand-alone with genset(s) and solar (greenfield)

CAN bus

ASC Solar

(V, I)

V
I

V

Consumers

V

ASC Genset

I
V

G
~
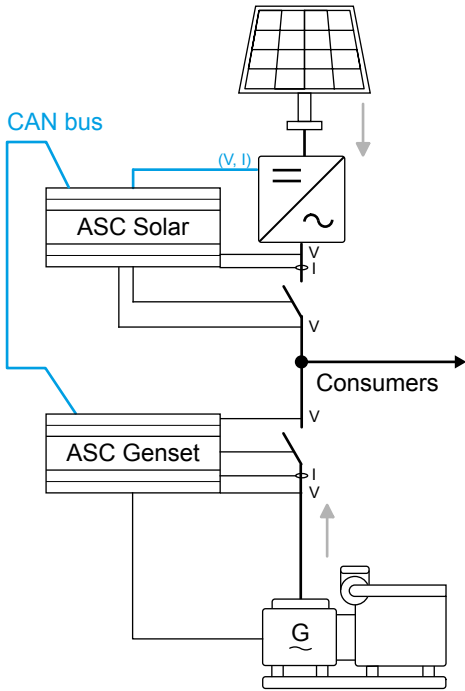
Stand-alone with genset(s), solar and battery (greenfield)

CAN bus

ASC Solar

(V, I)

V
I

V

Consumers

V

AGC Genset

I
V

V

ASC Battery

I
V

(V, I)

G
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+ −
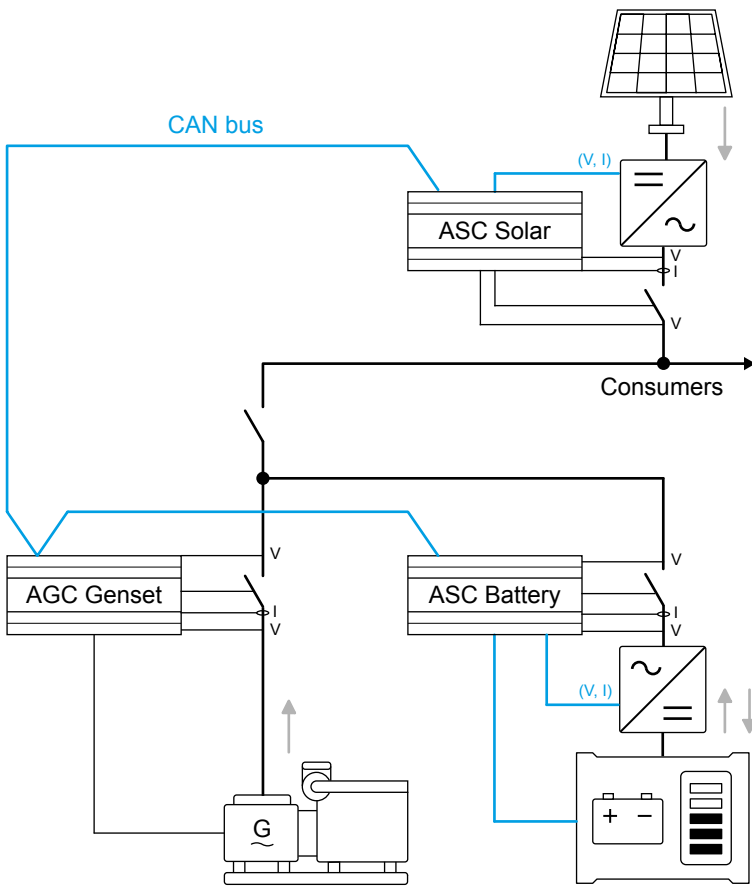
Stand-alone battery (brownfield or greenfield)
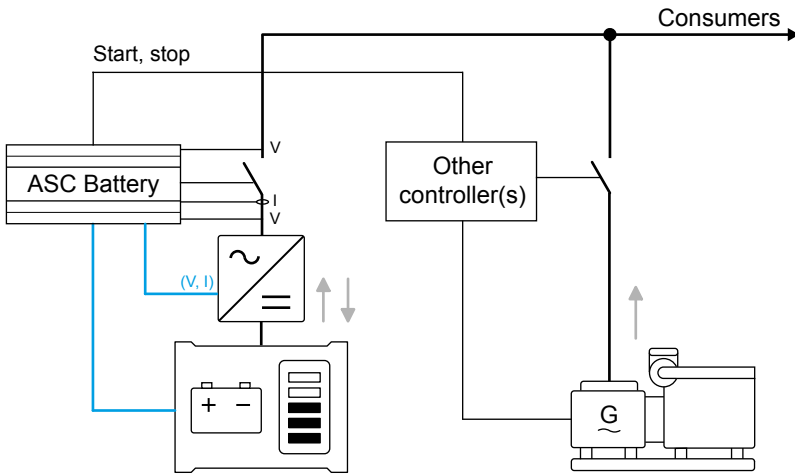
Stand-alone with solar and battery (greenfield)
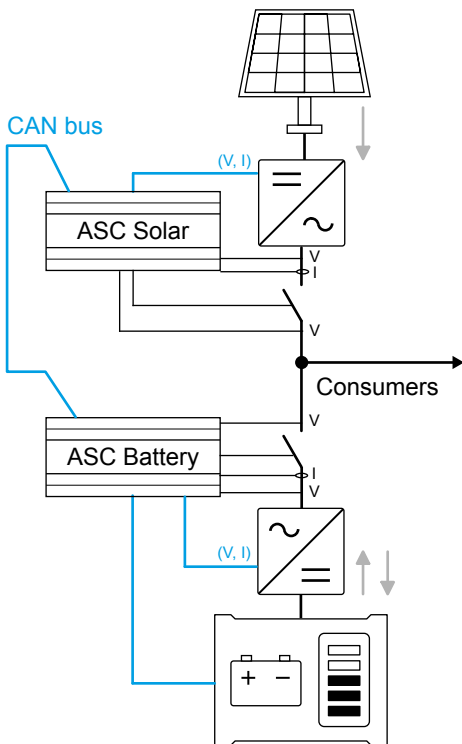
3.3   Communication protocols

3.3.1   Compatibility and compliance

DEIF hybrid controllers are compatible with photovoltaic and battery systems from a wide range of manufacturers.

SunSpec compliance

All DEIF hybrid controllers are compliant with the SunSpec standards (see sunspec.org). DEIF controllers are therefore compatible with new inverters that use the generic SunSpec protocol.

Testing

Many PV inverter makers and battery system makers use the same protocol for a wide range of their products. New PV inverters and battery systems often comply with the older protocol. If a specific inverter or battery management system is not listed here, but the maker is listed, there is a good chance that the DEIF controller is compatible.

If your PV inverter or Battery system is not listed, DEIF can help to confirm compliance using the Modbus protocol documentation.

Implementing new protocols

Since new photovoltaic and battery 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.

3.3.2 List of supported protocols

The ASC-4 Solar supports a wide range of PV systems, power meters, weather stations, and forecast systems.

The ASC-4 Battery supports a wide range of BMS, BCU, ESS, and PCS protocols.

> **More information**
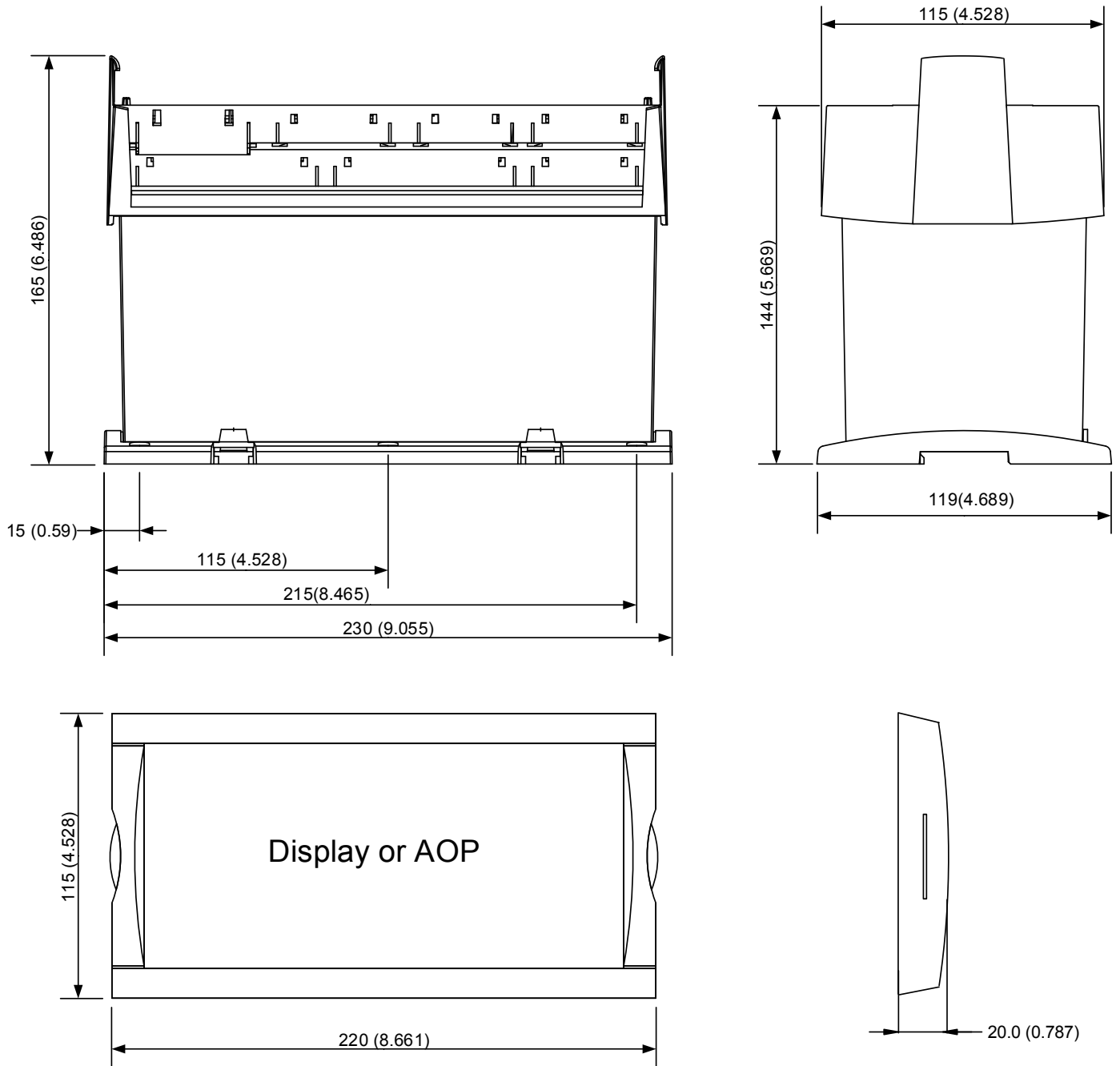> See the **Application note, DEIF hybrid controller compatibility**.

4. Technical information

4.1 Technical specifications

Accuracy	Class 1.0 -25 to <u>15 to 30</u> to 70 °C Temperature coefficient: ±0.2 % of full scale per 10 °C Class 0.5 with option Q1 Averaged frequency: +/-10 mHz, 15 to 30 °C, 45 to 65 Hz Positive, negative and zero sequence alarms: Class 1 within 5 % voltage unbalance Class 1.0 for negative sequence current Fast over-current: 3 % of 350 %*In Analogue outputs: Class 1.0 according to total range Option EF4/EF5: Class 4.0 according to total range To IEC/EN 60688
Operating temperature	-25 to 70 °C (-13 to 158 °F) -25 to 60 °C (-13 to 140 °F) if Modbus TCP/IP (option N) is available in the controller (UL/cUL Listed: Max. surrounding air temperature: 55 °C/131 °F)
Storage temperature	-40 to 70 °C (-40 to 158 °F)
Climate	97 % RH to IEC 60068-2-30
Operating altitude	0 to 4000 m above sea level Derating 2001 to 4000 m above sea level: Max. 480 V AC phase-phase 3W4 measuring voltage Max. 690 V AC phase-phase 3W3 measuring voltage
Measuring voltage	100 to 690 V AC ±20 % (UL/cUL Listed: 600 V AC phase-phase) Consumption: Max. 0.25 VA/phase
Measuring current	-/1 or -/5 A AC (UL/cUL Listed: from CTs 1 to 5 A) Consumption: Max. 0.3 VA/phase
Current overload	$4 \times I_n$ continuously $20 \times I_n$, 10 sec (max. 75 A) $80 \times I_n$, 1 sec (max. 300 A)
Measuring frequency	30 to 70 Hz
Aux. supply	Terminals 1 and 2: 12/24 V DC nominal (8 to 36 V DC operational). Max. 11 W consumption Battery voltage measurement accuracy: ±0.8 V within 8 to 32 V DC, ±0.5 V within 8 to 32 V DC @ 20 °C Terminals 98 and 99: 12/24 V DC nominal (8 to 36 V DC operational). Max. 5 W consumption 0 V DC for 10 ms when coming from at least 24 V DC (cranking dropout) The aux. supply inputs are to be protected by a 2 A slow blow fuse. (UL/cUL Listed: AWG 24)
Digital inputs	Optocoupler, bi-directional ON: 8 to 36 V DC Impedance: 4.7 kΩ OFF: <2 V DC
Analogue inputs	-10 to +10 V DC: Not galvanically separated. Impedance: 100 kΩ (G3) 0(4) to 20 mA: Impedance 50 Ω. Not galvanically separated (M15.X)
Multi-inputs	0(4) to 20 mA: 0 to 20 mA, ±1 %. Not galvanically separated Digital: Max. resistance for ON detection: 100 Ω. Not galvanically separated Pt100/1000: -40 to 250 °C, ±1 %. Not galvanically separated. To IEC/EN60751 RMI: 0 to 1700 Ω, ±2 %. Not galvanically separated V DC: 0 to 40 V DC, ±1 %. Not galvanically separated

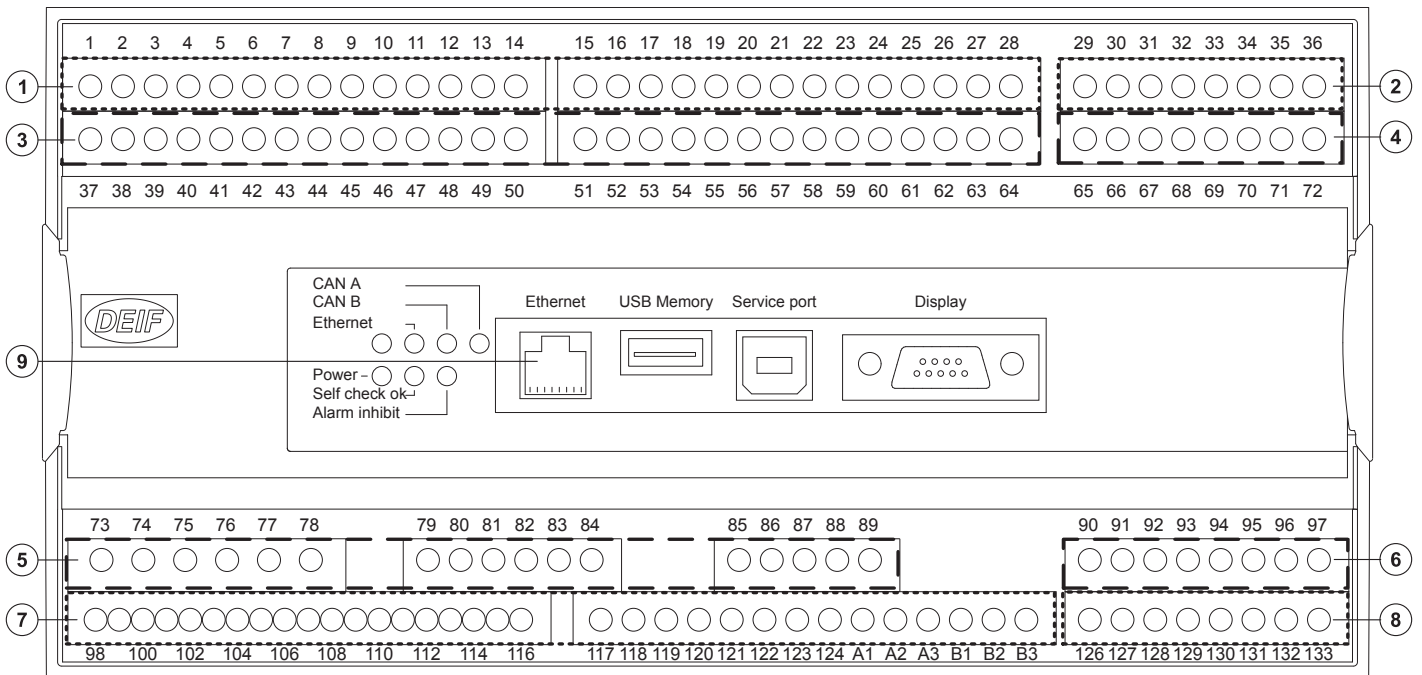|	
Relay outputs	Electrical rating: 250 V AC/30 V DC, 5 A. (UL/cUL Listed: 250 V AC/24 V DC, 2 A resistive load) Thermal rating @ 50 °C: 2 A: Continuously. 4 A: t_{on} = 5 sec, t_{off} = 15 sec (Unit status output: 1 A)
Open collector outputs	Supply: 8 to 36 V DC, max. 10 mA (terminal 20, 21, 22 (com))
Analogue outputs	0(4) to 20 mA and ±25 mA. Galvanically separated. Active output (internal supply). Load max. 500 Ω. (UL/cUL Listed: Max. 20 mA output) Update rate: Transducer output: 250 ms. Regulator output: 100 ms
Galvanic separation	Between AC voltage and other I/Os: 3250 V, 50 Hz, 1 min Between AC current and other I/Os: 2200 V, 50 Hz, 1 min Between analogue outputs and other I/Os: 550 V, 50 Hz, 1 min Between digital input groups and other I/Os: 550 V, 50 Hz, 1 min
Response times (delay set to min.)	**Mains/Busbar** Over-/under-voltage: <50 ms Over-/under-frequency: <50 ms **Inverter/Power converter** Over-current: <250 ms Over-/under-voltage: <250 ms Over-/under-frequency: <350 ms Overload: <250 ms **Other** Digital inputs: <250 ms Emergency stop: <200 ms Multi-inputs: 800 ms Wire failure: <600 ms
Mounting	DIN rail mount or base mount with six M4 screws Tightening torque: 1.5 Nm for the six M4 screws (countersunk screws are not to be used)
Safety	To EN 61010-1, installation category (over-voltage category) III, 600 V, pollution degree 2 To UL 508 and CSA 22.2 no. 14-05, over-voltage category III, 600 V, pollution degree 2
EMC/CE	To EN 61000-6-2, EN 61000-6-4, IEC 60255-26
Vibration	3 to 13.2 Hz: 2 mm$_{pp}$. 13.2 to 100 Hz: 0.7 g. To IEC 60068-2-6 & IACS UR E10 10 to 58.1 Hz: 0.15 mm$_{pp}$. 58.1 to 150 Hz: 1 g. To IEC 60255-21-1 Response (class 2) 10 to 150 Hz: 2 g. To IEC 60255-21-1 Endurance (class 2) 3 to 8.15 Hz: 15 mmpp. 8.15 - 35 Hz 2g. To IEC 60255-21-3 Seismic (class 2)
Shock (base mount)	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 Endurance (class 2) 50 g, 11 ms, half sine. To IEC 60068-2-27
Bump	20 g, 16 ms, half sine. To IEC 60255-21-2 (class 2)
Material	All plastic materials are self-extinguishing according to UL94 (V1)
Plug connections	AC current: 0.2 to 4.0 mm^2 stranded wire. (UL/cUL Listed: AWG 18) AC voltage: 0.2 to 2.5 mm^2 stranded wire. (UL/cUL Listed: AWG 20) Relays: (UL/cUL Listed: AWG 22) Terminals 98-116: 0.2 to 1.5 mm^2 stranded wire. (UL/cUL Listed: AWG 24) Other: 0.2 to 2.5 mm^2 stranded wire. (UL/cUL Listed: AWG 24) Tightening torque: 0.5 Nm (5-7 lb-in) Display: 9-pole D-sub female Tightening torque: 0.2 Nm Service port: USB B

Protection	Unit: IP20. Display: IP40 (IP54 with gasket: Option L). (UL/cUL Listed: Type Complete Device, Open Type). To IEC/EN 60529
Approvals	UL/cUL Listed to UL508 Applies to VDE-AR-N 4105 See www.deif.com for the most recent approvals.
UL markings	Wiring: Use 60/75 °C copper conductors only Mounting: For use on a flat surface of type 1 enclosure Installation: To be installed in accordance with the NEC (US) or the CEC (Canada) **AOP-2** Maximum ambient temperature: 60 °C Wiring: Use 60/75 °C copper conductors only Mounting: For use on a flat surface of type 3 (IP54) enclosure. Main disconnect must be provided by installer Installation: To be installed in accordance with the NEC (US) or the CEC (Canada) **DC/DC converter for AOP-2** Wire size: AWG 22-14 Tightening torque: 0.5 Nm (4.4 lb-in) Panel door mounting: 0.7 Nm D-sub screw: 0.2 Nm
Weight	Base unit: 1.6 kg (3.5 lbs) Option J1/J4/J6/J7: 0.2 kg (0.4 lbs) Option J2: 0.4 kg (0.9 lbs) Option J8: 0.3 kg (0.58 lbs) Display: 0.4 kg (0.9 lbs)

4.2   Unit dimensions in mm (inches)

115 (4.528)

165 (6.486)

144 (5.669)

15 (0.59)

115 (4.528)

215 (8.465)

230 (9.055)

119 (4.689)

115 (4.528)

Display or AOP

220 (8.661)

20.0 (0.787)

5. Hardware and software

5.1 Overview and options

① : The numbers in the drawing above refer to the slot numbers shown in the table below.

Slot #	Option/standard	Description
1		**Terminal 1-28, power supply**
	Standard	8 to 36 V DC supply, 11 W; 1 × status output relay; 5 × relay outputs; 2 × pulse outputs (kWh, kvarh or configurable open collector outputs); 5 × digital inputs
2		**Terminal 29-36, communication**
	Standard (H2.2)	Modbus RTU (RS-485). Can work as slave or as master for inverter communication.
3		**Terminal 37-64, inputs/outputs**
	M12	13 × digital inputs; 4 × relay outputs
4		**Terminal 65-72, inputs/outputs**
	E2	2 × 0(4) to 20 mA outputs, transducer
	M13.4	7 × binary inputs
	M14.4	4 × relay outputs
5		**Terminal 73-89, AC measuring**
	Standard	3 × PV/ESS current; 3 × PV/ESS voltage + N; 3 × busbar voltage + N
6		**Terminal 90-97, inputs/outputs**

Slot #	Option/standard	Description
	F1	2 × 0(4) to 20 mA outputs, transducer
	M13.6	7 × digital inputs
	M14.6	4 × relay outputs
	M15.6	4 × 4 to 20 mA inputs
7		**Terminal 98-124-A1-A3-B1-B3, communication, inputs/outputs**
	M4	8 to 36 V DC supply; 3 × multi-inputs; 7 × digital inputs; 4 × relay outputs Power management communication, CAN port A and B
8		**Terminal 126-133, inputs/outputs**
	H2.8	Modbus RTU (RS-485). Can work as slave or as master for power meter communication.
	M13.8	7 × digital inputs
	M14.8	4 × relay outputs
	M15.8	4 × 4 to 20 mA inputs
9		**LED I/F**
	N	Modbus TCP/IP
Accessories		
		AOP-1
		DU-2
Additional options		
	G5	Power management
	I1	System emulation
	Q1	Class 0.5 calibration
	T1	Critical power
	W1	One-year extended warranty
	W2	Two-year extended warranty
	W3	Three-year extended warranty

NOTE   There can only be one hardware option in each slot. For example, it is not possible to select option H2.8 and option M13.8 at the same time, because both options require a PCB in slot 8.

6. Ordering information

6.1 Order specifications

Variants

Type	Options specification				
Type	**Option**	**Option**	**Option**	**Option**	**Option**

Example:

Type	Options specification				
Type	**Option**	**Option**	**Option**	**Option**	**Option**
ASC-4 Solar	M14.4	M13.6	M15.8		

6.2 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.

6.3 Software version

This document is based on ASC-4 software version 4.21.