DATA SHEET

ASC Plant Management

Automatic Sustainable Controller

1. General information

- PV/diesel applications
- Self-consumption, IPP applications
- Meteorological data measuring
- Inverter monitoring
- SunSpec master and slave interface

SW version: 1.02.0 or later

1.1 Automatic Sustainable Controller, Plant Management

The Automatic Sustainable Controller, Plant Management (ASC PM) is a controller designed to serve as a link between sustainable power plants and genset plants, combining them so they work as one common hybrid plant.

The concept of the ASC PM is to maximise sustainable power penetration, depending on the total load demand to the hybrid without compromising constraints such as minimum genset load demand.

2. Application information

2.1 ASC PM Solar

The ASC PM Solar is the variant designed for PV control, and it enables integration of PV power and genset power.

2.1.1 Basic rule of operation

The PV plant is handled as a base loading power- and reactive power provider, not as a voltage- and frequency provider. Therefore, the ASC PM only operates the PV in case either utility or a genset constitutes a grid to which the PV can dispatch power.

2.1.2 Minimum genset load

A minimum genset load constraint is available in the ASC PM. The constraint applies in off-grid operation only. This constraint will cause the PV penetration to decrease if it is compromised. This is to secure a certain amount of load on the gensets and in this way eliminate the risk of reverse power situations and impure combustion and exhaust problems. In grid-tied operation the minimum genset load must be handled locally by each individual genset.

2.1.3 Spinning reserve

Settings for determination of the necessary spinning reserve in the genset plant are included. The spinning reserve is towards the power that is produced by the PV plant. Hence the settings determine how much spinning reserve the genset plant should keep to compensate for a potential decrease in PV production. Spinning reserve applies to power management applications only.

2.1.4 Power ramp

To avoid potential oscillations in the hybrid, the ASC PM provides both active and reactive power ramp-up/ramp-down functionality. This is to be able to control the rate of change of power references for the PV plant and thereby provide the genset plant time to adapt to the changes in the PV production.

2.2 Application types

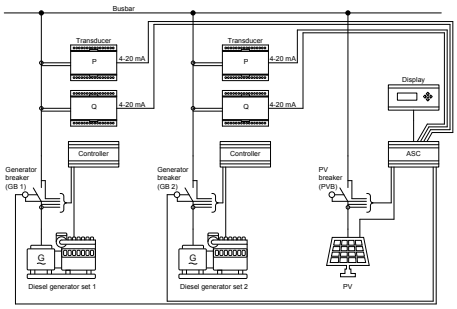
The ASC PM supports two types of applications:

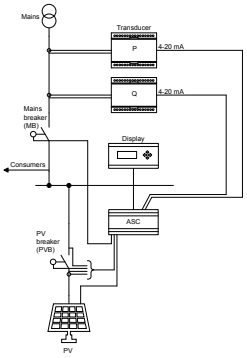
- Stand-alone applications
- Power management applications

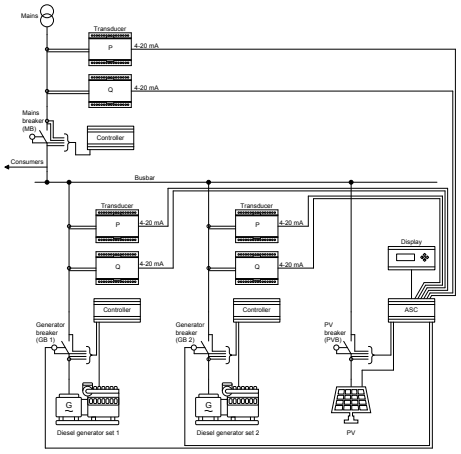
The ASC PM comes with the maximum capability built in, which means that the ASC PM can do both types of applications without any program or firmware change.

2.2.1 Stand-alone applications

In stand-alone solutions, the ASC PM does not have much information about the surrounding environment in which it is located. Based on transducer power readings and hardwired feedbacks alone, the ASC PM determines the power references to the PV plant. This approach can be applied to integrate PV power in already commissioned genset plants, whether they are equipped with DEIF controllers or not. The ASC PM can do both pure off-grid, pure grid-tied and a combination of the two.







The maximum capability of the stand-alone applications is 16 gensets, one mains and one PV plant.

The ASC PM supports four different plant modes:

- Island mode
- Fixed power mode
- Mains power export mode
- Peak shaving mode

Island mode:

When the ASC PM is in island mode and only gensets are connected to the busbar, the PV power references are determined on the basis of genset power and reactive power transducer readings alone. The active power reference is maximised to the limit dictated by the minimum genset load constraint. If the gensets are either in reverse power state or being overloaded, the power ramp will be skipped. For reactive power, it can be selected whether the PV plant should contribute with reactive power production to have the PV plant match the same cos phi as the genset plant, or whether the PV plant should not contribute with reactive power at all. In any case, if gensets are driven outside of their capability, the PV plant will pick up the surplus of reactive power. If the PV plant itself is driven outside of its capability, it can be selected whether to prioritise active or reactive production.

Fixed power mode:

When the ASC PM is in fixed power mode and either mains or genset is connected to the busbar, the PV power reference is determined by the fixed power reference setting in the ASC PM. If mains is connected to busbar, the reactive power reference is determined by the reactive power reference setting in the ASC PM and may depend on the mains reactive power transducer reading, if the selected reactive reference method dictates it.

The ASC PM can take in external active and reactive power references. The references can be applied as hardwired signals or via communication. This makes the ASC PM suitable for IPP applications as well.

If only gensets are connected, the minimum genset load constraint will be observed and power ramps will be skipped if the gensets are either in reverse power state or being overloaded. It can be selected whether the PV plant should contribute with reactive power production to have the PV plant match the same cos phi as the genset plant, or whether the PV plant should not contribute with reactive power at all. In any case, if gensets are driven outside of their capability, the PV plant will pick up the surplus of reactive power. If the PV plant itself is driven outside of its capability, it can be selected whether to prioritise active or reactive production.

Mains power export and peak shaving mode:

When the ASC PM is in mains power export or peak shaving mode and a mains is connected to the busbar, the PV power reference is determined by a combination of reference setting in the ASC PM and the mains power transducer reading. The reactive power reference is determined by the reactive power reference setting in the ASC PM and may depend on the mains reactive power transducer reading, if the selected reactive reference method dictates it. When the mains power export mode is used, the ASC PM

is able to keep both zero active power and zero reactive power across the point of connection. This makes the ASC PM suitable for self-consumption applications as well.

If only gensets are connected, the minimum genset load constraint will be observed and power ramps will be skipped if the gensets are in reverse power state. It can be selected whether the PV plant should contribute with reactive power production to have the PV plant match the same cos phi as the genset plant, or whether the PV plant should not contribute with reactive power at all. In any case, if gensets are driven outside of their capability, the PV plant will pick up the surplus of reactive power. If the PV plant itself is driven outside of its capability, it can be selected whether to prioritise active or reactive production.

The ASC PM can be operated in Auto mode or in Semi mode.

Auto mode:

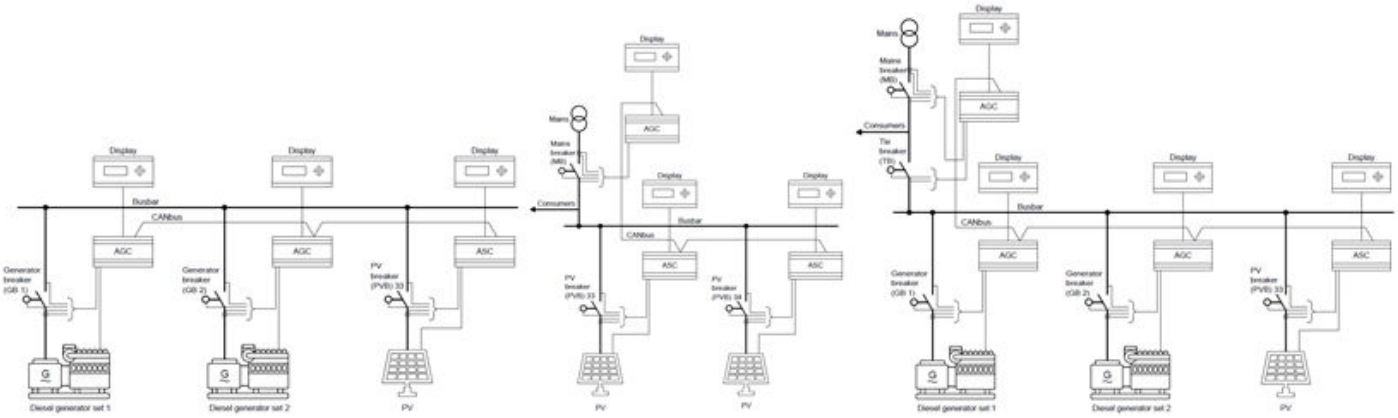
When the ASC PM is in auto mode, it can be started if the PVB is closed by means of the auto start/stop input, or via auto start/stop Modbus commands. The PVB will be closed if either mains or any genset is connected to the busbar, applying suitable voltage and frequency.

Semi mode:

When the ASC PM is in semi mode, the PVB can be opened/closed manually by means of the ASC PM display buttons, or remotely via digital inputs or Modbus commands. If the PVB is closed, and if either mains or any genset is connected to the busbar, applying suitable voltage and frequency, the PV plant can be started/stopped manually by means of the ASC PM display buttons, or remotely via digital inputs or Modbus commands.

2.2.2 Power management applications

In the DEIF power management solution, the ASC PM is fully integrated in the DEIF Application Configuration and SuperVision PC tool. The ASC PM is connected to the CAN bus that constitutes the internal DEIF power management communication link. For that reason, this approach is only applicable if the genset plant is equipped with AGC PM controllers from DEIF. The DEIF power management system fully integrates the PV plant and the genset plant. The ASC PM can do both pure off-grid, pure grid-tied and a combination of the two.



The maximum capability of the power management applications is 32 gensets/mains and eight PV plants.

The ASC PM supports five different plant modes:

- Island mode
- Fixed power mode
- Mains power export mode
- Peak shaving mode
- Power management mode

Island mode:

The same functionality as described in the paragraph "Stand-alone applications", except that the power and reactive power data from gensets and mains are received on the internal communication link.

Fixed power mode:

The same functionality as described in the paragraph "Stand-alone applications", except that the power and reactive power data from gensets and mains are received on the internal communication link.

Mains power export and peak shaving mode:

The same functionality as described in the paragraph "Stand-alone applications", except that the power and reactive power data from gensets and mains are received on the internal communication link.

Power management mode:

When the ASC PM is in power management mode, the overall mode is determined by the genset plant. It will follow the mode of the mains unit(s) if such is (are) present in the application, or - if not - it will be forced into island mode.

In case only gensets are connected to the busbar, the PV references are determined on the basis of genset power and reactive power data received on the internal communication link. The active power reference is maximised to the limit dictated by the minimum genset load constraint. If the gensets are either in reverse power state or being overloaded, the power ramp will be skipped. For reactive power, it can be selected whether the PV plant should contribute with reactive power production to have the PV plant match the same cos phi as the genset plant, or whether the PV plant should not contribute with reactive power at all. In any case, if gensets are driven outside of their capability, the PV plant will pick up the surplus of reactive power. If the PV plant itself is driven outside of its capability, it can be selected whether to prioritise active or reactive production.

If mains is connected to the busbar, the PV power reference is received from the genset plant via the internal communication link. The reactive power reference is determined by the reactive power reference setting in the ASC PM and may depend on the mains reactive power, if the selected reactive reference method dictates it. The reactive power reference can also be received from the genset plant if this is preferred.

The AGC PM Mains can take in external active and reactive power references. The references can be applied as hardwired signals or via communication. This makes the system suitable for IPP applications as well. When the mains power export mode is used in the AGC PM Mains, it enables the system to keep zero power across the point of connection. This makes the system suitable for self-consumption applications as well.

The ASC PM can be operated in Auto mode or in Semi mode.

Auto mode:

When the ASC PM is in auto mode, it will close the PV breaker and start the PV plant whenever suitable voltage and frequency are present on the busbar and:

- at least one genset in auto mode is connected to the busbar, **or**
- a mains is connected to the busbar and auto start is applied on the AGC PM mains unit.

Semi mode:

When the ASC PM is in semi mode, the PVB can be opened/closed manually by means of the ASC PM display buttons, or remotely via digital inputs or Modbus commands. If the PVB is closed, and if either mains or any genset is connected to the busbar, applying suitable voltage and frequency, the PV plant can be started/stopped manually by means of the ASC PM display buttons, or remotely via digital inputs or Modbus commands.

2.3 Inverter interfacing

The ASC PM offers protocol interface to the inverters listed below:

- FSC SMA
- DEIF Open
- SunSpec Generic
- SunSpec SMA
- SunSpec Fronius
- ConextCL Schneider Electric
- TRIO ABB
- PRO-33 ABB
- PVS800 ABB
- E-series Gamesa Electric
- Sungrow 10-60SG
- Delta RPI
- Huawei SUN2000 8-28
- Huawei SUN2000 33-40
- Huawei smart-logger
- Goodwe DT series
- Cluster controller SMA
- iMars BG series INVT

All the listed interfaces are Modbus-based.

Interfaces where the ASC PM serves as the slave are available both as Modbus RTU (requires option H2) and as Modbus TCP.

Interfaces where the ASC PM serves as the master are available as Modbus RTU only (requires option H2). For Modbus TCP interfacing, an external Modbus RTU to Modbus TCP gateway such as HD67510 from ADFWeb is required.

FSC SMA is a protocol designed for interfacing to the Fuel Save Controller provided by SMA Solar Technology AG. The ASC PM serves as the slave.

DEIF Open is a protocol designed by DEIF, where the ASC PM serves as the slave.

SunSpec Generic is a generic implementation of the SunSpec standardised protocol. It enables interfacing to any inverter, supporting both monitoring and control via SunSpec. When selected, the ASC PM will initially identify the SunSpec map in the inverter before it goes into normal operation. The ASC PM serves as the master.

SunSpec SMA is a protocol where the SunSpec map is preset according to the maker-specific protocol and the ASC PM will not need to initially identify it, as opposed to the SunSpec Generic. The ASC PM serves as the master.

SunSpec Fronius is a protocol where the SunSpec map is preset according to the maker-specific protocol and the ASC PM will not need to initially identify it, as opposed to the SunSpec Generic. The ASC PM serves as the master.

ConextCL Schneider Electric is a protocol designed for interfacing to the ConextCL inverter series provided by Schneider Electric. The ASC PM serves as the master.

TRIO ABB is a protocol designed for interfacing to the TRIO inverter series provided by ABB. The ASC PM serves as the master.

PRO-33 ABB is a protocol designed for interfacing to the PRO-33 inverter provided by ABB. The ASC PM serves as the master.

PVS800 ABB is a protocol designed for interfacing to the PVS800 inverter series provided by ABB. The ASC PM serves as the master.

Sungrow 10-60SG is a protocol designed for interfacing to the string inverter series provided by Sungrow. The ASC PM serves as the master.

Delta RPI is a protocol designed for interfacing to the RPI inverter series provided by Delta. The ASC PM serves as the master.

Huawei 8-28 is a protocol designed for interfacing to the 8-28 string inverter series provided by Huawei. The ASC PM serves as the master.

Huawei 33-40 is a protocol designed for interfacing to the 33-40 string inverter series provided by Huawei. The ASC PM serves as the master.

Huawei smart-logger is a protocol designed for interfacing to the smart-logger provided by Huawei. The ASC PM serves as the master.

Goodwe DT series is a protocol designed for interfacing to the DT string inverter series provided by Goodwe. The ASC PM serves as the master.

Cluster controller SMA is a protocol designed for interfacing to the STP inverter series from SMA. The ASC PM serves as the master.

iMars BG series INVT is a protocol designed for interfacing to the iMars BG string inverter series provided by INVT. The ASC PM serves as the master.

In addition to applying the active and reactive control references, the ASC PM can be set up to poll data from the inverters as well. The ASC PM can include a maximum of 42 inverters in its monitoring scheme. The polled data is made available in a designated Modbus map for a SCADA system to read out.

2.4 Weather station

The ASC PM offers the possibility of connecting sensors for weather-related measurements such as Plane of Array irradiation sensors, Back of Module temperature sensors, and so on. Based on these readings, the ASC PM will calculate the instantaneous maximum power that can be generated by the PV plant. If the circumstances dictate that the ASC PM curtails the PV power production, throttle counters will increase and thus reveal the amount of unutilised PV power. The readings are presented in the display and are available via Modbus for a SCADA system to read out.

2.5 Monitoring

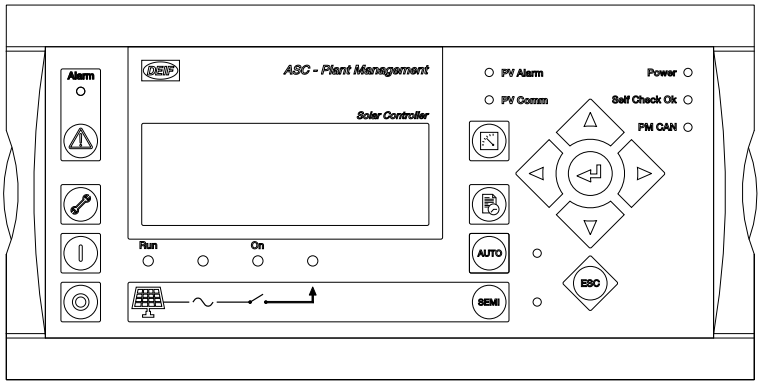
The ASC PM already offers Modbus slave functionality with a substantial proprietary protocol, including the inverter monitoring data and weather-related measurements described above. In addition to the proprietary protocol, a SunSpec map has been added to provide a standardised Modbus slave interface to PV SCADA systems. In the SunSpec map, the complete PV plant is treated as an entity. Even though the PV plant may consist of multiple string inverters, it will be aggregated power contribution from each inverter that gives the total PV production which can be read out from the ASC PM SunSpec map.

The following SunSpec models are included in the SunSpec Slave support:

- C001: Common model
- I103: Inverter model
- I120: Name plate model
- I121: Inverter controls basic settings model
- I122: Inverter controls extended measurements and status model
- I123: Immediate control model
- E302: Irradiation model
- E303: Back of module temperature model
- E307: Base meteorological model
- End model

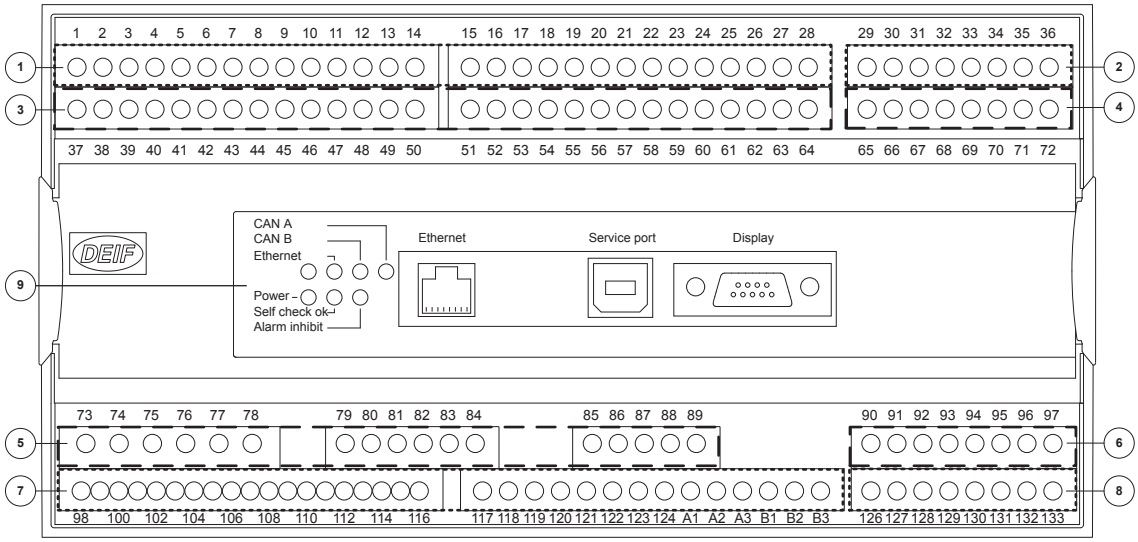
3. Display layout

3.1 ASC PM Solar display



4. Hardware, software and options

4.1 Hardware, software and options, ASC PM controller



(1) : The numbers in the drawing above refer to the slot numbers indicated 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 comm.
	M13.2	7 × binary inputs
	M14.2	4 × relay outputs
3		**Terminal 37-64, inputs/outputs**
	Standard (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 79-89, AC measuring**
	Standard	3 × PV voltage; 3 × busbar voltage
6		**Terminal 90-97, inputs/outputs**
	F1	2 × 0(4) to 20 mA outputs, transducer

Slot #	Option/standard	Description
	M13.6	7 × digital inputs
	M14.6	4 × relay outputs
	M15.6	4 × 4 to 20 mA inputs
7		**Terminal 98-125, communication, inputs/outputs**
	Standard (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 comm.
	M13.8	7 × digital inputs
	M14.8	4 × relay outputs
	M15.8	4 × 4 to 20 mA inputs
9		**Terminal 73-78, LED I/F AC measuring**
	Standard	3 × PV current
	Standard (N)	Modbus TCP/IP
Standard accessories		
		AOP-1
		DU-2
Additional options		
	W1	One-year extended warranty
	W2	Two-year extended warranty
	W3	Three-year extended warranty

INFO
There can only be one hardware option in each slot. For example, it is not possible to select option H2 and option M13.2 at the same time, because both options require a PCB in slot #2.

5. Technical information

5.1 Specifications and dimensions

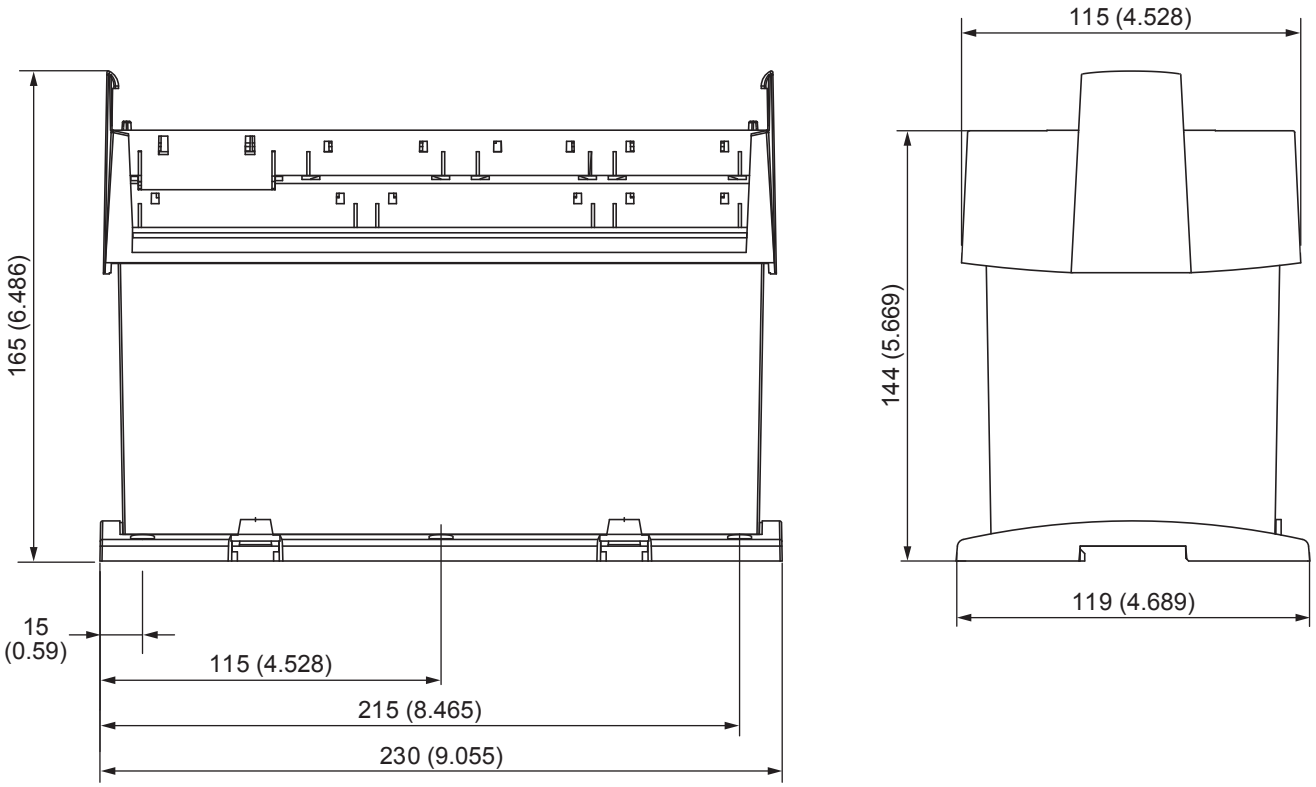
5.1.1 Technical specifications

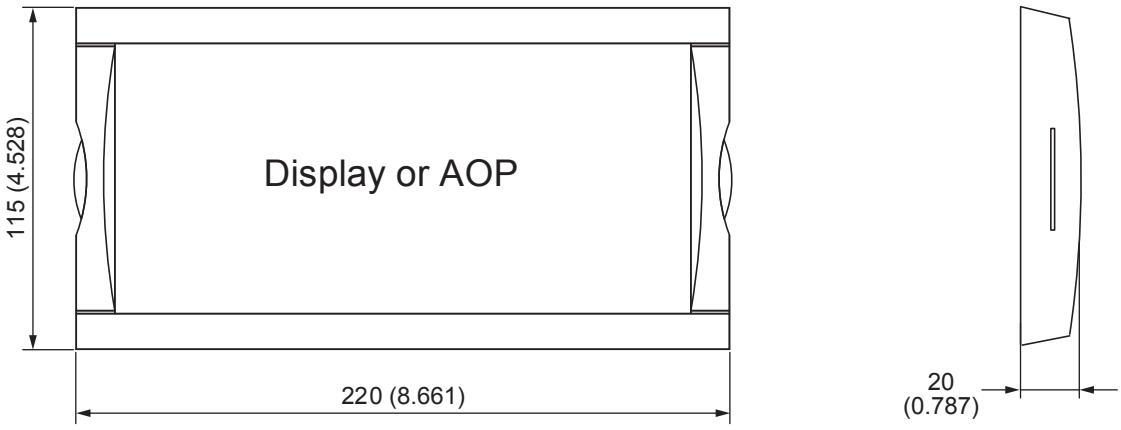
Accuracy	Class 0.5 -25 to 15 to 30 to 70 °C Temperature coefficient: ±0.2 % of full scale per 10 °C Positive, negative and zero sequence alarms: Class 1 within 5 % voltage unbalance Class 1.0 for negative sequence current Fast over-current: 3 % of 350 %*In Analogue outputs: Class 1.0 according to total 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 × I_n continuously 20 × I_n, 10 sec (max. 75 A) 80 × 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)
Binary 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 Binary: 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 binary input groups and other I/Os: 550 V, 50 Hz, 1 min
Response times (delay set to min.)	**Busbar:** Over-/under-voltage: <50 ms Over-/under-frequency: <50 ms Voltage unbalance: <250 ms **Inverter:** Over-current: <250 ms Over-/under-voltage: <250 ms Over-/under-frequency: <350 ms Overload: <250 ms Digital inputs: <250 ms Emergency stop: <200 ms Multi-inputs: 800 ms Wire failure: <600 ms
Mounting Tightening torque	DIN rail mount or base mount with six M4 screws 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 60 Hz: 0.15 mm_{pp}. 60 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)
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 Tightening torque Tightening torque	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) 0.5 Nm (5-7 lb-in) Display: 9-pole Sub-D female 0.2 Nm Service port: USB A-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
UL markings Tightening torque	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 0.5 Nm (4.4 lb-in) Panel door mounting: 0.7 Nm Sub-D 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)

5.1.2 Dimensions in mm (inches)




115 (4.528)
Display or AOP
220 (8.661)
20
(0.787)

6. Ordering information

6.1 Order specifications and disclaimer

6.1.1 Order specifications

Variants

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

Example:

Type	Options specification				
Type	**Option**	**Option**	**Option**	**Option**	**Option**
ASC PM Solar	H2	M14.4	M13.6	M15.8	

6.1.2 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.