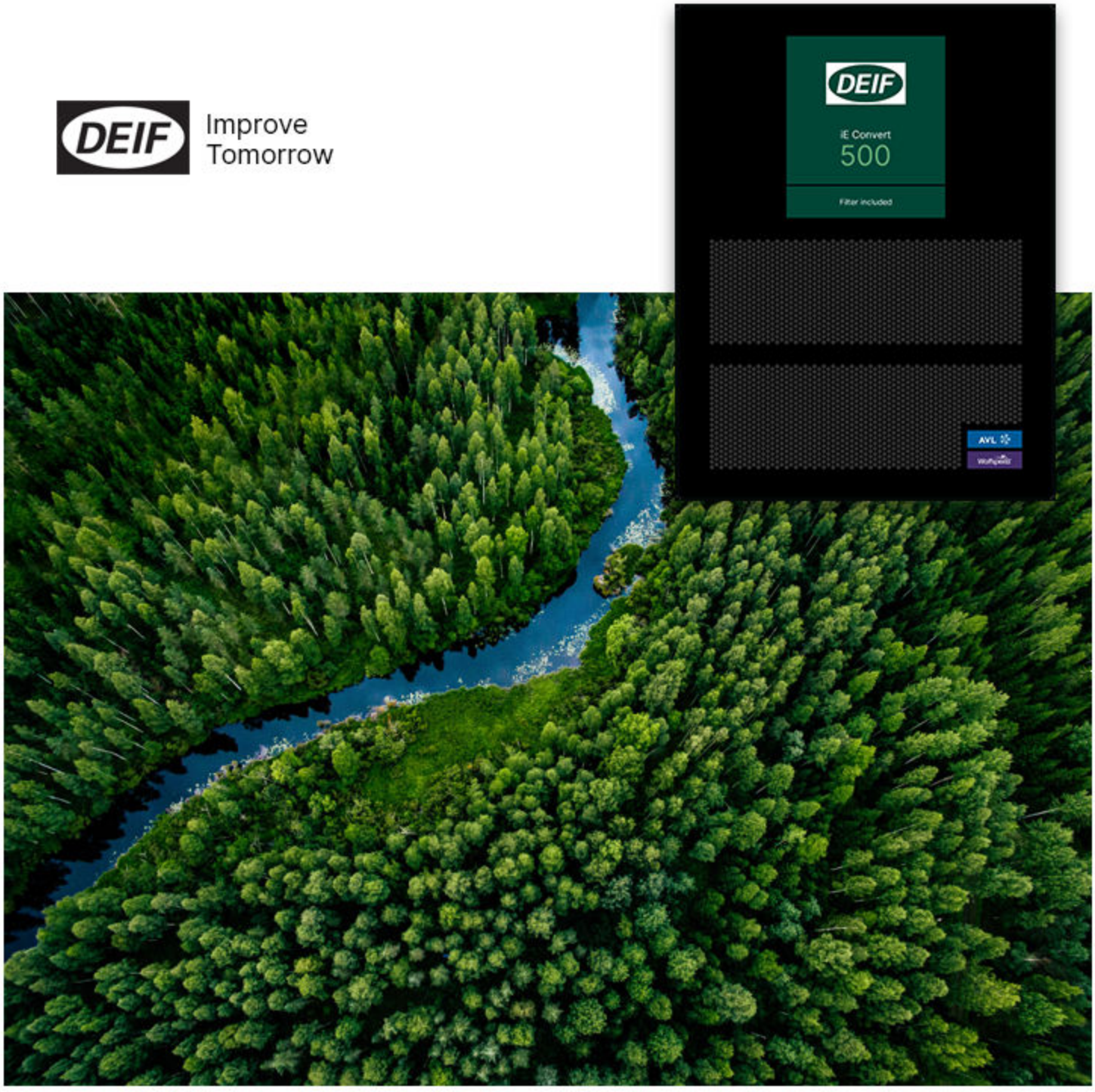
iE Convert

4921270002A

500 kVA AC/DC converter

Data sheet

Improve
Tomorrow



1. iE Convert

2. Technical specifications

3. Compatible products

4. Legal information

1. iE Convert

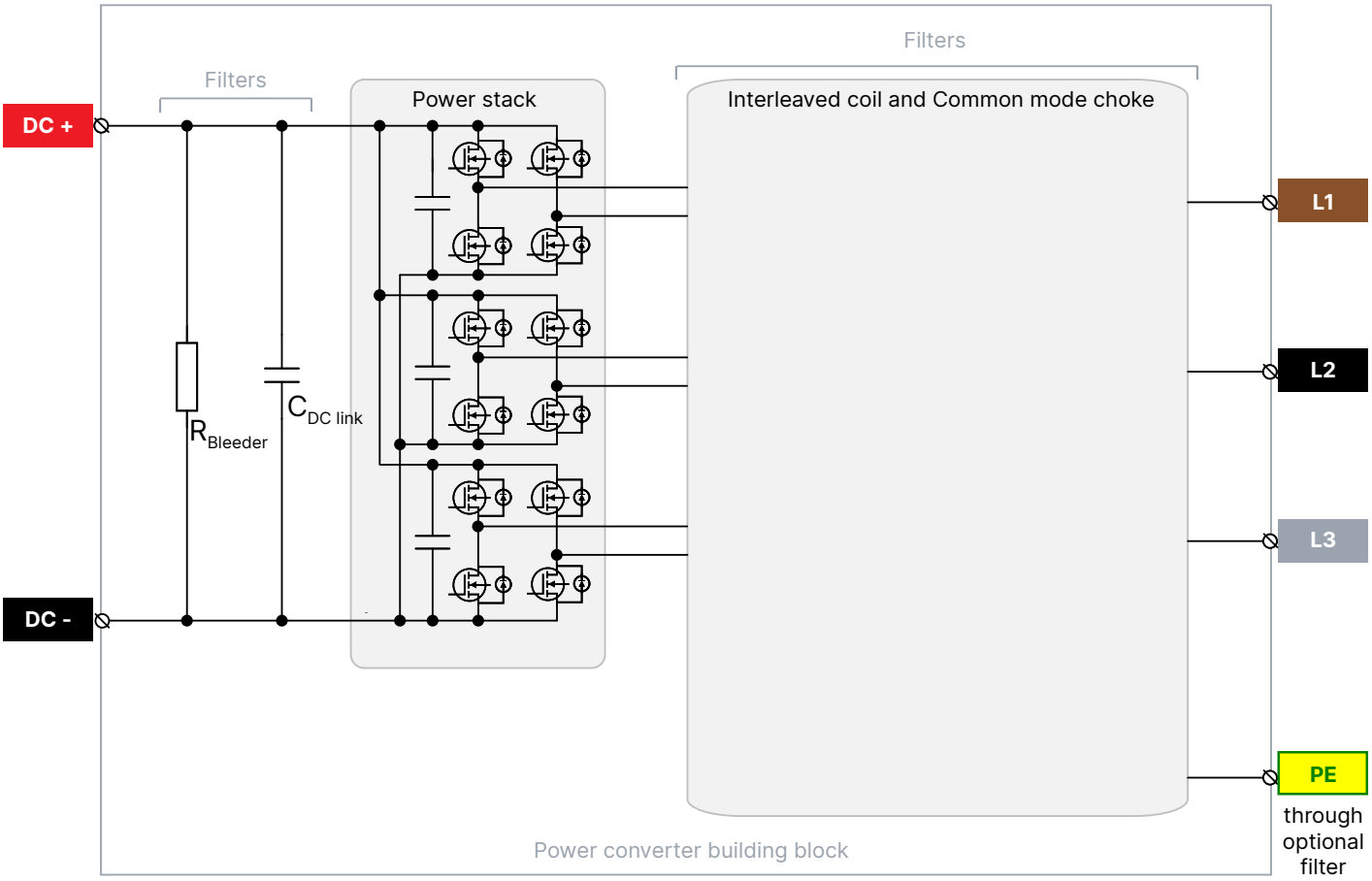
1.1 About the iE Convert 500 kVA AC/DC converter

The iE Convert 500 kVA AC/DC converter is a bidirectional power converter. It can be used in a wide variety of applications, including Active Front End (AFE), microgrid, and battery charging applications. The iE Convert converts AC to DC (and vice versa), with controllable power flow and low harmonic distortion. The converters can be used to improve the power factor and for harmonic mitigation.

The iE Convert uses SiC module power switching technology. This results in a more compact design with a very high efficiency. The iE Convert is liquid cooled.

Power converter electrical diagram

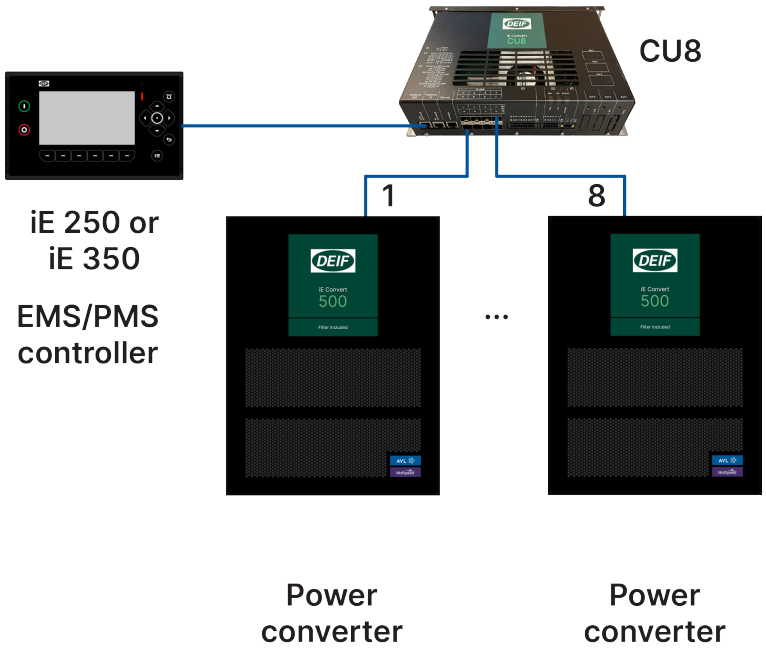
This electrical diagram shows the operation and parts of the power converter.



1.1.1 Power converter control

The power converter building blocks are controlled by a CU8 controller. One CU8 controller controls up to eight iE Convert power converters. For one CU8 controller, the power converters can be in two groups, which have different applications. The CU8 controller allows the power converters to run in parallel, which allows higher power capacity and/or redundancy.

For easy connectivity and configuration, you can connect the CU8 controller to a DEIF controller. For energy/power management (EMS/PMS) functions, and connections to external interfaces, you can use a DEIF iE 250 or iE 350 controller. If you want to use a PLC, you can use the DEIF iE 250, iE 350, or iE 650 PLC. Alternatively, you can use another EMS/PMS controller or PLC brand.



More information
See the **CU8 controller Data sheet**.

1.1.2 Flexible packages

DEIF supply

	Package A Components: Power stack and filters	Package B Power converter building blocks	Package C Complete IP2X power converters
Tested power stacks, filters, capacitor boards, chokes, and so on	●		
With covers			●
Assembled and tested power converter building blocks		●	●
Reference designs	●	●	●

Customer responsibilities

	Package A Components: Power stack and filters	Package B Power converter building blocks	Package C Complete IP2X power converters
Assemble the power converter building blocks	●		
I/O test the power converter building blocks	●		
Suitable containment	●	●	
Connection to a chiller	●	●	●
Energy management system*	●	●	●
Protection products*	●	●	●

NOTE * The DEIF energy management system and protection products are recommended.

1.1.3 Software versions

The information in this document relates to software version:

Software	Details	Version
CU8*	CU8 controller	1.x.x

NOTE * The CU8 writes application software to the power converters.

1.1.4 Easy configuration

Select the power converter building blocks that your application(s) require. You can then use the CU8 controller to select the power converter application(s) and the parameters.

For faster and easy integration, you can use a DEIF iE 250 or iE 350 controller for energy/power management (EMS/PMS). For PLC control, you can use the DEIF iE 250, iE 350 or iE 650 PLC.

1.2 Functions and features

	Functions
Bidirectional	• Rectifier: Convert AC power to DC power • Inverter: Convert DC power to AC power
Modularity	Connect up to eight power converters for higher capacity
Redundancy	Supports individual power converters, and clusters of power converters • Example: A CU8 controller with two groups of power converters • Example: Redundant/parallel systems, each with a CU8 controller and two groups of power converters
Features	Very dynamic FPGA-based control loop
	Active front end (AFE), grid-following, and PQ mode
	Microgrid, grid-forming, and VF mode
	Transition between grid-forming and grid-following
	Black start (from 0 V, 0 Hz)
	Battery charging and discharging
	Inertia for grid frequency stabilisation
	High-frequency supply, up to 400 Hz
Applications	Export power to grid
	Battery energy storage system (BESS)
	Frequency converter
	Ground power units (GPU) for aircraft
	Shore power to ships
	Connect gensets to a DC grid
Local control	Optional multi-line display with function keys (for example, using iE 250)
Other DEIF products	One-click integration

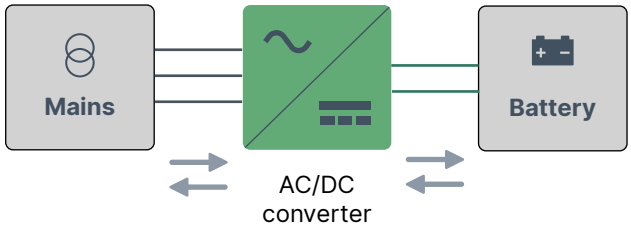
1.3 Application examples

More information
See the iE Convert Land Application Guide and the iE Convert Marine Application Guide for more application examples.

Battery systems

The power converter converts AC power to DC to charge the battery. When power is required from the battery, the power converter converts DC power to AC.

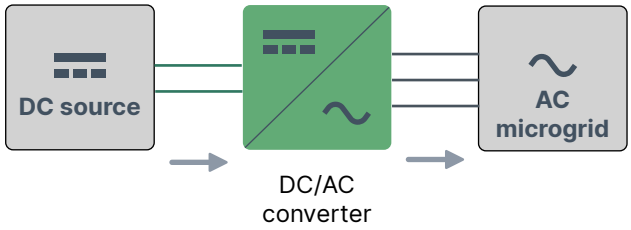
The battery increases the system efficiency, since it can be charged using excess power. The battery also increases the system robustness, since it can discharge when demand surges.



Microgrid

The power converter converts power from a DC source to AC power. The AC power then supplies a microgrid.

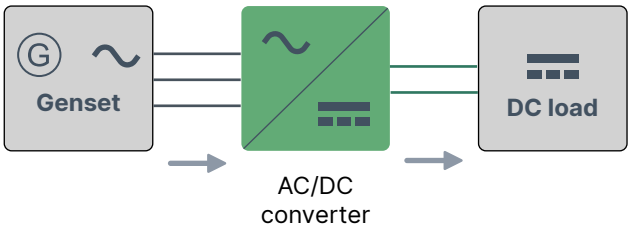
The DC/AC converter is grid-forming. That is, the microgrid runs at the required voltage and frequency, without the need for another AC power source.



Active front end (AFE) and genset

The power converter converts AC power from a genset to DC power.

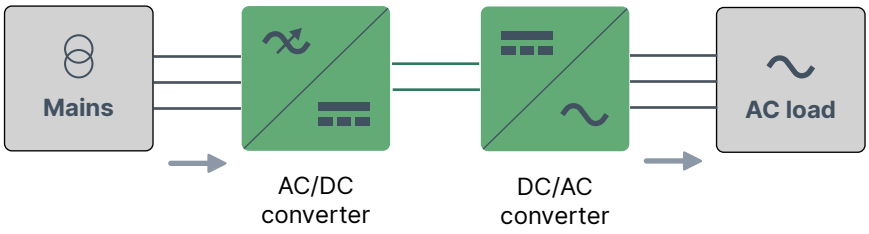
Through the power converter, the genset can supply the DC power alone. The genset is not a variable speed generator. Alternatively, the genset and power converter can supplement other DC power sources.



Shore power connection

Convert any shore power voltage and frequency to supply the voltage and frequency required onboard.

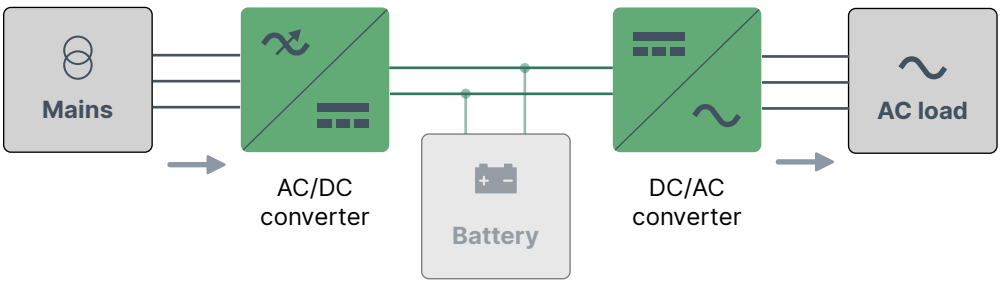
If galvanic separation is required, a DC//DC galvanic separation converter can be installed between the AC/DC converter and the DC/AC converter.



Aviation high frequency ground power unit

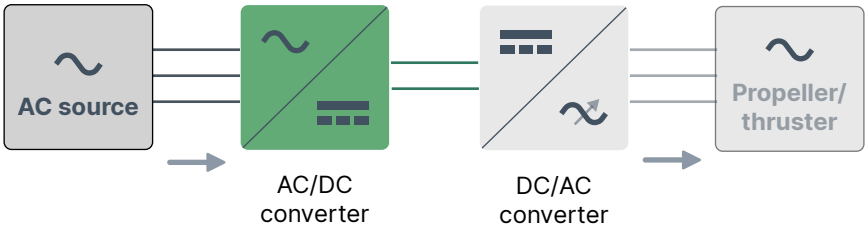
The power converter converts 50 Hz or 60 Hz AC power to 400 Hz AC power.

For critical power applications, a battery can be installed between the AC/DC converter and the DC/AC converter.



Supply DC power for a propeller or thruster drive

The power converter converts AC power to DC power. The DC power can then be used by another power converter to drive a propeller or thruster.



NOTE The standard configuration for all applications is 3-phase, 3-wire AC wiring. On request, 3-phase, 4-wire AC wiring is available.

2. Technical specifications

2.1 Electrical specifications

	Maximum 1200 V DC
Efficiency	Peak efficiency (stack and filter): 98 %
Apparent power	480 kVA (at nominal voltage) • V_{line} = 690 V and I_{line} = 402 A
Power quality, DC link to AC line, at 20 kHz	Voltage total harmonic distortion: < 5 % Single voltage harmonic distortion: < 3 %
Power quality, AC line to DC link, at 20 kHz	Maximum ripple voltage: < 2 % RMS Maximum ripple current: < 2 % RMS
Overload current	110 % of nominal current for 2 s, over 60 s
Short circuit current	< 100 kA
DC link	
Nominal voltage	1100 to 1200 V
Operating voltage range	550 to 1200 V
Maximum voltage	1350 V (transient)
Nominal current	436 A at 1100 V
DC link-side capacitance (inside the converter)	52 µF
AC line	
Nominal voltage	690 V AC (± 10 %) (at full power)
Operating voltage range	208 to 690 V AC (± 10 %)
Nominal current	402 A at 690 V
Nominal frequency	50 Hz/60 Hz (± 10 %) 400 Hz (± 10 %) (with derating)
AC phase configuration	Standard: 3-phase, 3-wire Optional: 3-phase, 4-wire (with neutral). Requires a separate filter.
Auxiliary supply	
Auxiliary supply	Voltage range: 12 to 36 V DC Nominal voltage: 24 V DC Power: 200 W Connector: D-sub
Standby power consumption (zero power output)	< 100 W

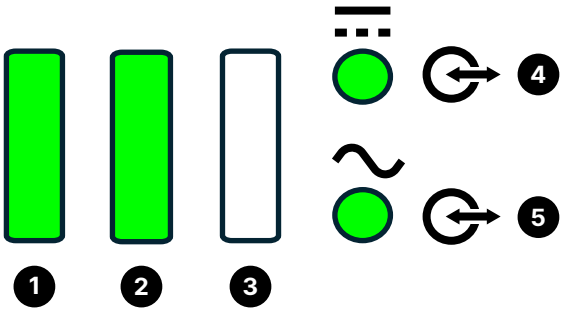
2.2 Alarms and protections

Protections
Hardware over-current trip
Hardware over-voltage trip
Inverter temperature protection
Inverter temperature trip

Protections
Short circuit protection
External temperature measurement
Software over-current trip
Software over-voltage trip
Coolant leak
Voltage and load change response

2.3 HMI and display

Power converter LEDs



No.	Name	Function
1	Auxiliary power	Green: Power OK OFF: No power
2	Converter	Green: Converter OK OFF: Converter not running
3	Error	Red: Error OFF: No error
4	DC link	Green: DC link OK OFF: No DC voltage input
5	AC line	Green: AC line OK OFF: No AC voltage input

CU8 controller LEDs

Name	Function
Controller front	
Status LED	Green: Status OK
Safety chain LED	Green: Safety chain in okay, and RCM okay. Orange: Safety chain in okay, and RCM not okay. Orange: Safety chain in not okay, and RCM not okay.

Name	Function
EtherCAT status	Green: Okay Green and orange flashing: Transmission error Red: Not okay OFF: Initialising
EtherCAT	Red: Transmission error
Communication connections	
EtherCAT connection (RJ45)	Green: Connection OK
Ethernet connection (RJ45)	Green: Connection OK Yellow: Activity
SFP+ connection (Enhanced small form-factor pluggable)	Green Red

Using an iE 7 display

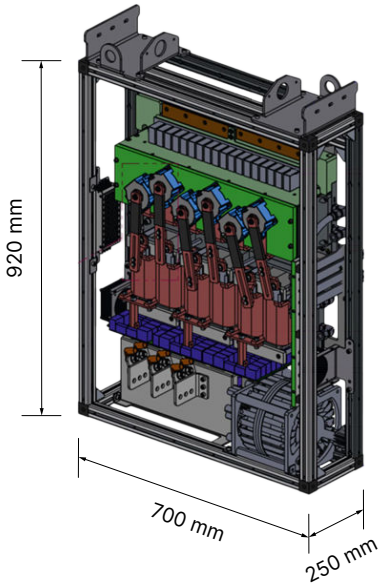
If you connect iE 250 or iE 350 to the CU8, you can use the iE 7 (the display for iE 250 or iE 350) to view the operation of the power converter(s). This configuration fulfils cybersecurity requirements.

CU8 controller display

You can connect a display to the CU8. This configuration does not fulfil cybersecurity requirements.

2.4 Dimensions and weight

iE Convert 500



Dimensions and weight	
Power converter (W x H x D)	700 mm x 920 mm x 250 mm
Cabinet	19" rack mount, 600 mm depth
Weight	< 150 kg

2.5 Mechanical specifications

Mechanical	
DC link	Busbars
AC line	Busbars
Input to control auxiliary power supply	Terminal block
Safety chain	2 inputs, 2 outputs
Breaker control	2 digital outputs
Design life	10 years
Mean time between failures (MTBF)	40000 hours

2.6 Environmental specifications

Operating conditions	
Ambient temperature	-20 to 60 °C, with derating over 50 °C (2.5 % per °C)
Altitude	0 to 2000 m, with derating from 1500 m
Humidity	95 % relative humidity, non-condensing

Storage conditions	
Ambient temperature	-20 to 70 °C
Altitude	Maximum 3000 m
Humidity	95 % relative humidity, non-condensing

Coolant	
Type	Antifrogen N-water mix: 25:75
Flow rate	16 litres/minute for each power converter
Maximum inlet temperature	40 °C, with derating above 35 °C (1 % per °C)
Minimum inlet temperature	20 °C
Pressure	Maximum: 3 bar Pressure drop: < 1.5 bar
Connectors	½", female quick connectors

Ratings	
Protection degree	IP2X
Pollution degree	II
Over-voltage category	III
Noise	<63 dB

2.7 Communication specifications

CU8 to iE 250/iE 350/iE 650 (or another controller)

Connections	Protocols
• Ethernet	• CANopen

Connections	Protocols
• CAN bus	• Modbus RTU • Modbus TCP

Power converter building blocks to CU8

Connection	Protocol
Fiber optic	EtherCAT

2.8 Grid codes

Standards
UL 1741 SB / IEEE 1547 (North America)
EN 50549-2 / VDE-AR-N 4110 (Europe)
AS/NZS 4777.2 (Australia/NZ for <200 kVA)

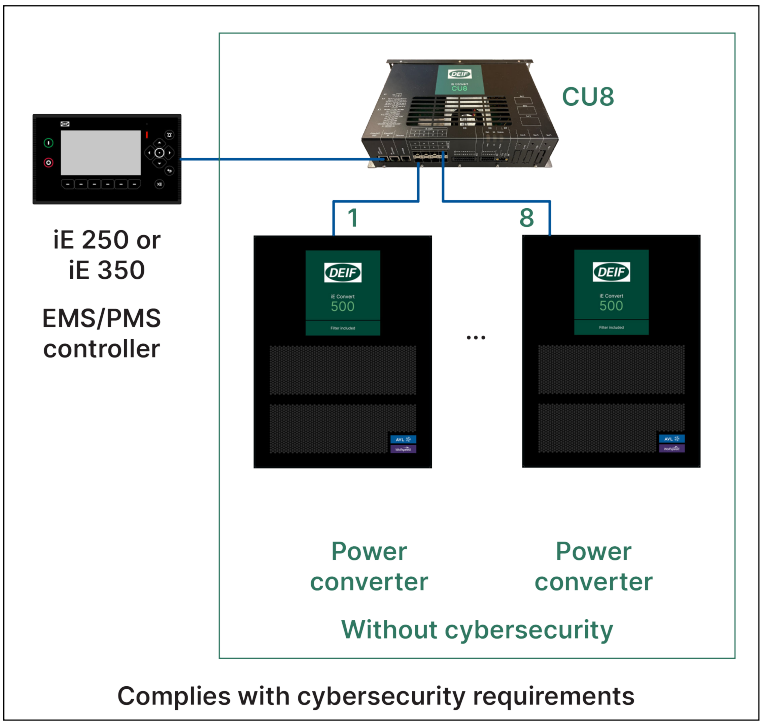
2.9 Approvals

Standards
Marine: DNV, ABS, LR, BV, CCS, KR, RINA and NK1
Land: CE to 61800-5-1, UL 6200

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

2.10 Cybersecurity

The power converters and the CU8 controller do not include cybersecurity features. However, if these are used with an iE 250, iE 350 or iE 650 to interface to the CU8, the whole system complies with cybersecurity requirements.



3. Compatible products

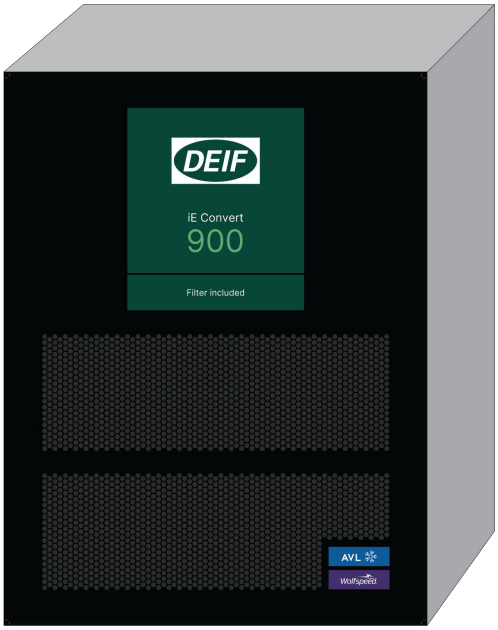
3.1 iE Convert power converters

iE Convert power converters are available for a range of specifications and applications.

Modules

iE 125

iE 500



iE 900

Applications

AC/DC

DC//DC GS

AC/DC Drive

DC/DC Buck-Boost

Voltage ratings

Maximum 850 V DC		Maximum 1500 V DC	
350 to 850 V DC	208 to 520 V AC	850 to 1500 V DC	400 to 690 V AC

3.2 Compatible equipment

Controllers with power management and cybersecurity

- iE 250 www.deif.com/products/ie-250
- iE 350 www.deif.com/products/ie-350
- iE 250 Marine www.deif.com/products/ie-250-marine
- iE 350 Marine www.deif.com/products/ie-350-marine

Controllers with power management

- iE 150 www.deif.com/products/ie-150
- iE 150 Marine www.deif.com/products/ie-150-marine
- AGC 150 www.deif.com/products/agc-150-generator

- AGC-4 Mk II www.deif.com/products/agc-4-mk-ii

PLCs with cybersecurity

- iE 250 PLC www.deif.com/products/ie-250-plc/
- iE 350 PLC www.deif.com/products/ie-350-plc/
- iE 650 PLC www.deif.com/products/ie-650-plc/

Isolation monitoring

- DC networks, ADL-111Q96 www.deif.com/products/adl-111q96
- AC networks, AAL-2 www.deif.com/products/aal-2

DC voltage measurement

iE Measure

Protection relays

Medium voltage relays, MVR-200 series www.deif.com/products/mvr-200-series/

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)

4. Legal information

4.1 Disclaimer and copyright

Preliminary information

The product described in this data sheet is still under development. All information is therefore preliminary.

Trademarks

DEIF and the DEIF logo are trademarks of DEIF A/S.
Bonjour® is a registered trademark of Apple Inc. in the United States and other countries.
*Adobe®, Acrobat®, and Reader®*are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.
CANopen® is a registered community trademark of CAN in Automation e.V. (CiA).
SAE J1939® is a registered trademark of SAE International®.
EtherCAT®, *EtherCAT P®*, *Safety over EtherCAT®*, are trademarks or registered trademarks, licensed by Beckhoff Automation GmbH, Germany.
VESA® and DisplayPort® are registered trademarks of Video Electronics Standards Assocation (VESA®) in the United States and other countries.
Google® and Google Chrome® are registered trademarks of Google LLC.
Modbus® is a registered trademark of Schneider Automation Inc.
Windows® is a registered trademark of Microsoft Corporation in the United States and other countries.

All trademarks are the properties of their respective owners.

Copyright

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.