GE VERNOVA

Power Conversion

# WIND FARM ELECTRIFICATION SOLUTIONS

www.gepowerconversion.com

# MEETING WIND ENERGY INDUSTRY CHALLENGES

**As the wind industry competes with traditional power generation, wind farm operators are faced with the challenges of controlling costs while attaining high energy yield through more powerful and reliable wind turbines, complying with rigorous grid rules, and ensuring efficient transfer of this intermittent energy source into the grid.**

Whether an onshore or offshore wind farm operation, large or small, GE Vernova's Power Conversion business can help you meet industry requirements.

Our proven electrification technologies and engineering solutions are readily available to help wind energy customers achieve optimized efficiency, reliability and availability, as well as grid compliance and stability.

Power Conversion's converter and generator technologies are recognized around the globe. With more than a century of expertise in the design, manufacture, installation and service of converters, and continuous commitment to innovation through investing in research and development, our converter technologies continue to grow and evolve with wind energy industry needs and long-term strategies.

## Lifecycle support for your installed base, for sustained efficiency and operability

Given the drive to reduce operations and maintenance spend and achieve an improved Levelized Cost of Energy (LCOE) in the energy market, efficient operation of wind assets is critical. Power Conversion offers lifecycle services which can help maximize uptime and improve energy production across wind farms. Our global presence, local footprint and responsiveness mean we can offer comprehensive service packages for electrical systems.

**Power Conversion's services program can be tailored to meet your needs to include:**

- Spares and replacement parts
- Onsite troubleshooting and repair services
- Retrofits, refurbishments and upgrades
- Customized training on site or at a GE Vernova facility
- 24/7 remote support via cyber-secured VISOR
- Preventive maintenance
- Service contracts

**Benefits of our support and services**

Engaging us to support your installed base can provide you:

- Optimized converter reliability and/or performance
- Reduced turbine down-time through on-time and expert support
- Customized management of your software updates - solely supported by Power Conversion
- Complete obsolescence management and support throughout converter's design life
- Secure and environmentally friendly delta packaging, for improved protection where handling at site may risk damage

## Providing original spare parts

**Holding the right spares in stock is vital for keeping your operations running efficiently, as well as avoiding long lead times and the unavailability of critical parts.**

As a leading OEM (Original Equipment Manufacturer), we commit to supporting your MV3000 converter installed base, offering genuine spares that can be purchased directly from us. We ensure all parts supplied are fully compatible for optimizing system reliability or performance (Fit-Form-Function), including obsolescence management.

Our experts can also work with you to build an **optimal spares strategy based on the criticality of each component for your specific operational process** and the related spares' delivery lead time.

- **Capital spare parts** - large spare parts can take a long time for delivery
- **Operational spare parts** - key parts for unplanned maintenance and upfront insurance is required
- **Maintenance spare parts** - key parts for planned maintenance, personalized by unit and by maintenance type
- **Spare parts packages** - commissioning spare parts packages / operational spare parts packages / insurance spare parts packages
- Recommended spare parts list
- Inventory refill
- Repair services
- Spare parts obsolescence management

## Performing repairs

**A repair requires appropriate special tools and technical knowledge as per specified standards**

Failure to follow these standards may increase risk of equipment failure due to lack of expertise, mishandling of tools or reuse of already damaged components. As part of our repair service, we will inspect and thoroughly test returned components and as far as site and customer information may allow, analyse probable cause for failure.

**We only reuse component parts that have been tested and confirmed to meet the required operating standards for reuse.**

As a starting point, to manage your outages better and/or minimize production disturbances, it is recommended to consider the capital and operational spare packages in the table below.

| Part | Type of part | Function | Risk in case of failure |
|---|---|---|---|
| **Rectifier** | Capital & operational parts | Conversion of AC to DC | Drive out of order |
| **DC** | Capital & operational parts | Storage and stabilization of electric energy | Voltage unbalancing, output power fluctuation, decrease of the power stacks lifetime, drive trip |
| **Inverter** | Capital & operational parts | Heart of drive technology | Drive out of order |
| **Cooling** | Capital & operational parts | Keep power stacks at working temperature | Drive out of order |

# Extending equipment life and accommodating power increase

At Power Conversion we are developing upgrade paths to enable wind energy customers to migrate to the latest RXi based control technology, that can help to increase converter life and reliability. The low-risk CDC to PECe upgrade solution not only simplifies your drive system, but also brings added flexibility for future enhancements and enables digital connectivity. Power Conversion is also developing new Delta Module Replacements (DMR) that are an enabler to potentially increasing the power output of wind turbines. The DMR is a fit-form-function replacement and offers higher reliability and an increase in turn off capability of up to 50%, in case of a failure event.

## The CDC to PECe upgrade

Modernization to the PECe platform can be a low cost option for replacement of CDC with PECeLite controller. This enables wind farm operators to keep systems up to date, without the need to undertake a complete system replacement. PECe provides improved core product security, establishes the foundation for meeting IEC 62443-3-2 Cyber Security requirements and helps ensure robust systems, networks and application protection. The PECe platform is the standard performance drive controller of choice for all Power Conversion's AC and DC drives, across the LV and MV power range. PECe can deliver a powerful, rugged and cost-effective configuration which works in stand-alone mode or with existing drive systems, to help meet stringent operational requirements.

## Upgrade benefits

- Modern control system with fast network access and enhanced security features
- Scalable performance, simplified upgrade process and futureproof modular configuration, based on a range of power stacks, I/O interfaces, and modern COMeCPU module
- Adaptability to new grid code regulation through software
- Remote monitoring and diagnostics capability via Power Conversion's Visor solution, enabling remote service support and providing automatic drive trip notification/trip history
- Reduced requirement for spares through use of modular control hardware configuration, enabling application for a wide range of drives
- Total lifecycle care through our global expert network and local presence

# Replacing your Delta Modules holds many advantages

**Over the last 25 years, Power Conversion has been a reliable provider of Delta modules for industrial drives, wind converters in renewable energy, and marine propulsion applications.**
**In order to consistently assist our customers in these dynamic markets even beyond the Delta product life, we have introduced an advantageous replacement solution.**

The LV3 Delta Module Replacement (DMR)* represents a significant advancement, offering a high current density and 3-phase liquid-cooled power module that serves as an effective upgrade to our existing MV3000 Liquid Cooled Delta (LCD) module range.

Designed with meticulous attention to detail, the LV3 DMR seamlessly integrates as a “Fit, Form and Function” replacement for MV3000 Liquid Cooled Delta (LCD) module range. Compatibility with the MV3000 CDC and PECe control interfaces, identical dimensions to the liquid-cooled DELTA modules, and matching electrical characteristics ensure a smooth transition.

**The DMR is available in two current ratings, 850A and 1000A, both at 690V, with the flexibility to achieve larger power ratings by connecting modules of the same rating in parallel. All familiar options and variants from the previous generation power modules remain available, maintaining consistency.**

Key components from the LCD, such as the reliable capacitor bank, sharing resistors, return pipe, bleed valve, fan assembly, mechanical support, and switch mode power supply (SMPS), have been seamlessly incorporated into the DMR, ensuring a seamless integration of proven elements.

The advantages of the DMR over the DELTA module are manifold.

With a proven operational history dating back to 2018, the DMR is expected to enhance reliability by 40% compared to DELTA modules, thanks to a more robust design. This improvement is driven by leveraging insights from our previous generation modules and an improved cooling concept. It is further impacted by using cutting edge semiconductors with a higher Save Operating Area (SOA) margin in all operating states. An enhanced lamination technique with improved isolation significantly reduce partial discharge issues. The LV3 DMR helps in reduction of losses, leading to improved efficiency and lower cooling requirements.

Opting for the DMR means an unchanged upgrade process, minimizing downtime as the rest of the system remains unaffected. Moreover, the identical characteristics of the DMR and DELTA module translate to minimal re-training requirements for site personnel, ensuring a seamless transition to the enhanced system. Embrace the future of power modules with the LV3 Delta Module Replacement, where innovation meets reliability.

## Key Advantages

**Proven operational excellence**
Field-tested since 2018, the LV3 DMR boasts a robust track record

**Enhanced Reliability**
Up to 40% improvement in reliability compared to DELTA modules, thanks to an optimized design incorporating practical field experiences and improved materials

**Efficiency Boost**
Experience improved overall system efficiency

LV3 DMR - your reliable and efficient upgrade solution.

* Reach out to us at services.powerconversion@ge.com to plan your replacement

# LV3 DMR 850A CDC

**Scalable. Flexible.Powerful.**

The LV3 DMR Power Stack is a high current density, liquid-cooled, power electronics module developed for a wide application range. It forms the basis of a modular, low voltage drive portfolio. Together with a scalable control architecture, the LV3 DMR Power Stack covers the range of sub- to multi-megawatt power conversion and variable frequency drive applications.

## LV3 DMR Key data summary

- ModernizationVoltage rating: 400–690V
- Maximum current: 850 Amps
- IGBT based power module
- 3-phase in-/output and DC link connections
- Grid or electric machine applications
- Liquid-cooled
- Weight: 115 kg

## Technical Specifications

| **Electrical Data** | |
|---|---|
| **Network type** | TN, TT, IT |
| **Voltage range** | 690 $V_{AC}$ +10% / -20% |
| **Current rating** | 850 $A_{rms}$ |
| **Overload** | 110% Full-load current for 10s/10min at $T_{in}$=50°C |
| **Supply frequency (nominal)** | 50Hz, 60Hz |
| **Output frequency range** | 20Hz to 200Hz, below on request |
| **Switching frequency** | 2,500Hz |
| **Interlock time** | 4.8µs |
| **DC Link** | |
| **Nominal voltage** | 1,100$V_{dc}$ |
| **Maximum voltage** | 1,200$V_{dc}$ (transient <100ms) |
| **Capacitance** | 11.6mF |
| **Capacitor bank cooling** | air-forced |
| **Environmental Data** | |
| **Max. operating temperature** | +55°C |
| **Min. operating temperature** | +5°C (non-condensing) |
| **Non-operational tempera-ture** | -20°C to +70°C |
| **Storage and transport** | -20°C to +60°C |
| **Coolant** | |
| **Type** | Water/Glycol mixture: 60%/40% |
| **Maximum voltage** | +60°C |
| **Capacitance** | +5°C, below on request |
| **Capacitor bank cooling** | 25 l/min (400mBar) |
| **Mechanical** | |
| **Dimensions** | 1,265mm H x 251mm W x 542mm D |
| **Weight** | 115kg |
| **IP rating** | IP00 |
| **Power terminals** | 2 studs M10 per AC phase<br>2 studs M10 per DC connec-tion |
| **Water connection in/out** | Return pipe/staubli with Ø22mm<br><br>Hosetails with Ø 22mm<br>Vent/return pipe/hosetails with Ø 22mm options |

# LV3 DMR 1000A CDC

**Scalable. Flexible.Powerful.**

The LV3 DMR Power Stack is a high current density, liquid-cooled, power electronics module developed for a wide application range. It forms the basis of a modular, low voltage drive portfolio. Together with a scalable control architecture, the LV3 DMR Power Stack covers the range of sub- to multi-megawatt power conversion and variable frequency drive applications.

## LV3 DMR Key data summary

- ModernizationVoltage rating: 400–690V
- Maximum current: 1000 Amps
- IGBT based power module
- 3-phase in-/output and DC link connections
- Grid or electric machine applications
- Liquid-cooled
- Weight: 115 kg

## Technical Specifications

| **Electrical Data** | |
|---|---|
| **Network type** | TN, TT, IT |
| **Voltage range** | 690 $V_{AC}$ +10% / -20% |
| **Current rating** | 1000 $A_{rms}$ |
| **Overload** | 110% Full-load current for 10s/10min at $T_{in}$=50°C |
| **Supply frequency (nominal)** | 50Hz, 60Hz |
| **Output frequency range** | 20Hz to 200Hz, below on request |
| **Switching frequency** | 2,500Hz |
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| **Nominal voltage** | 1,100$V_{dc}$ |
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| **Capacitor bank cooling** | air-forced |
| **Environmental Data** | |
| **Max. operating temperature** | +55°C |
| **Min. operating temperature** | +5°C (non-condensing) |
| **Non-operational tempera-ture** | -20°C to +70°C |
| **Storage and transport** | -20°C to +60°C |
| **Coolant** | |
| **Type** | Water/Glycol mixture: 60%/40% |
| **Maximum voltage** | +60°C |
| **Capacitance** | +5°C, below on request |
| **Capacitor bank cooling** | 25 l/min (400mBar) |
| **Mechanical** | |
| **Dimensions** | 1,265mm H x 251mm W x 542mm D |
| **Weight** | 115kg |
| **IP rating** | IP00 |
| **Power terminals** | 3 studs M10 per AC phase<br>2 studs M10 per DC connec-tion |
| **Water connection in/out** | Return pipe/staubli with Ø22mm<br><br>Hosetails with Ø 22mm<br>Vent/return pipe/hosetails with Ø 22mm options |

# Deltasafe Bag

### Protective solution for delta module transportation

Storage and transportation of delta modules can present challenges as it is time-consuming, involves manual handling and requires special storage conditions. To safeguard the delta modules and to enable a quick exchange in the event of a failure, we offer a reusable and sustainable delta protection bag, that will help transportation and lifting of delta modules more easily and quickly.

DELTAsafe is a strong and lightweight multi-function protective bag for lifting and transporting delta modules at offshore and onshore wind farms. It enables technicians to lift the sensitive equipment from the base to the top of wind turbine safely and securely. It also helps OEM service teams to improve their overall service efficiency, by transporting the delta modules and protecting the modules from any external damage.


### Benefits

- **Reuseability** - DELTAsafe bag is a reusable and sustainable inverter protective system that can help wind energy businesses to reduce costs and save time. Once the change-over is complete, the faulty product can be put into the DELTAsafe bag and returned to the manufacturer.
- **Ease for transportation** - The bag can be easily moved around warehouses, vehicles and towers. It has multiple handles enabling four people to lift and move the product easily. It is also durable for mechanical lifting, such as by forklift or tower crane.
- **Optimmized protection** - It is a lightweight solution strong enough to provide maximum protection to protect the internal critical components from damage during transportation.

## Training

The MV3000 Wind Converter uses unique hardware and software to control the turbine power flow and ensure grid code compliance. The converter is an essential component in the power conversion process, and understanding how it works and is maintained is critical in supporting the operating lifetime of equipment.

Investment in converter maintenance and troubleshooting training develops the operators' expertise in MV3000 converters, supporting improved productivity through sustainably safe and efficient operations. Maintenance technicians can build new skills, develop their existing skill sets, and gather new knowledge about MV3000 product and services. The training benefits are realized through increased performance, availability and reliability of the MV3000 drive.

Onsite training offers a convenient option that is flexible in both content and delivery, by avoiding attendee travel costs and enabling a group of engineers to be trained together on the installed equipment

Training can:

- Be bespoke to your installation
- Target real life situations
- Limit disruption to operations, by enabling site engineers to remain on hand
- Offer workshops which accommodate application of customer specific data,securely and with complete confidence
- Keep maintenance technicians up to date with industry leading technology and practices

Training is delivered by Power Conversion's team of expert engineers with extensive experience of the MV3000 wind converter equipment range.

## Service Contracts

Power Conversion offers Service Agreements adapted to wind industry customers' operational requirements, to help minimize risk of losses through downtime and repair work.

Our service contractual agreements offer

- A dedicated resource for day to day contact
- Fast and responsive mobilization of field service engineers
- A scheduled maintenance program aligned to planned outages, that reduces the risk of failure, therefore minimizing downtime and losses
- A dedicated remote support engineer, highly product trained,who can reinforce customers' local engineering team, providing enhanced capability, especially on remote sites
- KPI monitoring and obsolescence management that can support customers in making strategic decisions for minimizing risk
- Expert recommendations for optimizing efficiency of existing equipment and options to upgrade/ extend life of the fleet
- Services and Asset Performance Management (APM) enabling wind farm operators to plan ahead and improve availability.

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## About Power Conversion, a GE Vernova business

We apply the science and systems of power conversion to help drive the electric transformation of the world’s energy infrastructure. Designing and delivering advanced motor, drive and control technologies that help improve the efficiency and decarbonization of energy-intense processes and systems, helping to accelerate the energy transition across marine, energy and industrial applications.
**We are a at the heart of electrifying tomorrow's energy.**

**www.gepowerconversion.com/services**