Frequency Converters

Water Cooled Medium voltage
10000 to 40000 kW / 3.3 kV
INGEDRIVE™ MV500

The most reliable, versatile medium-voltage family for applications with high power demands

The INGEDRIVE™ MV500 range of frequency converters has been designed for applications requiring high energy exchange levels in extremely demanding environmental conditions. Ingeteam has invested more than four decades of experience in designing and manufacturing power converters, applying all of its know-how and including the latest advances in control electronics, with the most reliable semiconductors and passive elements on the market. The result is a robust and reliable family of frequency converters with a high power density per m³, making it one of the most compact designs currently available.

Based on a modular design, INGEDRIVE™ MV500 medium-voltage converters cover a wide range of powers for the most demanding applications in sectors including mining, steelmaking, oil & gas, and the marine sector amongst others. Likewise, its versatile control architecture together with its powerful CPU (Converter Processing Unit) makes it possible to control any type of electrical rotary machine (be it induction, synchronous or permanent magnet) with the best possible performance in terms of speed and torque precision.

The INGEDRIVE™ MV500 frequency converter range extends up to 40MW and is available for an output voltage of 3300V.

Frequency converters
water cooled, medium voltage

Sectors
Marine & Offshore
Oil & Gas
Power Generation
Mining, Cement, Materials Handling
Steelmaking
Water Treatment
Test Benches and Wind Tunnels
Main Benefits

Robustness and Integrity
The MV500 range offers different rectification configuration and a 3L-NPC inverter based on IGCT power semiconductors, making enhanced robustness and reliability key features of this range.

Reliable and User Friendly
Since it is designed with a minimum number of components, the 3L-NPC topology with HV-IGCTs makes it highly reliable and user friendly.

Easy Maintenance
It has been designed to minimise and facilitate maintenance and user tasks.

Highly Compatible
The INGEDRIVE™ MV500 converter is designed for installation with new or existing motors thanks to the option of including a sinusoidal filter.

Designed for highly-demanding climatic conditions
The INGEDRIVE™ MV500 family has been specially designed to work in highly demanding environmental conditions in terms of temperature and salinity.
High-performing, robust, reliable design

It includes advanced control, protection and communications functional features.

Cooling outlet
- Highly-efficient design.
- Redundant cooling pumps.
- Internal air/water exchangers, to minimise losses to air.

High-quality packaging
- Front access for all user and maintenance actions.
- Protection level from IP44 to IP54.

Safety
- Grounding switch and key sequence for maximum safety including door blocking.
- Emergency stop button.

Control Unit
- Powerful CPU for regulation and control, with a built-in PLC for basic control logic.
- Remote diagnostics, monitoring and control via a web application without the need to install any additional software.
- Easily accessible cabinet and main components.
- Modular and scalable control topology.
- Robust, certified control design.

Touch screen for local control (HMI)
- Powerful, user-friendly interface.
- Remote and local accessible control.

Cooling outlet
- Highly-efficient design.
- Redundant cooling pumps.
- Internal air/water exchangers, to minimise losses to air.

High-quality packaging
- Front access for all user and maintenance actions.
- Protection level from IP44 to IP54.

Safety
- Grounding switch and key sequence for maximum safety including door blocking.
- Emergency stop button.

Control Unit
- Powerful CPU for regulation and control, with a built-in PLC for basic control logic.
- Remote diagnostics, monitoring and control via a web application without the need to install any additional software.
- Easily accessible cabinet and main components.
- Modular and scalable control topology.
- Robust, certified control design.

Touch screen for local control (HMI)
- Powerful, user-friendly interface.
- Remote and local accessible control.
Sinusoidal Filter
- Optional sinusoidal filter, permitting long distances between the motor and the converter or connection to the old motor.

Input/output cabinet
- High compatibility with the motor
- Optional sinusoidal filter, permitting long distances between the motor and the converter or connection to the old motor.

Easily-accessible cabinets
- For control and power cabling.
- Available with upper or lower inlet.

AFE Inverter with 3L-NPC topology based on IGCT semiconductors basic power modules [BPM]
- Based on IGCTs.
- Easy access, maintenance and exchange.
- Control via fibre optic.

Power management module
- Built into the power cabinet and communication with the CPU via fibre optic.

Air/Water Exchangers
Control Features

In order to analyse the potential, architecture and adaptability of the control system offered by INGEDRIVE™ equipment, the following three areas need to be considered:

HMI and Operator Panel

The whole INGEDRIVE™ family has powerful, user-friendly interface tools developed for parametrisation, commissioning, use and maintenance and for users of all levels, using the following:

· Web Application: Embedded in the CPU with functional features such as software updating, alarms log, parametrisation, with user level definition.

· Operating panel: user-friendly tool with a touch screen containing important information such as the general status, measurement, alarms and basic local control functional features.

· Remote Diagnosis, Control and Log: The whole INGEDRIVE™ family offers clients powerful tools for commissioning and support based on web technology. This server technology only requires a web browser, allowing remote access via Ethernet to all enabled functional features.

· Customized panels: Ingeteam offers a package of tools for developing and customizing the HMI: both the web application and the operating panel are easily customizable so that they can be adapted to client requirements, permitting customized development according to the client's own requirements.

Hardware Architecture

The control hardware is based on standard shared modules for the whole INGEDRIVE™ family, both in low and medium voltage. The control system consists of the following main modules: PMM (Power Management Module) and CPU (Converter Processing Unit) which permit a multi-drive configuration and can be used for different topologies.

The main characteristics are as follows:

· Reliable hardware based on standard modules.
  Versatile modular design
  Validated in different application sectors

· Advanced processing capacity
  DSP processor for regulation and control functions
  PLC microprocessor for control logic functions

· Powerful interface for inputs and outputs
  High-resolution measurements
  Option for digital/analog input/output expansion

Permits communication with multiple field buses
High electromechanical resistance
Robust design with metal casing
EMC-certified (IEC 60092 / IEC 61800)
PLC and Control Software

Standard INGEDRIVE™ devices contain a PLC whose programming is based on the IEC61131-3 standard, allowing the client to use their own logic and program their own signals and communication according to their needs. The INGEDRIVE™ family’s control system is so powerful and versatile that it can be adapted to the different converter topologies of the whole range, such as the following:

- Two-level inverter.
- Three-level NPC inverter with vector modulation or selective harmonic elimination.
- 5-level inverters with H-Bridge topology.

Furthermore, the control system is capable of managing not only single-drive but also multi-drive configurations, adapting itself to the requirements of different applications with the following functional features:

- DC bus voltage regulation using DFE or AFE technology.
- Frequency converter for hybrid topologies: Static Frequency Converter.
- Option to control multiple types of machine with auto-tuning control algorithms developed for each type of motor.
  - Asynchronous motor.
  - Synchronous motor (brush / brushless).
  - Permanent magnet motors.
  - Vector control.
  - Encoderless vector control (sensorless).
- Redundant topologies using doubly-fed motors: Synchronous and Asynchronous.
Why Ingeteam?

One of Ingeteam’s cornerstones and hallmarks by which our clients recognise us is our flexibility and ability to adapt our products, services and solutions which, together with the high standards of quality in our products, make INGEDRIVE™ a leading reference in the major sectors where we are present.

**Flexibility:** Adapting ourselves to design requirements, adapting our products to specific applications, offering flexible service and support whenever and wherever our clients need it.

**Customization,** taking the main element of any INGEDRIVE™ equipment which is the BPM (Basic Power Module) or power module. Ingeteam’s design and engineering department adapts the final product to comply with each client’s specific requirements, without compromising reliability or robustness and increasing usability and optimisation for each application.

---

**Topologies**

**Multi-Drive Solutions:** multi-drive applications in which several inverter stages are connected to a common DC bus. When some motors brake, others can accelerate transferring energy between both via its/their DC bus connection. (Example: Mill stands with coilers and downcoilers for the steelmaking industry).

**Redundant single-drive solutions:** applications consisting of motors doubly-fed by two converters whose rectifier stage can be DFE or AFE.

**Single-Drive Solutions:** Standard applications based on a single motor fed by an AFE or DFE converter.
Certification

The MV500 series complies with the IEC standards for medium-voltage equipment as well as having certifications such as the following:

- CE marked certificates
- Marine application certification: BV, DNV-GL, LR, etc.
- Asbestos Free
- Green Passport

Why Ingeteam?

Load tests of all equipment at rated current

With the aim of including the latest advances in power electronics in INGEDRIVE™ equipment, Ingeteam boasts the largest power electronics laboratory in southern Europe and one of the biggest in the world. The testing and validating facilities cover a surface area of 13,000 m² with a capacity for testing equipment over 40MVA and with voltages up to 6.6 kV and a team of international engineers and researchers.

Manufactured 100% in Europe

Ingeteam designs and manufactures the entire INGEDRIVE™ range in its logistics and manufacturing centres in Europe. Ingeteam always works with mainly European leading brands and directly controls the entire manufacturing process to thus ensure the final quality of its products.

Hence, Ingeteam offers combined or specific tests, besides the routine tests carried out on all INGEDRIVE™ equipment.

We not only manufacture devices but also personalise them to offer the best solution in a wide range of sectors including the marine sector, industry, mining, and oil & gas. Perhaps this is why over 90% of our clients rate us as being flexible and as providing highly-customizable solutions. These two cornerstones are complemented with demanding quality standards which all of our products are subjected to, allowing Ingeteam to offer.

More than 45 years’ experience in power converters

Over 45 years’ experience in power electronics for applications in a wide range of sectors including energy generation, industry, mining and the marine sector have created an extensive, solid knowledge base. This enables our design and engineering department to advise our clients on the best option and adapt equipment and software to each particular application, thus offering custom-made solutions.

More than 45 years’ experience in power converters

Over 45 years’ experience in power electronics for applications in a wide range of sectors including energy generation, industry, mining and the marine sector have created an extensive, solid knowledge base. This enables our design and engineering department to advise our clients on the best option and adapt equipment and software to each particular application, thus offering custom-made solutions.

More than 45 years’ experience in power converters

Over 45 years’ experience in power electronics for applications in a wide range of sectors including energy generation, industry, mining and the marine sector have created an extensive, solid knowledge base. This enables our design and engineering department to advise our clients on the best option and adapt equipment and software to each particular application, thus offering custom-made solutions.
## Considerations

| Motor type: | Squirrel Cage induction |
| Performance: | 97.1% |
| Power factor: | 0.91 |

| Ambient temperature: | 0 °C to 45 °C (max.). Up to 55 °C with reduction factor |
| Load type: | Variable torque |

| Network voltage: | Motor voltage |
| Altitude: | < 1000 m.a.s.l. (metres above sea level) / Up to 5000 m.a.s.l. with reduction factor |

### 3300 VAC

<table>
<thead>
<tr>
<th>Rectifier Type</th>
<th>Power kW</th>
<th>Current A</th>
<th>Width mm</th>
<th>Weight kg</th>
<th>Width mm</th>
<th>Weight kg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12 Pulse</strong></td>
<td>10000</td>
<td>1980</td>
<td>4010</td>
<td>5300</td>
<td>9010</td>
<td>14900</td>
</tr>
<tr>
<td></td>
<td>18000</td>
<td>3564</td>
<td>7010</td>
<td>9500</td>
<td>9010</td>
<td>14900</td>
</tr>
<tr>
<td></td>
<td>20000**</td>
<td>3960</td>
<td>11010</td>
<td>14800</td>
<td>14010</td>
<td>22900</td>
</tr>
<tr>
<td></td>
<td>27000</td>
<td>5346</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>24 Pulse</strong></td>
<td>10000</td>
<td>1980</td>
<td>4810</td>
<td>6600</td>
<td>5810</td>
<td>9300</td>
</tr>
<tr>
<td></td>
<td>18000</td>
<td>3654</td>
<td>7010</td>
<td>9500</td>
<td>9010</td>
<td>14900</td>
</tr>
<tr>
<td></td>
<td>20000**</td>
<td>3690</td>
<td>14010</td>
<td>19000</td>
<td>18010</td>
<td>29800</td>
</tr>
<tr>
<td></td>
<td>36000**</td>
<td>7128</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Double winding motor required (not applicable when using sinusoidal output filter)

**Note:** For synchronous motors, INGERIVE MV500 is available up to 40 MW.

**Depths:** 1260 mm  Height: 2320 mm

---

### Frequency converters

**water cooled, medium voltage**
In sectors in which the environmental component is highly demanding such as in the marine sector, mining or oil & gas, being able to depend on a reliable, robust device such as INGEDRIVE™ MV500 which is designed for aggressive environments, is essential.
<table>
<thead>
<tr>
<th><strong>Standard Characteristics</strong></th>
<th></th>
</tr>
</thead>
</table>
| **Hardware Interface** | Analog inputs: 2  
Analog outputs: 2  
Digital inputs: 9  
Digital outputs: 10  
Emergency control with wire break detection: 4  
Basic control panel: E-Stop, CPU access and local-remote switch  
Redundant Encoder (Except for sensorless control) [Encoder not supplied with the drive] |
| **Miscellaneous** | Lighting and socket in control cabinet  
Color operation touch screen (HMI) - 10”  
Three way valve (for Internal water temperature control)  
Redundant cooling pump set  
Space heaters (to avoid condensation in enclosures)  
Varnished boards  
Fixing rods and door retainers (only marine applications)  
Lifting lugs  
RAL7035 cabinet color  
IP44, IP54 with suitable MCT sealing modules  
CE Marking and green passport certification  
Halogen free and flame retardant materials  
Special tool (power stack handling fork lift)  
Road truck packing (basic wooden box)  
Redundant Deionization Tank |
| **Electronic Components** | Insulation Monitoring System (Except for transformerless connection)  
Internal Precharge and Discharge System  
Long life Polypropylene Capacitors  
Internal UPS |
| **Functionalities** | Black Out Prevention  
Fault Ride Through Capability  
Sensorless vector control  
Flying Start Functionality |
| **Software** | Programming plus Ingewebapp Remote Access. No license required |
| **Documentation** | Documentation set (2 printed + 2 digital) in English or Spanish |
## Optional Features

### Hardware Interface
- Extended hardware interface/package
  - Analog inputs: +2
  - Analog outputs: +2
  - Digital inputs: +10
  - Digital outputs: +10
- Extended emergency control circuit with wire break detection: +5
- Emergency control with wire break + short-circuit detection
- Extended control panel: BCP + drive connection and NFU control
- Synchronous transfer (IC3 I/O modules+ Voltage measurement) (Bypass contactors are excluded) (These modules will be placed external to the VFD in a cabinet supplied by others)
- Expansion I/O modules for additional connectivity
- External heaters control and feeding (up to 300W)
- External fans control and feeding
- External Pt100 measurement (up to 8 channels)

### Communications
- F.O. Adaptor
- Profibus-DP, Modbus TCP, CAN Open, Modbus RTU, DeviceNet
- Other Fieldbus Communication Protocol

### Miscellaneous
- Filter for primary coolant
- Primary sea water cooling
- Special RAL painting
- Reactive power compensation only for converters with AFE rectifiers
- Special degree of protection
- Customized cabinet indications (placed on door)
- Vibration Dampers
- Packing for maritime transportation
- MCT sealing modules
- Cooling pipes - side access

### Electrical Components
- Output breaker
- Output manual switch
- EMI filter
- Insulation Monitoring System (Only for transformerless connection)
- Excitation module for synchronous motors (Ref.: MC9101-A)
- Special auxiliary supply voltage
- Grid side top power cable access
- Motor side top power cable access
- Over Voltage Limiter Unit (OVLU)
- Dynamic Braking Chopper
- Control top cable access

### Documentation
- Additional documentation set and language

### Certification
- DNV-GL, LR, BV, CCS, RINA, RRR, TL, Others
In our commitment to offering our clients complete and personalised solutions, Ingeteam offers a 360° CRS (Customer Relationship Service) with all of our product range, providing you with comprehensive consultancy, direct technical support, training and maintenance services throughout the lifetime of our products.

360° CRS is a dynamic, personalised service that covers all of stages and contact points between Ingeteam and our clients. The 360° CRS programme is supported by a professional technical team whose goal is client satisfaction and continuous improvement of products and services, always hand in hand with the latest advances and technologies in each application sector.
The following services are part of the 360º CRS programme

24/7 support included.
Direct access to design engineers and I+D and direct assistance with key technicians and engineers providing advice and high-quality support to our clients.

Once the warranty period has expired, Ingeteam offers its clients the option to extend out-of-hours customer support services provided by the Ingedrive technical support team by means of customized contracts to suit the needs of our clients.

25-year life cycle incl. service + spares
Ingeteam guarantees the repair service of the entire INGEDRIVE™ family for a period of 25 years as of the date of purchase of our equipment.

Remote Access
INGEDRIVE™ products are ready to be monitored remotely which enables Ingeteam’s technical team to offer our clients the option to track and analyse any incident in a device remotely.

Commissioning
The commissioning of INGEDRIVE™ equipment is carried out by highly-qualified, multidisciplinary staff with experience in a wide range of sectors, to ensure your installation has best adaptation and best performance. This, together with the fact that devices leave the factory having been completely tested and verified, makes the commissioning time considerably shorter.

Spare Parts Stock
Ingeteam has designed the INGEDRIVE™ range based on the concept of power stacks. This enables us to have a permanent stock of main converter components in our logistical and manufacturing centres, reducing the supply times for immediately attending to potential emergencies to a minimum.

Repairs [Field Service]
Anytime, anywhere. The aim of INGEDRIVE™ Support is to minimise the impact of a potential stoppage or incident in our devices.

Technical Support and Engineering
Ingeteam offers its clients pre-sales technical and engineering support in order to provide assistance and advice during the initial stages and from the project definition to the commissioning of our equipment and delivery of our installations.

Training [Training Centre]
Ingeteam’s team of course leaders offers comprehensive, customized theory and practical programmes to meet the training requirements of its clients.

Ingeteam has a specific area for providing theory and practical classes where we have specific material and converters with different topologies from the entire INGEDRIVE™ range. The different options can be summarised in two levels in which the subject content and depth of learning is adapted to the student and to the aim of the course.

- User Level Course:
  - Explains maintenance and troubleshooting Aimed at users and end users.
- Expert Level Course:
  - Aimed at equipment commissioning engineers. Suitable for integrators.