Delta MVD2000 Series

Medium Voltage Drive

www.deltaww.com/mvd
As the world Top 1 switching power supply and energy management solution supplier, Delta Group is also the leading manufacturer in multiple product fields in the world. Delta supplies products including power supply management package solutions, video displays, industrial automation, network communication products, and recycle-energy products.

Delta Group has established business operation branches all over the world, as well as manufacturing plants in Taiwan, China Mainland, Thailand, Mexico, Japan, India, Brazil, and Europe. As the leading supplier in electrical and electronic industries in the world, Delta Group has defined its operation mission as “Environmental Protection, Energy Saving, and Earth Caring”, and made long-lasting efforts on executing green environmental protections. Delta implemented a green manufacturing process free of lead many years ago, as well as recycling measures and waste retreatment plans.

In the past 40 years, Delta Group insisted on the operation mission of “Environmental protection, Energy Saving, and Caring for the Earth”, pursued continuous innovation, which led to its leading role in many product fields, and being listed in the TOP 50 among Asian Excellent Enterprises sponsored by Forbes.

Delta Group aims to realize environmental protection by establishing and promoting green buildings, and implementing green manufacturing processes, source recycling, and wastes retreatment plans; Delta was elected as the only Chinese enterprise listed in the Global Top 100 Low-Carbon Enterprise sponsored by CNBC. In 2010, Delta was recognized by the Anyong Award of Annual Entrepreneur, Social Responsibility Award and Award of Best Chinese Business Leader by CNBC.

More information refers to the website: www.deltaww.com
Delta MVD2000 Series

The MVD2000 is a medium voltage variable speed drive series for speed and torque control based on advanced frequency-conversion multilevel inverter technologies and advanced vector control algorithms. The MVD2000 is a modular and configurable cost-effective solution that provides efficient and reliable operation across many industrial applications. Simple installation requirements, easy operation and maintenance make the MVD2000 the drive of choice across industrial segments that require energy savings or speed control for constant torque loads over the operating speed range.

MVD2000 delivers high performance control accuracy using vector control. The ability to independently control motor flux and speed yields fast dynamic response to load fluctuations and high torque at low speeds, including during motor start-up.

Both encoder and sensor-less vector control approaches are available for selection. The speed sensors can be installed depending on actual application conditions. For cases without the speed sensors, the system can still provide fast dynamic responses and high output torque when the motor is running at low speed.

Applications

The MVD2000 series is applied for speed control of square torque loads such as fans, pumps, and compressors, as well as for mills, crushers, and conveyor belts that require constant torque operation over the entire speed range. Accurate speed and torque controls result in better energy saving, improved process quality, and prolonged equipment lifetime. Various industry segments that require reliable and stable operation can benefit from MVD2000’s high performance:

- Power generation: coal mills, blower fans, and water pumps.
- Metallurgy: conveyor belts, positive displacement pumps, fans, and water pumps.
- Mining: crushers, conveyor belts, PD pumps, fans and water pumps.
- Oil & Gas: compressors, PD pumps, centrifugal pumps, fans and water pumps.
- Cement & Materials: crushers, mixers, extruders, rotary kilns, drying furnaces, fans and water pumps.
- Sugar & Ethanol: mills, pumps, and fans.
- Municipal works: water supply pumps, sewage pumps, heat network pumps.
Advanced Features & Benefits

Advanced Technologies
- Advanced vector control algorithms with and without speed sensors to enhance motor control performance.
- Advanced auto tuning of motor parameters to improve the stability of the vector control.
- DC current braking injection.
- Power loss ride through, and synchronous transfer for single or several motors.
- Coordination and control of master-slave variable frequency inverters to meet load sharing application requirements.
- Use of phase-shift multi-pulse input transformer to decrease the input grid current harmonics and meet the IEEE 519-1992 requirements.
- Use of cascaded multilevel inverter technologies to deliver nearly sinusoidal output voltage waveforms, meeting motor drive requirements for long-distance cables.

Enhanced Process & Quality Control
- Capability to produce large output torque at low speeds and during motor startup, increasing speed response and control accuracy within motor torque limits.
- Integrated PID controller for precise control on flow, pressure or other process variable.
- Control operation under temporary input power loss and capability to restart automatically after grid fault and recovery.
- Advanced protection functions such as motor stall and output fault to ground.
- Friendly customer interface for easy system integration with customer’s process.

Control and Monitoring Functions
- Speed command (rpm)
- Operating speed (rpm)
- Input/output power, current, voltage
- Accumulated running time
- MVD status
- System bypass switches and user breaker status
- Programmable analog I/Os
- Alarms and faults
- Event recording

Lower Cost of Ownership
- System efficiency is higher than 98%, which decreases system operating costs (excluding phase-shift transformer).
- Optimized blower and water pump operations to ensure energy-saving and shorten the investment recovery period.
- Integration of input transformer allows three-cable-in-three-cable-out reduced installation engineering effort.
- Smooth speed control decreases mechanical stress, eliminates pipe-hammer effect and reduces maintenance costs.
- Multilevel output voltage and controlled starting currents reduce motor stress.
- Synchronous transfer switchgear cabinet for soft starter applications for single or multiple motors.

Protection Functions
- Over-current protection
- Over-load protection
- Transformer high-temperature alarm & over-temperature protection
- MVD over-temperature protection
- Under-voltage & over-voltage protection
- Motor over-load protection (external protection relay connection)
- Cooling fan abnormal alarm
- Cabinet door open protection
- Cabinet pressure alarm
- Output short-circuit protection
- Input/output phase loss protection
- Communication failure protection
- Output grounding protection
- Motor stall alarm/protection
- Motor reverse rotation alarm/protection
- Over-speed and under-speed alarm/protection

System Structure

System Diagram

Modular System
Each output phase consists of multiple power modules connected in series to achieve the required output voltage level.

<table>
<thead>
<tr>
<th>System voltage</th>
<th>Cells / Phase</th>
<th>Phase-shift transformer (pulses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3kV</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>4.16kV</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>6kV</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>6.6kV</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>10kV</td>
<td>8</td>
<td>48</td>
</tr>
<tr>
<td>11kV</td>
<td>9</td>
<td>54</td>
</tr>
</tbody>
</table>

*N+1 redundant power cells (option)
### MVD2000 Specifications & Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Technology</strong></td>
<td>Cascaded multilevel inverter based on IGBT devices</td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td>&gt;98% (Rated, excluding transformer)</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td></td>
</tr>
<tr>
<td>Voltage range</td>
<td>-10%~+10% (normal operation), -10%~30% (continuous running at derated speed)</td>
</tr>
<tr>
<td>Frequency</td>
<td>50Hz/60Hz (-2%~+2%)</td>
</tr>
<tr>
<td>Control power supply</td>
<td>AC380 V (three-phase four-wire system) or AC220V, 3kVA single-ohase capacity</td>
</tr>
<tr>
<td>Input current harmonic</td>
<td>Meets IEEE519 standard, without input filter</td>
</tr>
<tr>
<td>Power factor</td>
<td>&gt;0.96 (lagging at rated speed and power)</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>3.3kV~11kV</td>
</tr>
<tr>
<td>Max. output frequency</td>
<td>75Hz</td>
</tr>
<tr>
<td>Overload capacity</td>
<td>150% per min/10 min. (standard), other options available</td>
</tr>
<tr>
<td>Start-up torque</td>
<td>150% rated torque (standard), other options available</td>
</tr>
<tr>
<td>Speed regulation range</td>
<td>1%~100% (with encoder), 5%~100% (without speed sensor)</td>
</tr>
<tr>
<td>Speed control resolution (steady state)</td>
<td>±0.01% (with speed sensor, depending on sensor accuracy), ±0.5% (without speed sensor)</td>
</tr>
<tr>
<td>Speed response bandwidth</td>
<td>60rad/s (with speed sensor), 20rad/s (without speed sensor)</td>
</tr>
<tr>
<td>Current response bandwidth</td>
<td>600rad/s</td>
</tr>
<tr>
<td><strong>Control Parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Control methods</td>
<td>Vector control with encoder and encoderless</td>
</tr>
<tr>
<td>Modulation method</td>
<td>SVPWM</td>
</tr>
<tr>
<td>Acceleration &amp; deceleration time</td>
<td>0~3000s (programmable)</td>
</tr>
<tr>
<td>Alarms</td>
<td>Power cell under-voltage, analog reference loss, cooling fan over-temperature, cooling fan power supply failure, cabinet over-pressure, air filter blocked, control power supply failure, transformer high-temperature, HMI communication failure, ac input under-voltage, UPS failure, PLC communication failure, flying start failure</td>
</tr>
<tr>
<td>Protections</td>
<td>Over-current, over-load, short-circuit, input over-voltage, input/output phase loss, input voltage power loss, output fault to ground, transformer over-temperature, power cell communication failure, optical fiber communication failure, high-voltage cabinet door open, control power supplies failures, dc auxiliary power supply failure, power cell over-temperature, power cell over-voltage, power cell IGBT gate drive failure, over-speed protection, under-speed protection, reverse rotation protection, motor stall protection</td>
</tr>
<tr>
<td>Functions</td>
<td>Speed skipping, PID regulator, fault event log, flying start, power loss ride through, automatic restart, auto-tuning, S-curve acceleration, adaptive acceleration and deceleration, DC braking current injection, forward/reverse rotation selection, jogging, system bypass, synchronous motor transfer option, master-slave control</td>
</tr>
<tr>
<td>Analog input</td>
<td>0<del>10V/4</del>20mA, two channels (expandable)</td>
</tr>
<tr>
<td>Analog output</td>
<td>0<del>10V/4</del>20mA, four channels. (expandable)</td>
</tr>
<tr>
<td>Digital input / output</td>
<td>10-channel input, 8-channel output (expandable)</td>
</tr>
<tr>
<td>Human machine interface</td>
<td>Chinese/English touch-screen LCD display</td>
</tr>
</tbody>
</table>

![Cascaded Output Voltage Map](image1.png)

![Power Unit Schematic Diagram](image2.png)
### Standards

<table>
<thead>
<tr>
<th>Standard No.</th>
<th>Standard Title</th>
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<tbody>
<tr>
<td>GB/T 156-2007</td>
<td>Standard Voltages</td>
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<tr>
<td>GB/T 1980-2005</td>
<td>Standard Frequencies</td>
</tr>
<tr>
<td>GB/T 2423.10-2008</td>
<td>Environmental testing for electric and electronic products - Part 2: Test methods - Test Fc: Vibration (sinusoidal)</td>
</tr>
<tr>
<td>GB 2681-81</td>
<td>Colors of insulated conductors used in electrical assembly devices</td>
</tr>
<tr>
<td>GB 2682-1981</td>
<td>Colors of indicator lights and push-buttons used in electrical assembly devices</td>
</tr>
<tr>
<td>GB/T 3797-2005</td>
<td>Electrical control assemblies</td>
</tr>
<tr>
<td>GB/T 3859.1-93</td>
<td>Semiconductor convertors - Specification of basic requirements</td>
</tr>
<tr>
<td>GB/T 3859.2-93</td>
<td>Semiconductor convertors - Application guide</td>
</tr>
<tr>
<td>GB/T 3859.3-93</td>
<td>Semiconductor convertors - Transformers and reactors</td>
</tr>
<tr>
<td>GB 4208-2008</td>
<td>Degrees of protection provided by enclosures (IP code)</td>
</tr>
<tr>
<td>GB/T 4588.1-1996</td>
<td>Sectional specification: Single and double sided printed boards without plain holes</td>
</tr>
<tr>
<td>GB/T 4588.2-1996</td>
<td>Sectional specification: single and double sided printed boards with plated-through holes</td>
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<tr>
<td>GB 7678-87</td>
<td>Semiconductor self-commutated converters</td>
</tr>
<tr>
<td>GB/T 10233-2005</td>
<td>Basic testing method for low-voltage switchgear and control-gear assemblies</td>
</tr>
<tr>
<td>GB 12668-90</td>
<td>General specification for speed control assembly with semiconductor adjustable frequency for A.C. motor</td>
</tr>
<tr>
<td>GB/T 15139-94</td>
<td>General technical standard for electrical equipment structure</td>
</tr>
<tr>
<td>GB/T 13422-92</td>
<td>Power semiconductor converters—Electrical test methods</td>
</tr>
<tr>
<td>GB/T 14549-93</td>
<td>Quality of electric energy supply-Harmonics in public supply network</td>
</tr>
<tr>
<td>GB/T 12668.3-2003</td>
<td>Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods</td>
</tr>
<tr>
<td>GB/T 12668.4-2006</td>
<td>Adjustable speed electrical power drive systems—Part 4: General requirements—Rating specifications for A.C. power drive systems above 1000 V A.C. not exceeding 35 kV</td>
</tr>
<tr>
<td>IEEE 519-1992</td>
<td>IEEE recommended practices and requirements for harmonic control in electrical power systems</td>
</tr>
<tr>
<td>IEC 60038</td>
<td>IEC standard voltages</td>
</tr>
<tr>
<td>IEC 60076-1</td>
<td>Power transformers - Part 1: General</td>
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</table>

### Control Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display parameters</td>
<td>Reference speed, output speed, input/output current, operating status indication</td>
</tr>
<tr>
<td>Communication interface</td>
<td>Isolated RS485, industrial Ethernet (option), GPRS (option)</td>
</tr>
<tr>
<td>Communication protocol</td>
<td>MODBUS, PROFIBUS, other options</td>
</tr>
</tbody>
</table>

### Environment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-5°C~+40°C (normal operation); +40°C~+50°C (de-rating operation)</td>
</tr>
<tr>
<td>Storage/transportation temperature</td>
<td>-40°C~+70°C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>5%~95%, no condensation</td>
</tr>
<tr>
<td>Altitude</td>
<td>&lt;1000m</td>
</tr>
</tbody>
</table>

### Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension &amp; quality</td>
<td>Refer to the spec list</td>
</tr>
<tr>
<td>Color</td>
<td>RAL7035 (or customized)</td>
</tr>
<tr>
<td>Cooling method</td>
<td>Forced air cooling</td>
</tr>
<tr>
<td>Protection level</td>
<td>IP30 (standard), other configurations can be customized</td>
</tr>
</tbody>
</table>

Delta Medium Voltage Drive
Product Dimensions

6kV MVD2000 outline drawings shown below:
### Product Selection

<table>
<thead>
<tr>
<th>Rated Voltage (kV)</th>
<th>Rated Output Current (A)</th>
<th>Motor Shaft Power (kW)</th>
<th>Cabinet Dimensions (H×W×D) (mm)</th>
<th>Weight (kg)</th>
<th>Bypass Cabinet (Option)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CT</strong></td>
<td><strong>VT</strong></td>
<td><strong>Constant Torque Load</strong></td>
<td><strong>Variable Torque Load</strong></td>
<td><strong>2400x3200x1200</strong></td>
<td><strong>3200</strong></td>
</tr>
<tr>
<td>40</td>
<td>50</td>
<td>183</td>
<td>229</td>
<td>2400×2800×1200</td>
<td>2500</td>
</tr>
<tr>
<td>56</td>
<td>70</td>
<td>256</td>
<td>320</td>
<td>2400×3000×1200</td>
<td>3000</td>
</tr>
<tr>
<td>96</td>
<td>120</td>
<td>439</td>
<td>549</td>
<td>2400x3200x1200</td>
<td>5000</td>
</tr>
<tr>
<td>152</td>
<td>190</td>
<td>695</td>
<td>869</td>
<td>2700x3430x1200</td>
<td>6000</td>
</tr>
<tr>
<td>200</td>
<td>250</td>
<td>914</td>
<td>1143</td>
<td>2700x3800x1200</td>
<td>7400</td>
</tr>
<tr>
<td>244</td>
<td>305</td>
<td>1116</td>
<td>1395</td>
<td>2700×4100×1400</td>
<td>8500</td>
</tr>
<tr>
<td>350</td>
<td>438</td>
<td>1600</td>
<td>2003</td>
<td>2700x4850x1400</td>
<td>9500</td>
</tr>
<tr>
<td>448</td>
<td>560</td>
<td>2048</td>
<td>2561</td>
<td>2700x5450x1400</td>
<td>10500</td>
</tr>
<tr>
<td>544</td>
<td>680</td>
<td>2488</td>
<td>3109</td>
<td>278x6200x1400</td>
<td>11500</td>
</tr>
<tr>
<td>672</td>
<td>840</td>
<td>3073</td>
<td>3841</td>
<td>278x6200x1400</td>
<td>12000</td>
</tr>
</tbody>
</table>

| **MVD2000** | **3.3** | **6.6** | **10** | **11** |
|-------------------|--------------------------|------------------------|----------------------------------|-------------|-------------------------|
| **Rated Voltage (kV)** | **Rated Output Current (A)** | **Motor Shaft Power (kW)** | **Cabinet Dimensions (H×W×D) (mm)** | **Weight (kg)** | **Bypass Cabinet (Option)** |
| **CT** | **VT** | **Constant Torque Load** | **Variable Torque Load** | **2400x3800x1200** | **2400x4800x1200** | **2400x5000x1200** | **2400x5100x1200** | **2400x5000x1200** | **2400x5100x1200** | **2400x5100x1200** | **2400x5100x1200** |
| 40 | 50 | 366 | 457 | 7100 | 8450 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 56 | 70 | 512 | 640 | 7500 | 8950 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 96 | 120 | 878 | 1097 | 7900 | 9350 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 152 | 190 | 1390 | 1738 | 8300 | 9750 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 200 | 250 | 1829 | 2286 | 8700 | 10150 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 244 | 305 | 2231 | 2789 | 9100 | 10550 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 350 | 438 | 3201 | 4005 | 3700 | 5160 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 448 | 560 | 4097 | 5121 | 4100 | 5560 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 544 | 680 | 4975 | 6219 | 4500 | 5930 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |
| 672 | 840 | 6146 | 7682 | 5000 | 6490 | 6000 | 7500 | 6000 | 7500 | 6000 | 7500 |

CT: Constant torque  
VT: Variable torque  
Width W2 (mm)  
Bypass Cabinet (Option) (kg)
Installation Diagram

Installation foundation

For wiring safety and convenience, it is recommended to install the MVD cabinet on a cable trench as shown in the drawing below.

Cross section of cable and installation trench

Detail requirements:
1. It is recommended to set the minimum length of cable trench as the total MVD length, adding 1m to the left and right for easy cabling and maintenance.
2. The MVD is placed on the trench rail using 10\# channel steel (use 16\# channel steel if the MVD power is ≥1800kW and 18\# double-T steel if the MVD power is ≥4000kW).
3. Reserve free space on top and front of the MVD cabinet, so that the distance between cabinet top and ceiling is ≥800mm, and the distance between cabinet front and walls is ≥1500mm.
4. For ventilation and maintenance convenience, the distance from the rear of the dry-type transformer cabinet and the back wall shall be ≥1000mm.

MVD Cooling Proposal

There are three possible cooling solutions which are open-air-duct cooling, sealed air conditioning cooling, and air conditioning with air-duct cooling.

Open-air-duct cooling

Sealed-air-conditioning cooling

Air-duct & air-conditioning cooling
Reliability & Certification

Delta provides quality assurance through rigorous inspection and testing based on international standards. To ensure that the drive operates as predicted upon start-up, Delta Electronics has built a state-of-the-art, multi-megawatt test facility for full load capacity and full load burn-in verification. A detailed test procedure reduces start-up time during installation and commissioning in the field.

Advanced test methods and equipment

High-voltage frequency converter series model
2: MV2000

Rated voltage:
A: 3.3 kV
B: 4.16 kV
C: 6 kV
D: 6.6 kV
E: 10 kV
F: 11 kV

Rated current

Version No. (01~ZZ): Indicates different customer needs
01~RZ: induction motor
S0~ZZ: synchronous motor

Startup cabinet
S: available
N: not available

By-pass cabinet
A: automatic
B: manual
N: none

Cooling type
A: forced air cooling
L: liquid cooling
H: hybrid cooling

Global Sales & Service

The warranty period is one year counted from receiving the equipment at customer’s site. During the warranty period, Delta will provide replacement of defective parts and repairs. Worldwide service capability ensures response in less than 8 hours, arrival at site in less than 24 hours and troubleshooting in less than 48 hours.

System Model Names

<table>
<thead>
<tr>
<th>M</th>
<th>V</th>
<th>D</th>
<th>2</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-voltage frequency converter series model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Version No. (01~ZZ):

Indicates different customer needs
01~RZ: induction motor
S0~ZZ: synchronous motor

Startup cabinet
S: available
N: not available

By-pass cabinet
A: automatic
B: manual
N: none

Cooling type
A: forced air cooling
L: liquid cooling
H: hybrid cooling

International certificates

ISO 9001:2008
ISO 14001:2004
OHSAS 18001:2007
QC 080000:2007
TL 9000 R5.0
CE (EMC)
Europe, Middle East, Africa

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F +41 31 998 54 85

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F +90 216 499 8070

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