Delta MVD 1000 Series

Medium Voltage Drive

www.deltaww.com/mvd

DELTA

Smarter. Greener. Together.

Table of Content

Delta's solar energy system covers the 2009 World Games Stadium.

Delta Group

Delta Group is the world's leading provider of power management and thermal management solutions, as well as a major source for components, visual displays, industrial automation, networking products, and renewable energy solutions. Delta Group has sales offices worldwide and manufacturing plants in Taiwan, China, Thailand, Japan, Mexico, India, Brazil and Europe. As a global leader in power electronics, Delta's mission is, "To provide innovative, clean and efficient energy solutions for a better tomorrow." Delta is committed to environmental protection and has implemented green, lead-free production and recycling and waste management programs for many years.

For more information about Delta Group, please visit: www.deltaww.com.

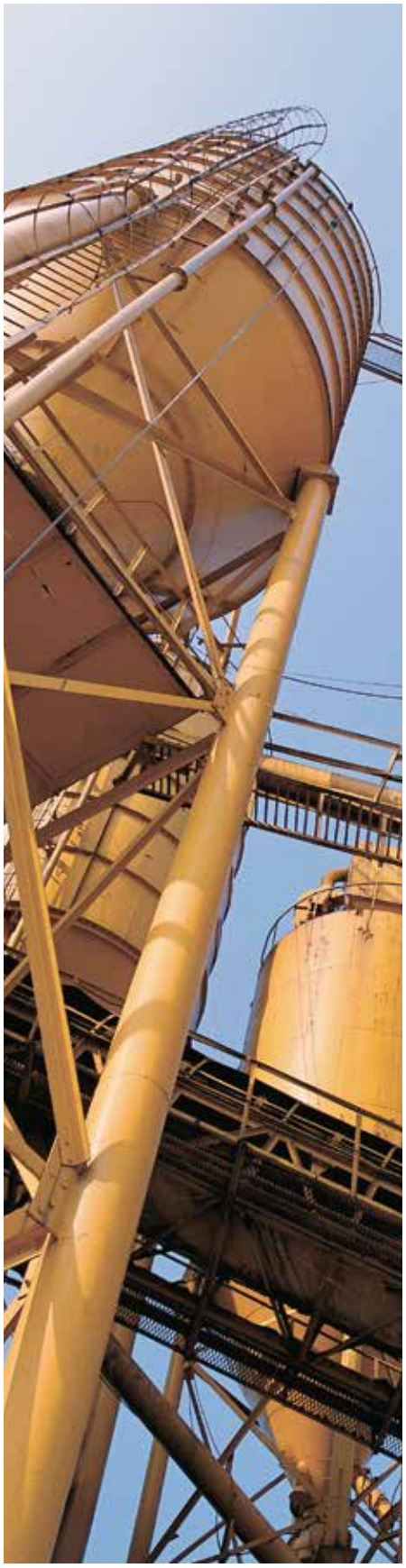
Why Drives Matter

Drives can save an average of 40% of the electricity a motor uses as well as reduce related CO2 emissions. Since industry accounts for one-third of the world's electricity consumption and electric motors consume 65% of industrial electricity in regions such as the EU, the potential global energy savings from a wider use of drives would be substantial. For an industrial enterprise drives can reduce energy costs, minimize wear on motors and other equipment, and reduce maintenance costs. A reliable, high-performance drive such as Delta's MVD1000 medium voltage drive can provide an enterprise with greater energy-savings as well as increased productivity.

[1] "Energy Efficient Motor Driven Systems," European Copper Institute, Fraunhofer-ISI, KU Leuven and University of Coimbra (April 2004)

Delta MVD1000 Series

Delta medium voltage drive is a high-efficiency, compact, high reliable and energy-saving solution. According to demand of different motors and loads, Delta provides general type and vector control type MVDs, which have a broad range of applications in segments such as power generation, oil & gas, mining, metals, cement, and public facilities. MVD is used to drive medium voltage motors loaded for instance by fans, pumps, compressors, mills, crushers, mixers, and extruders. MVD provides process control, so it can increase production efficiency, reduce energy loss, improve equipment protection, and reduce maintenance cost. Delta provides customers complete solutions with easily operated variable frequency drives.



Advanced Features & Benefits

Leading Technology

- Multi-pulse input rectification reduces input current harmonic distortion, meeting IEEE 519-1992
- Advanced drive concept provides multilevel output voltages and enhanced motor operation
- Advanced control functions enhance adaptability against instable grid

Protection Features

- Over current
- Over load
- Transformer over temperature
- MVD over temperature
- Under voltage / over voltage
- Motor overload (external)
- Blower fault
- High voltage cabinet door open
- Cabinet air pressure abnormal
- Output short circuit
- Input / output phase loss
- Communication fault
- Output fault to ground

Enhanced Process & Quality Control

- Built-in proportional integral differential (PID) controller enhances control of process variables such as flow and pressure
- Ride through and flying start features ensure a more continuous process in spite of input voltage dips
- Friendly user interface provide easy-to-use system integration

Control & Monitoring Features

- Frequency reference (Hz)
- Actual frequency (Hz)
- Input / output power / current / voltage
- Cumulative operating hours
- Drive status
- Status of system bypass switches and MCB
- Analog inputs / outputs monitoring
- Fault / Alert messages
- Fault diagnosis function
- Ride-through and flying start functions

Lower Cost of Ownership

- System efficiency is more than 98.5% (without phase-shifted transformer)
- Optimized pump and fan operation ensure significant energy savings and short return on investment
- Integrated transformer enables a three-cable-in-three-cable-out installation concept using considerably less engineering effort
- Reduced mechanical stresses eliminate hammer effect in pipelines and vent ducts, and lowers maintenance cost
- Multilevel voltages and motor soft start minimize stresses

Major Applications

Power Generation	Forced draft fan, induced draft fan, boiler feed-water pump, cooling water pump, compressor,circulation water pump, compressor, condensator pump
Oil & Gas	Gas compressor, electrical submersible pump, pipeline pump, brine pump, feed-water pump
Mining	Ventilation fan, baghouse fan, slurry pump, feed pump, gas compressor, blast furnace fan
Metallurgy	Forced draft fan (FDF), induced draft fan (IDF), baghouse fan, descaling pump, feed-water pump, booster pump, coiler blast, furnace fan, gas compressor
Cement	Kiln IDF, baghouse fan, separator fan, raw mill IDF
Public Facilities	FDF, IDF, raw sewage pump, freshwater pump, feed-water pump

Reduced Energy Consumption & CO_2 Emissions

For many applications the MVD1000 can provide significant reductions in energy consumption and CO2 emissions. The example below shows the benefits of using the MVD1000 for two forced draft fans in one of the worlds leading steel companies.

Application: Two Forced Draft Fans (FDF) in one Chinese steel company using Delta MVDs

Specifications	FDF 1 / FDF 2
Rated fan power	4300 KW
Total hours 2010	7105 Hrs
Rated speed	890 RPM
Rated voltage	10000V
Rated motor power	4400KW
Rated current	305A
CO2 emissions	0.637CO2eq/kWhr

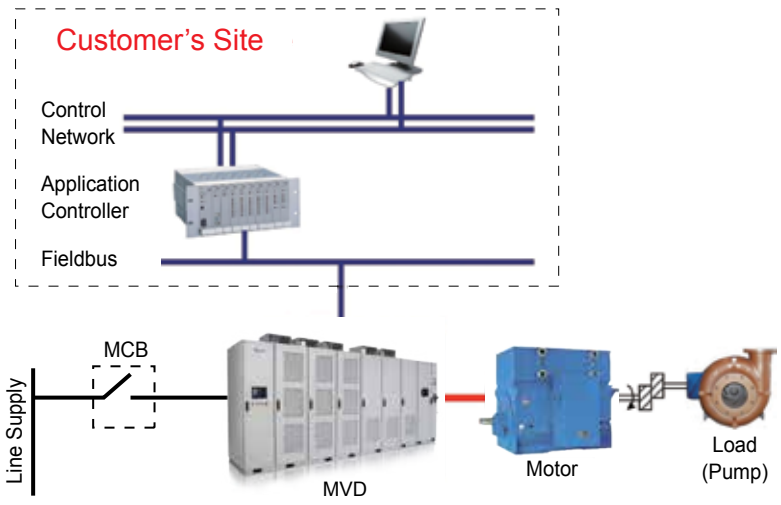
Energy Savings Comparison (MVD vs. Damper)

Motor	FDF 1	FDF 2
Energy usage (Damper)	2311kW/yr	2350kW/yr
	16,560,255kWhr/yr	16,700,073kWhr/yr
Energy usage (MVD)	893kW/yr	968kW/yr
	6,343,167kWhr/yr	6,880,787kWhr/yr
Energy Savings	62%	59%
Savings Amount (per year)	US$686,222	US$659,504

CO_2 Emissions Comparison (MVD vs. Damper)

Motor	FDF 1	FDF 2
Damper	10,549 tons/yr	10,638 tons/yr
MVD	4,041 tons/yr	4,383 tons/yr
Reduction	6,508 tons/yr	6,255 tons/yr
	62%	59%

Typical MVD System



Delta MVD1000 Advantages

Delta MVD1000 is easy to operate and maintain, and offers special features for integration into a broad range of applications.

System Cooling fans

- Effective air-cooling design.
- Easy maintenance.

Transformer Cabinet

- The transformer secondary windings provide isolated phase-shifted power for improved current waveforms and lower grid harmonic distortion.
- Cooling fans specifically mounted for transformer.

Bypass Cabinet

Manual or synchronous transfer bypass cabinets.

Power Cell Cabinet

- Modular design of power cell allows easy interchange and maintenance.
- Optical interface with main controller cabinet.

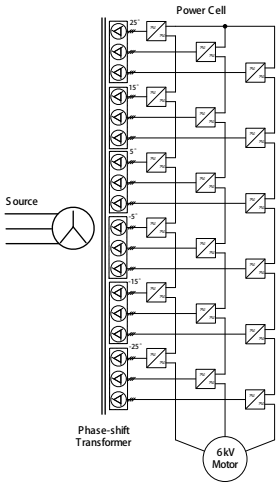
Controller Cabinet

- Touch screen display for monitoring and parameter setting.
- High performance DSP for reliable control
- Analog and digital signal I/Os for different types of applications
- Reliable UPS power control system

System Architecture

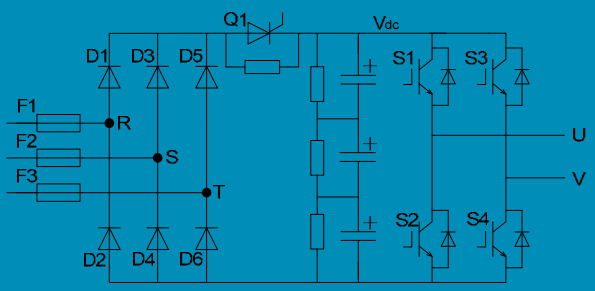
- IGBT-based power cells connected in series to achieve working voltage using modular design for high flexibility and reliability
- Extremelly low motor and AC line current harmonics
- Fast transient response and wide motor frequency range

System voltage	Cells/Phase	Phase-shift transformer(pulses)
3.3kV	3/4	18/24
4.16kV	4/5	24/30
6kV	5/6	30/36
6.6kV	6	36
10kV	8/9	48/54
11kV	10	60



Power Cell Topology

The power cell inputs are connected with the 3-phase low voltage outputs of the transformer secondary windings. A three-phase diode rectifier charges the DC link capacitor, which supplies the H-bridge single phase inverter circuit formed by 4 IGBTs. The power cells receive the PWM signal through optical fiber to control the on/off states of IGBTs S1~S4. The resulting output of each power cell is a single-phase pulse width modulated waveform.



Power cell components

- Three phase diode rectifying circuit
- DC capacitor for energy storage
- IGBT inverting circuit
- Gate drives, control board, and auxiliary power supply

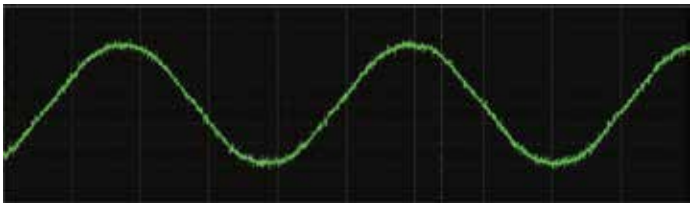
Advantages

- Compact size
- Simple
- Easy installation and maintenance

High Input / Output Power Quality

Low Input / Output Harmonics (6kV)

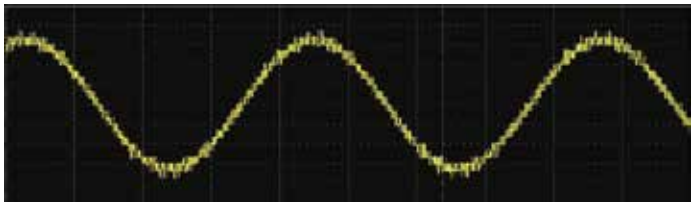
- 1.5% Output current distortion
- 0.25% Output voltage distortion
- 1.8% Input current distortion at rated load



Output current waveform

Almost Sine Wave Output

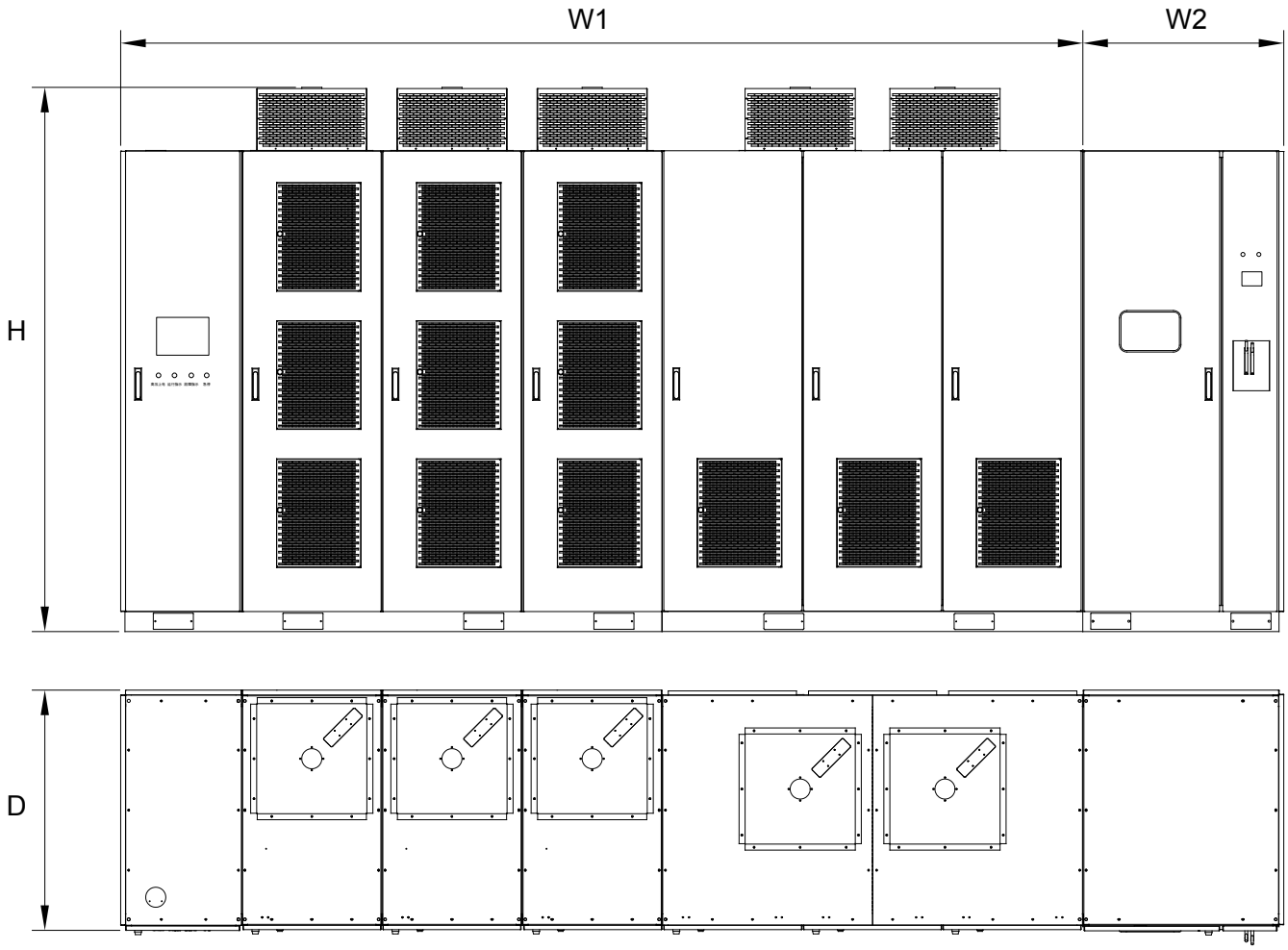
- No extra output filter required
- Applicable to induction or synchronous motors
- No need for motor derating operation
- Low dv/dt, avoid damaging insulation of motor and cables
- No torque ripple resulting from output harmonics
- Cable length limited by voltage drop



Output voltage waveform

Dimensions

Front Panel (6kV series)



Standard Product Selection

Rated Voltage	Motor power	MVD Model Name	H	W1	D	Weight	Bypass cabinet (optional)	
							W2	Weight
kV	kW		mm	mm	mm	kg	mm	kg
3.3	160	MVD1□A035A□□	2100	2800	1200	1500	1030	700
	200	MVD1□A045A□□	2100	2800	1200	1500	1030	700
	250	MVD1□A055A□□	2100	2800	1200	1800	1030	700
	315	MVD1□A070A□□	2100	2800	1200	1800	1030	700
	355	MVD1□A080A□□	2100	2800	1200	2600	1030	700
	400	MVD1□A090A□□	2100	2800	1200	2600	1030	700
	450	MVD1□A100A□□	2100	2800	1200	2600	1030	700
	500	MVD1□A110A□□	2100	2800	1200	2600	1030	700
	530	MVD1□A120A□□	2400	3740	1200	3300	1030	900
	630	MVD1□A140A□□	2400	3740	1200	3300	1030	900
	710	MVD1□A160A□□	2400	3740	1200	3300	1030	900
	800	MVD1□A175A□□	2400	3740	1200	3300	1030	900
	900	MVD1□A200A□□	2400	3740	1200	4000	1030	900
	1000	MVD1□A220A□□	2400	3740	1200	4000	1030	900
	1120	MVD1□A245A□□	2400	3740	1200	4000	1030	900
	1250	MVD1□A275A□□	2400	4300	1400	4800	1030	900
	1350	MVD1□A300A□□	2400	4300	1400	4800	1030	900
	2000	MVD1□A438A□□	2700	4850	1400	9500	1030	800
	2560	MVD1□A560A□□	2700	5450	1400	10500	1030	800
	3110	MVD1□A680A□□	2782	6200	1400	11500	1030	800
	3840	MVD1□A840A□□	2782	6200	1400	12000	1030	800
4.16	160	MVD1□B030A□□	2100	3100	1200	1600	1030	700
	200	MVD1□B035A□□	2100	3100	1200	1600	1030	700
	250	MVD1□B045A□□	2100	3100	1200	1600	1030	700
	315	MVD1□B055A□□	2100	3100	1200	1900	1030	700
	355	MVD1□B065A□□	2100	3100	1200	1900	1030	700
	400	MVD1□B070A□□	2100	3100	1200	1900	1030	700
	450	MVD1□B080A□□	2100	3100	1200	3000	1030	700
	500	MVD1□B090A□□	2100	3100	1200	3000	1030	700
	560	MVD1□B100A□□	2100	3100	1200	3000	1030	700
	630	MVD1□B110A□□	2100	3100	1200	3000	1030	700
	710	MVD1□B125A□□	2400	3800	1200	3800	1030	900
	800	MVD1□B140A□□	2400	3800	1200	3800	1030	900
	900	MVD1□B160A□□	2400	3800	1200	3800	1030	900
	1000	MVD1□B165A□□	2400	3800	1200	3800	1030	900
	1120	MVD1□B195A□□	2400	4200	1200	4300	1030	900
	1250	MVD1□B220A□□	2400	4200	1200	4300	1030	900
	1350	MVD1□B235A□□	2400	4200	1200	4300	1030	900
	1500	MVD1□B260A□□	2400	4200	1400	5100	1030	900
	1800	MVD1□B300A□□	2400	4200	1400	5100	1030	900
	2520	MVD1□B438A□□	2700	5400	1400	9500	1030	800
	3230	MVD1□B560A□□	2700	6000	1400	10400	1030	800
	3920	MVD1□B680A□□	2782	6900	1400	11600	1030	800
	4840	MVD1□B840A□□	2782	6900	1400	13500	1030	800

Rated Voltage	Motor power	MVD Model Name	H	W1	D	Weight	Bypass cabinet (optional)	
							W2	Weight
kV	kW		mm	mm	mm	kg	mm	kg
6	280	MVD1□C035A□□	2100	3720	1200	2500	1030	700
	315	MVD1□C040A□□	2100	3720	1200	2500	1030	700
	355	MVD1□C045A□□	2100	3720	1200	2500	1030	700
	400	MVD1□C050A□□	2100	3720	1200	3100	1030	700
	450	MVD1□C055A□□	2100	3720	1200	3100	1030	700
	500	MVD1□C060A□□	2100	3720	1200	3100	1030	700
	560	MVD1□C070A□□	2100	3720	1200	3100	1030	700
	630	MVD1□C075A□□	2100	3820	1200	3800	1030	700
	710	MVD1□C085A□□	2100	3820	1200	3800	1030	700
	800	MVD1□C100A□□	2100	3820	1200	4600	1030	700
	900	MVD1□C110A□□	2100	3820	1200	4600	1030	700
	1000	MVD1□C120A□□	2100	3820	1200	4600	1030	700
	1120	MVD1□C135A□□	2400	4070	1200	4600	1030	700
	1250	MVD1□C150A□□	2400	4070	1200	5900	1030	800
	1400	MVD1□C170A□□	2400	4070	1200	5900	1030	800
	1600	MVD1□C185A□□	2400	4070	1200	7400	1030	800
	1800	MVD1□C210A□□	2400	4070	1400	7400	1030	800
	2000	MVD1□C230A□□	2400	4070	1400	7400	1030	800
	2240	MVD1□C260A□□	2400	4070	1400	7800	1030	800
	2500	MVD1□C290A□□	2400	4070	1400	7800	1030	800
	3640	MVD1□C438A□□	2740	7180	1450	10500	1030	950
	4660	MVD1□C560A□□	2900	8000	1500	12000	1030	1050
	5650	MVD1□C680A□□	2900	8000	1600	13200	1030	1050
	6980	MVD1□C840A□□	2900	8000	1600	14000	1030	1050
6.6	250	MVD1□D030A□□	2100	3800	1200	3200	1030	700
	315	MVD1□D035A□□	2100	3800	1200	3200	1030	700
	355	MVD1□D040A□□	2100	3800	1200	3200	1030	700
	400	MVD1□D045A□□	2100	3800	1200	3200	1030	700
	450	MVD1□D050A□□	2100	3800	1200	3200	1030	700
	500	MVD1□D055A□□	2100	3800	1200	3800	1030	700
	560	MVD1□D065A□□	2100	3800	1200	3800	1030	700
	630	MVD1□D070A□□	2100	3800	1200	3800	1030	700
	710	MVD1□D080A□□	2100	3800	1200	5700	1030	700
	800	MVD1□D090A□□	2100	3800	1200	5700	1030	700
	900	MVD1□D100A□□	2100	3800	1200	5700	1030	700
	1000	MVD1□D110A□□	2100	3800	1200	5700	1030	700
	1120	MVD1□D125A□□	2400	4430	1200	6800	1030	900
	1250	MVD1□D140A□□	2400	4430	1200	6800	1030	900
	1350	MVD1□D150A□□	2400	4430	1200	6800	1030	900
	1500	MVD1□D165A□□	2400	4430	1200	6800	1030	900
	1800	MVD1□D190A□□	2400	4430	1200	6800	1030	900
	2000	MVD1□D210A□□	2400	4800	1200	8300	1030	900
	2240	MVD1□D235A□□	2400	4800	1200	8300	1030	900
	2400	MVD1□D250A□□	2400	4800	1200	8300	1030	900
	2500	MVD1□D265A□□	2400	5100	1400	9400	1030	900
	2900	MVD1□D305A□□	2400	5100	1400	9400	1030	900
	4000	MVD1□D438A□□	2700	6600	1400	9800	1030	1050
	5120	MVD1□D560A□□	2700	7800	1400	10700	1030	1050
	6220	MVD1□D680A□□	2782	7800	1400	11300	1030	1050
	7680	MVD1□D840A□□	2782	7800	1400	12500	1030	1050

Rated Voltage	Motor power	MVD Model Name	H	W1	D	Weight	Bypass cabinet (optional)	
							W2	Weight
kV	kW		mm	mm	mm	kg	mm	kg
10	280	MVD1□E020A□□	2100	4200	1200	3800	1030	700
	315	MVD1□E022A□□	2100	4200	1200	3800	1030	700
	355	MVD1□E025A□□	2100	4200	1200	3800	1030	700
	400	MVD1□E030A□□	2100	4200	1200	3800	1030	700
	450	MVD1□E035A□□	2100	4200	1200	3800	1030	700
	560	MVD1□E040A□□	2100	4200	1200	3800	1030	700
	630	MVD1□E045A□□	2100	4200	1200	3800	1030	700
	710	MVD1□E055A□□	2100	4200	1200	5100	1030	700
	800	MVD1□E060A□□	2400	4200	1200	5100	1030	700
	900	MVD1□E065A□□	2400	4200	1200	5100	1030	700
	1000	MVD1□E075A□□	2400	4920	1200	5900	1030	700
	1120	MVD1□E080A□□	2400	4920	1200	5900	1030	700
	1250	MVD1□E090A□□	2400	4920	1200	5900	1030	700
	1400	MVD1□E105A□□	2400	4920	1400	6500	1030	700
	1600	MVD1□E115A□□	2400	4920	1400	6500	1030	700
	1800	MVD1□E130A□□	2400	4920	1400	6500	1030	700
	2000	MVD1□E140A□□	2400	5640	1400	8200	1030	800
	2240	MVD1□E155A□□	2400	5640	1400	8200	1030	800
	2500	MVD1□E175A□□	2400	5640	1400	8200	1030	800
	2800	MVD1□E195A□□	2400	5640	1400	9700	1030	800
	3150	MVD1□E220A□□	2400	5640	1400	9700	1030	800
	3550	MVD1□E250A□□	2400	5640	1400	10800	1030	800
	4000	MVD1□E275A□□	2400	5640	1400	10800	1030	800
	6070	MVD1□E438A□□	2740	9280	1500	13500	1030	1000
	7760	MVD1□E560A□□	2900	10400	1550	14000	1030	1050
	9420	MVD1□E680A□□	2900	11400	1600	15600	1030	1050
	11640	MVD1□E840A□□	2900	11400	1600	17300	1030	1050
11	315	MVD1□F020A□□	2100	5100	1200	5000	1030	700
	355	MVD1□F025A□□	2100	5100	1200	5000	1030	700
	450	MVD1□F030A□□	2100	5100	1200	5000	1030	700
	530	MVD1□F035A□□	2100	5100	1200	5000	1030	700
	560	MVD1□F040A□□	2100	5100	1200	5000	1030	700
	630	MVD1□F045A□□	2100	5100	1200	5000	1030	700
	710	MVD1□F050A□□	2100	5100	1200	6100	1030	700
	800	MVD1□F055A□□	2400	5400	1200	6100	1030	900
	900	MVD1□F060A□□	2400	5400	1200	6100	1030	900
	1000	MVD1□F065A□□	2400	5400	1200	6100	1030	900
	1120	MVD1□F075A□□	2400	5400	1200	7500	1030	900
	1250	MVD1□F085A□□	2400	5400	1200	7500	1030	900
	1350	MVD1□F090A□□	2400	5400	1200	7500	1030	900
	1500	MVD1□F100A□□	2400	5400	1200	7500	1030	900
	1800	MVD1□F120A□□	2400	5400	1200	7500	1030	900
	2000	MVD1□F135A□□	2400	6200	1400	9500	1030	900
	2400	MVD1□F150A□□	2400	6200	1400	9500	1030	900
	2800	MVD1□F175A□□	2400	6200	1400	9500	1030	900
	3000	MVD1□F190A□□	2400	6200	1400	9500	1030	900
	3150	MVD1□F200A□□	2500	6500	1450	12000	1030	1000
	3400	MVD1□F215A□□	2500	6500	1450	12000	1030	1000
	3800	MVD1□F240A□□	2500	6500	1450	12000	1030	1000
	4000	MVD1□F250A□□	2500	6500	1450	12000	1030	1000
	4200	MVD1□F265A□□	2500	6500	1450	13100	1030	1000
	4600	MVD1□F290A□□	2500	6500	1450	13100	1030	1000
	6680	MVD1□F438A□□	2850	9900	1450	13900	1030	1050
	8540	MVD1□F560A□□	2900	11900	1550	15000	1030	1050
	10360	MVD1□F680A□□	2900	12500	1600	16800	1030	1050
	12800	MVD1□F840A□□	2900	12500	1600	19000	1030	1050

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 Testing

• High Voltage Distribution Cabinets

• Low voltage inverter (re-generation)

• Central Control Room

• Full Load Burn-in Chamber

• Thermal Chamber

• Motor-Generator Groups

International Certification

ISO 9001:2008

ISO 14001:2004

OHSAS 18001:2007

QC 080000:2007

TL 9000 R5.0

CE(EMC)

Delta MVD1000 Specifications

Input Frequency	50Hz/60Hz (-2% ~ +2%)
Control Power	AC380V (three-phase four-wire) or AC220V, 3kVA
Input current distortion	<5% (at rated speed and load, complying with IEEE 519)
Power factor	>0.96 (at rated speed and load)
Efficiency	>98% (at rated frequency and load, excluding transformer)
Frequency range	0~75Hz
Frequency resolution	0.01Hz
Overload capacity	120% for 1 min every 10 min; 150% stop immediately
PID function	Built-in PID regulator with configurable parameters
Modulation method	SPWM/SVPWM
Speed acceleration & deceleration time	0~3000s (configurable)
Function configuration	Torque boost, frequency skipping, automatic voltage regulation, failure diagnosis, flying start, system bypass, ride through, multipoint V/F control, power cell bypass (optional), space heater synchronous transfer switch (optional)
Analog inputs	0~10V / 4~20mA 2 channels (expandable)
Analog outputs	0~10V / 4~20mA 4 channels (expandable)
Digital I/Os	10 digital inputs and 8 digital outputs (expandable)
Communication interface	Isolated RS485, Industrial Ethernet (optional), GPRS (optional)
Communication protocol	MODBUS, PROFBUS, Others
Operating temperature	-5℃ to +40℃ (normal operation)
Storage/transportation temperature	-40 ℃ to +70 ℃
Relative humidity	5% to 95%, non condensating
Altitude	<1000m (normal operation) derated use at higher altitude
Cooling	Forced air cooling
Protection level	IP30 (standard) others can be customized
Regulations and certification	IEC, IEEE, GB, and CE mark

Input Voltage:
3.3 kV~11 kV
(-/+10%)

Motor Shaft Power:

3.3 kV:	160~3840kW	4.16 kV:	160~4840kW
6 kV:	280~6980kW	6.6 kV:	250~7680kW
10 kV:	280~11640kW	11 kV:	315~12800kW

Compliance & Standards

Standard No.	Standard Name
GB 156-2007	Standard voltages
GB/T 1980-2005	Standard frequencies
GB/T 2423.10	Electric and electronic products--Basic environmental test regulations for electricians--Guidelines for vibration (sine)
GB/T 2681	Colors of insulated conductors used in electrical assembly devices
GB 2682	Colors of indicator lights and push-buttons used in electrical assembly devices
GB/T 4588.1-1996	Specification for single and double sided printed boards with plain holes
GB/T 4588.2-1996	Sectional specification: Single and double sided printed boards with plated-through holes
GB 7678-87	Semiconductor self-commutated converters
GB/T 10233-2005	Basic test method for electric-driven control gear assemblies
GB 12668-90	General specification for speed control assembly with semiconductor adjustable frequency for A.C. motor
GB/T 15139-94	General technical standard for electrical equipment structure
GB/T 13422-92	Power semiconductor converters--Electrical test methods
GB/T 14549-93	Quality of electric energy supply harmonics in public supply network
IEEE 519-1992	IEEE recommended practices and requirements for harmonic control in electrical power systems
GB/T 12668.4-2006	Adjustable speed electrical power drive systems. Part 4: General requirements. Rating specifications for A.C. power drive systems above 1000 V A.C. and not exceeding 35 kV
GB/T 3797-2005	Electric-driven control gear-Part 2: Electric-driven control gear incorporating electronic devices
GB/T 2900.18-2008	Electrotechnical terminology--Low voltage apparatus (eqv IEC60050-441:1984)
GB/T 3859.1-93	Semiconductor converters. Specification of basic requirements-eqv IEC60146-1 -1:1991)
GB/T 3859.2-93	Semiconductor converters. Application guide (eqv IEC60146-1-2:1991)
GB/T 3859.3-93	Semiconductor converters. Transformers and reactors (eqv IEC 60146-1-3,1991)
GB 4208-2008	Degrees of protection provided by enclosures (IP Code) (eqv IEC 60529:1989)
GB/T 16935.1-2008	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests (idt IEC 60664-1-1992)
IEC 60038:1983	IEC Standard voltages
IEC 60050-151:2001	International electrotechnical vocabulary, chapter 151: electrical and magnetic devices.
IEC 60050-551:1999	International Electrotechnical Vocabulary. Chapter 551: Power electronics.
IEC 60076	Electric power transformer
IEC 60721-3-1:1997	Classification of environmental conditions Part 3: classification of groups of environmental parameters and their severities, storage.
IEC 60721-3-2:1997	Classification of environmental conditions Part 3. Classification of groups of environmental parameters and their severities, transportation.
IEC 60721-3-3:2008	Classification of environmental conditions Part 3. Classification of groups of environmental parameters and their severities, operation. Stationary use at weather protected locations.
IEC 61000-2-4:2002	Electromagnetic compatibility (EMC) Part 2- Environment chapter 4- Compatibility levels in industrial equipment for low frequency conducted disturbances.
IEC 61000-4-7:2002	Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques chapter 7. General guide on harmonics and inter-harmonics measurements and instrumentation, for power supply systems and equipment connected.
IEC 61800-3:2004	Adjustable speed electrical power drive systems Part 3: product standard including specific test methods.
IEC 60757-1983	Identification of insulated and bare conductors by colors.
IEC 61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical , thermal and energy

Delta MVD1000 Successful Application

Delta MVD1000 Application for Water Circulation Pump in Coking Plant

1. Water Circulation Pump Introduction

Prior to installing the MVD1000, the water circulation pump at the Shandong Coking Group CO was driven by an induction motor directly started from the grid. During startup the valve used to control pressure was closed, and then open accordingly to regulate the required pressure at the top of the cooling tower. The original system presented the following problems:

(1) The outlet pressure and flow was higher than the actual needs, which caused low efficiency and serious losses in the pipeline.

(2) The performance of the valve tuning system was inefficient and since the valve's sealing was not perfect, water leak was observed.

(3) The process efficiency is quite low, especially at light load.

(4) The overall installation required heavy maintenance work and high cost.

Circulation pump drive motor overview:

10kV drive and load parameters:

Parameter / Device	Quantity	Rated Power (kW)	Rated Speed (rpm)	Rated Voltage (kV)	Rated Current (A)
Circulation pump	1	560	1490	10	40

Measured parameter of:

Parameter / Device	Actual Input Voltage (kV)	Operating Current (A)	Pressure (Mpa)	Valve Open rate	Pressure Requirement (Mpa)	Remark
Circulation pump	10.5	27.9	5.0	100%	3.5	Direct online startup

2.MVD Application

The MVD system has been installed indoors with the following steps accounted for:

(1) A remote user's control panel has been setup for operation. The user can control the on / off MVD state, set speed and monitor the status via the remote control panel

(2) The MVD can feedback its status to the plant DCS (distributed control system). For the remote control available case, the MVD can accept the DCS remote control command.

(3) The DCS can set load speed via 4~20mA analog input signal. In return, the MVD can send back to DCS the speed, current, and other variables relative to its status via 4~20mA analog output signal.

(4) The end user's existing DCS valve control system is preserved, so the DCS can switch to original valve control system whenever the MVD is under scheduled maintenance.

3. Energy Saving Effect with MVD

10kV Energy Saving Economic Analysis

Energy saving estimation

• Data provided by user

(1) Pump rated speed, n_1 = 1490rpm

(2) Operation point (Q_0, H_0): Q_0, H_0 with real power on the grid side = 462kW

(3) Operation point (Q_1, H_1): Q_1, H_1 = 5MPa and P_1 = 353kW

(4) Efficiency, η, vs. speed, n, pump characteristic curve

(5) Desired operation point (Q_2, H_2): H_2 = 3.5MPa

• From affinity laws

(1) $Q_1 / Q_2 = n_1 / n_2$

(2) $H_1 / H_2 = (n_1 / n_2)^2 \rightarrow 5 / 3.5 = (1490 / n_2)^2 \rightarrow n_2 = 1246rpm$

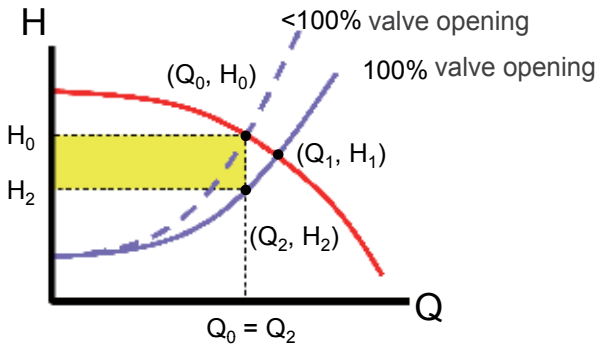
(3) $P_1 / P_2 = (n_1 / n_2)^3 \rightarrow 353 / P_2 = (1490 / 1246)^3 \rightarrow P_2 = 206kW$

• Power saving $\Delta P = P_{grid} – (P_2 / \eta_{pump,\ 2} / \eta_{MVD})$

= 462 – (206 / 0.8 / 0.96)

= 214kW

Power saving rate = 214 / 462 × 100% = 46%



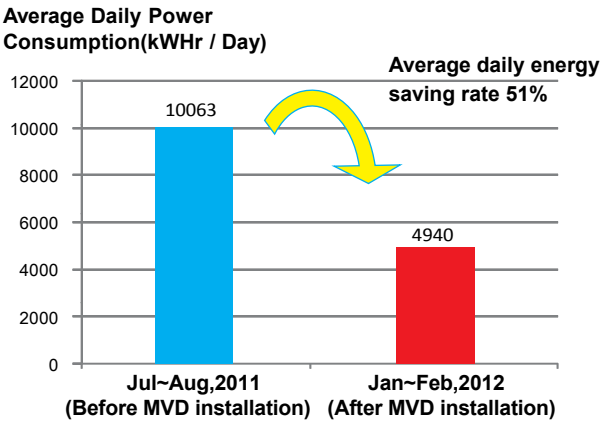
Other MVD Application Benefits:

(1) Elimination of the grid voltage fluctuation during motor startup.

(2) Elimination of the inrush motor current and its impact on mechanical stresses.

(3) Extension of motor and pipeline lifetime, reducing maintenance and costs.

Delta MVD Measured Energy Saving Effect



4. Remarks

The result after installing the MVD for the circulation water pump application has been very impressive. The stability of the process increased, providing a more economic operation. The system efficiency has been enhanced with more than 40% energy saving. It will save more than 75,000 USD on the power bill per year and provide very short payback time. Besides, MVD1000 extends the life time of the motor, pump and pipelines, and reduces carbon dioxide emissions.

Delta has been recognized and trusted by customers for delivering high performance operation, quality products, technical service, site technology, and energy savings. Delta MVD requires a small footprint, it is easy to install and has significantly improved plant efficiency, enhanced grid stability by providing motor soft start , and increased the lifetime of equipment.

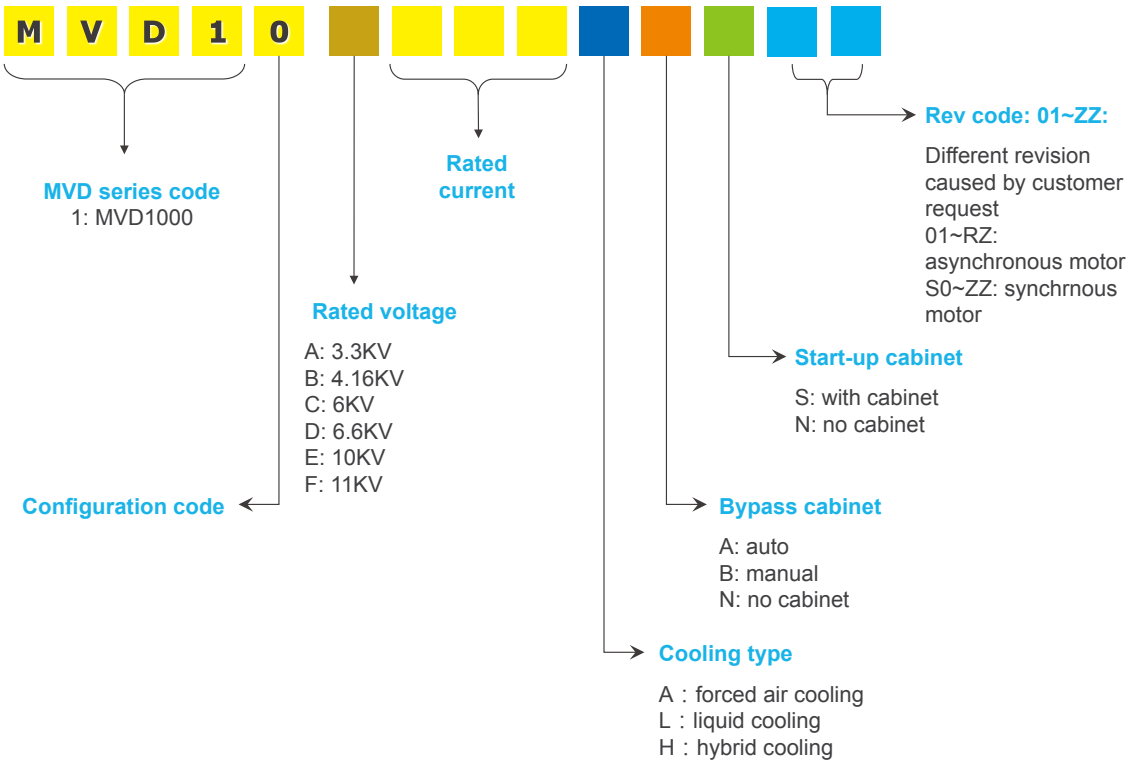
• On-site picture

• MVD1000 for circulation water pump

Global Sales & Service

Delta Electronics has sales and service locations around the world.

System Model Names



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