MV1000
The Efficient, Reliable Medium Voltage AC Drive
The Next Generation

Most MV Drives offer energy savings with improved process control. The MV1000 provides these features of course, but leapfrogs the industry with state-of-the-art features and outstanding reliability.

Building on past success, the MV1000 minimizes application and installation issues, by providing:
- Minimal Input Power Distortion (THD)
- Multi-phase Input Transformer with Galvanic Isolation
- Near Sinusoidal Output Waveform
- Proven Reliability with High Performance
- Compact Size
- User Friendliness
- Compatibility with Yaskawa A1000 LV Products

The MV1000 offers high performance and proven Yaskawa reliability. Based on the A1000 control platform, application flexibility is assured. Yaskawa’s proven QC/QA processes offer the highest reliability in the MV drive industry.

A History of the path we took to bring you the MV1000 Medium Voltage AC Drive:

Low Voltage Drive:
- G7 - 7th generation low-voltage drive
  - Developed to meet a wide range of applications
  - The world’s first general-purpose low-voltage drive

MV1000:
- 1998 - VS-686HV5S
- 2002 - VS-686HV5SD

Medium-voltage drive:
- 1996 - VS-686HV5

Installation Friendly
- Power system friendly: 36-pulse input exceeds industry requirements; transformer provides isolation and makes drive insensitive to power line quality issues.
- Motor friendly: 17-level motor waveform suitable for standard motors

Proven Reliability
- Yaskawa’s superior design and quality control provides reliability that is unmatched in the industry.
- Highest MTBF = Lowest Life Cycle Cost (LCC)

High Performance
- Control platform based on hugely successful A1000 low voltage product
- Open loop vector (OLV) or closed loop vector (CLV) for control of the most difficult loads

Compact Design
- Optimal packaging facilitates transportation, installation, and maintenance

User Friendly
- Operation, adjustment, maintenance, and management are simple and intuitive
- Utilizes the same keypad as Yaskawa’s 1000 series low voltage drives and a parallel parameter set

Global Standards
- Conforms with UL, CSA, IEEE 519 and other global standards

A History of the path we took to bring you the MV1000 Medium Voltage AC Drive:

High-voltage drive:
- G7 - 7th generation high-voltage drive
  - Designed to meet the needs of large power systems

MV1000:
- 2005 - MV1S

2.3 kV Models: 200 - 2750 HP
3.3 kV Models: 175 - 4000 HP
4.16 kV Models: 300 - 12,000 HP
6.6 kV Models: 330 - 16,000 HP
11 kV Models: Consult Yaskawa
### Application Friendly

Reduced input harmonics combined with motor friendly output

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Yaskawa Smart Harmonics™ Technology and PWM Control

Input Total Harmonic Distortion (THD) < 2.5% without filters!

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**Minimized Input Harmonics Exceed Guidelines**

Yaskawa’s original Smart Harmonics™ Technology incorporated in the MV1000 drastically reduces input harmonics.

The resulting input waveform is near sinusoidal, exceeding the requirements of IEEE519-1992.

No input filter is necessary.

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**Measured Harmonics and Input Current**

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<thead>
<tr>
<th>Harmonic</th>
<th>5th</th>
<th>7th</th>
<th>11th</th>
<th>13th</th>
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<tr>
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<td><strong>MV1000 1000 HP 4.16 kV</strong></td>
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<td>0.16%</td>
<td>0.03%</td>
<td>0.04%</td>
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<tr>
<td><strong>Typical 24-Pulse Scheme</strong></td>
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<td>1.60%</td>
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<td>0.20%</td>
<td>0.10%</td>
<td>1.90%</td>
<td>0.80%</td>
<td>3.80%</td>
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**9/17 Level Output Waveform using Enhanced Cascaded H Bridge (CHB) Configuration**

**Configuration of One Power Cell**

MV1000 uses multiple 3-level power cells and requires only 2 power cells per phase at 4.16 kV.

**Cell Waveform**

Output voltage of single power cell

**Phase Waveform**

Line to neutral voltage for 4.16 kV drive

Result is “9-level” waveform

**Output Waveform**

Line to line voltage for 4.16 kV drive

Result is “17-level” line to line voltage waveform applied to motor

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Motor friendly output allows the use of existing motors without supplemental filtering, even at long lead lengths!
Yaskawa Quality and Reliability

Yaskawa’s quality has always led the drives industry, and each generation builds on the last. The last generation medium voltage product (the MV1S) has a proven field MTBF greater than 300,000 hours. The MV1000 builds on the previous generation MV Drives success using the same rigorous design rules and Quality Control/Quality Assurance (QC/QA) practices.

With ISO 9001 certification, a Supplier Rating Program, and rigorous testing, Yaskawa ensures that quality and reliability are designed in and built in. Field data confirms that calculated MTBF (Mean Time Between Failures) targets are exceeded in actual production units.

We’re the only industrial drives and motion control manufacturer to win the Deming Medal, the most prestigious quality award in manufacturing.

Yaskawa constantly tracks and measures product failures in time (FIT). The actual FIT data demonstrates a high quality and reliability rate that is the envy of our Industry. This field data confirms that we do, in fact, exceed our design targets for reliability.

Yaskawa’s overall FIT is based on the failure reports received from the field for a period of time, monthly (including Warranty and Non-Warranty items), and is as follows:

- FIT = Qty of Failures / ([30 days x 24 hours per day] x [total qty of units shipped]) x 10^9. Our calculations follow the Bellcore TR-332 Standard.
- MTBF is defined for a repairable system and is calculated as the inverse number of FIT mentioned above (MTBF = 1/FIT).

Cost Control and Quality Go Hand in Hand

Providing a high-quality product actually lowers manufacturing costs. Lean processes, rigorous inventory control, less defects and waste, fewer returns, and minimal repair and replacement translate to reduced costs that enable Yaskawa to offer a superior product at a very competitive price.

Kaizen: Continuous Improvement

Yaskawa has incorporated the Kaizen philosophy of continuous improvement into every facet of its operations. Kaizen literally means “change for the better”. Key elements of the process are teamwork, personal discipline, improved morale, quality circles, and suggestions for improvement from all levels of employees.

The ultimate effects of the Kaizen process, elimination of waste and inefficiency, achieving discipline and standardization, mean that every day Yaskawa is improving the quality of its products while lowering costs.

Defect Prevention is the Key to Quality

Yaskawa manufacturing processes are designed to prevent defects. Production associates have paperless on-line resources at their workstations, providing highly detailed and up-to-date work instructions for every process step. Practice mechanisms are available in the Kaizen center for them to improve their assembly skills. Complex assemblies are made simple with the use of animations and video. All components are verified and approved before they are installed, and frequent in-process quality checks prevent a unit from moving down the line until quality is assured.

Yaskawa incorporates the Kaizen method of continuous incremental improvements along with our Total Quality Management processes to create a unique and highly effective approach to zero-defect manufacturing.

Our internal assembly failure rate is 0.01% (assembly errors found in the actual assembly process)

The field assembly failure rate is 0.0062% (assembly errors that are found after the product is installed in the field).
Advanced Features

Precision Control and Stability
Open Loop Vector control enables smooth acceleration from low speed without using an encoder. Operation is stable, unaffected by fluctuations in load. The high performance vector control can be applied to synchronous motors as well as induction motors.

Starting Characteristics
Motor Torque
Motor Speed
Motor Control

Running Multiple Motors
The capability to run multiple induction motors in parallel with a single drive can reduce the size of the system as a whole.

Motor Current
Motor Speed
Motor Torque

Speed Search Function
Input Voltage
Motor Speed
Speed Reference
Motor Control

Kinetic Energy Braking (KEB) Function
Input Voltage
Motor Speed
Speed Reference
Motor Control

KEB (Kinetic Energy Braking) Function uses stored mechanical energy in the load to continue operation during a momentary power loss

Synchronous Transfer from MV1000 to Utility Power

Voltage Waveform Display
- Drive Output Voltage (green)
- Utility Supply Voltage (red)

Current Waveform Display
- Drive Output Current (purple)
- Utility Supply Current (yellow)
- Motor Current (blue)

No Disturbance to Motor Current During Transition

Other Important Design Features
- Power dip ride through
- Undervoltage trip at 70% of nominal input
- Automatic restart
- Auto tuning
- DC bus capacitors designed for over 20 years life
- Individual IGBT junction temperature monitoring (via keypad or over communication link)
- Proprietary patented transformer design

Transition from utility power to drive also available.

Utility Contactor Closes
Drive Stop (Base Block)
Drive Output Contactor Opens

Utility and Drive Synchronized

Utility and Drive Synchronized
Optimal Packaging Design

Modular design with optimal footprint and maintainability

Typical Configuration of 1000 HP MV1000

**Power Cell Section**
- Two cells connected in series per single output phase
- Output phases are wye connected to generate the rated output voltage
- Each individual power cell can be drawn out for maintenance

**Transformer Section**
- Houses input and output power terminals and 36-pulse transformer

**Control Section**
- Houses the control boards and I/O interfaces, with roll-out drawer
- Communicates with power cell through fiber optic cables
- Low voltage circuit breakers for auxiliary circuitry
- Communication plug-ins and other options (same as 1000 series low voltage drives)

**Cooling Fans**
- Individual speed monitoring
- Redundant fan option

Typical Configuration of 2000 HP MV1000 with Input Switchgear

**Input Switchgear**
- Non-load break switch
- E-rated, current-limiting fuses
- Vacuum contactor for interrupting circuit
- All CSA/UL rated components
- Viewing window

**Cooling Fans**
- Individual speed monitoring
- Redundant fan option

**Transformer Section**
- Multi-pulse transformer
- Two power cells per phase

**Control Section**
- Houses the control boards and I/O interfaces, with roll-out drawer
- Communicates with power cell through fiber optic cables
- Low voltage circuit breakers for auxiliary circuitry
- Communication plug-ins and other options (same as 1000 series low voltage drives)
User Friendly

Simple operation, adjustment and maintenance

Same User Interfaces as Yaskawa 1000 Series Low Voltage Drives

Digital Operator
A Digital Operator with an easy-to-view LCD display (the same as used on Yaskawa’s 1000 series low-voltage drives) is provided on the front panel as standard, making it easy to operate and set the drive.

Network Compatibility
The RS-485 communication function (Modbus protocol) is installed as standard. By adding an optional communication card, major network protocols can be supported.

USB Copy Unit
Enables the copying and transfer of parameters between drives using simple operations. This unit can also be used as a conversion connector between the communication port (RJ-45) of a drive and a USB port of a PC.

Note: No USB cable is needed to copy parameters to other drives.

Parameter Edit
Displays and edits drive parameters.

Pattern Operation
Runs the drive automatically in the preset patterns.

Oscilloscope
Displays the monitor data in real time while the drive is running.

DriveWizard Plus MV Programming Software
Provides support for a variety of adjustment and maintenance tasks

DriveWizard Plus MV enables consolidated management of the parameters for each drive on a PC. A variety of functions including monitoring, parameter editing, pattern operation, and oscilloscope functions facilitates adjustment and maintenance of the drives. In addition, the extensive trace and event log functions enable implementation of preventive maintenance and a quick response in case of a malfunction.
Industries/Applications

**Oil/Gas**

**Applications:**
- Mid-Stream Compressors & Pumps
- Oil Field Water Injection Pumps
- High Efficiency Fracking Pumps

**Water/Wastewater Treatment**

**Applications:**
- Pumps
- Aeration
- Fans

**Tire/Rubber**

**Applications:**
- Banbury Mixers
- Extract Fans
- Conveyors

**Mining**

**Applications:**
- Slurry Pumps
- Ventilation Fans
- Conveyors

**Power Generation**

**Applications:**
- ID and FD Fans
- Conveyors
- Ball Mills
- Bag House Fans

**Cement**

**Applications:**
- Conveyors
- Fans
- Rotary Kilns

**Chemical and Petrochemical**

**Applications:**
- Pumps
- Compressors
- Extruders
Aftermarket Support

Global Field Service
Yaskawa's certified field assistance is available globally, whenever and wherever you need it. Not only will you be quickly up and running, but our service engineers will educate your team about the Yaskawa products on your machines. We protect your investment beyond your immediate needs to maximize your machine’s life cycle. Many of our business partners send their equipment all over the world. Regardless of where you send your equipment, Yaskawa can arrange for field support.

Technical Training Services
Yaskawa TTS surrounds our customers with training options by offering classes at Yaskawa training facilities, onsite at the customer’s location as well as through the internet. Practical, hands-on training classes are held at our facilities. Factory onsite classes and Drives Road Show classes bring the classroom to the customer’s site to eliminate the need for travel.
eLearning Modules and eLearning Videos are user-friendly, computer-based training lessons that are effective, time efficient, instruction that can be performed anytime or anywhere there is a computer or mobile device. This is a perfect way to get the training you need in the least amount of time.

Technical Phone Support
Unlike our competitors, Yaskawa provides technical phone support at no charge to our customers. Yaskawa provides Customer Technical Support utilizing certified engineers to answer your questions quickly and effectively. These engineers are supported by an online global knowledge base that can be accessed by our customers from the Support section of yaskawa.com.

Yaskawa America Inc. Technical Phone Support:
United States: 1-800-YASKAWA (927-5292), dial 2
Outside the United States: 1-847-887-7457, dial 2
Hours: 7:00am to 5:30pm (CST) Mon-Fri
Email: technical_support@yaskawa.com

Yaskawa Solution Center
The Solution Center is a self-service knowledge database providing all the functionality and content customer need to resolve issues themselves, immediately, 24/7.

Our goal is to provide an online center where you can quickly find support solutions managed by our technical support teams along with documentation already available on yaskawa.com.

Check it out at solutioncenter.yaskawa.com

Factory Repair
Yaskawa has the best repair turnaround, best repair warranty, and best repair pricing in the industry. Our team of certified repair specialists will repair your Yaskawa products using original parts and factory tested procedures in our state-of-the-art repair facility to ensure your products are returned in perfect working order. All repairs meet the standards established by our global team. Our service includes the latest software and Engineering Change Order upgrades, a thorough cleaning, and a full evaluation of all boards and component items.

Yaskawa’s repair services are also accompanied by the best warranty in the industry. Call 1-800-YASKAWA for Repair Support or fill out the Repair Request Form at www.yaskawa.com

Exchange Inventory
Recognizing that maximizing uptime is critical, Yaskawa has the broadest range of exchange inventory in the industry that can be shipped at any time and to any location.

Parts Inventory
Unlike others who attempt to provide you with low quality replacement parts, Yaskawa’s high regard for quality enables us to support your investment with the largest inventory of factory authorized replacement parts.
**Catalog Code Designation**

**Product Type**
- Drive

**Product Series**
- MX1000 Series

**Region Code**
- A: Japan
- U: U.S.A.

**Input Voltage**
- A: 2.3 kV
- C: 3.3 kV
- D: 4.16 kV
- F: 6.6 kV
- J: 11.8 kV

**Output Voltage Class**
- A: 2 kV Class
- C: 3 kV Class
- D: 4 kV Class
- F: 6 kV Class

**Note:** Other input voltages available up to 15 kV. Please consult Yaskawa.

**Input Frequency**
- 50 Hz
- 60 Hz

**Output Frequency**
- 0.01 to 120 Hz

**Frequency Accuracy**
- Digital input: within ±0.01% of the max output frequency (-10°C to +40°C)
- Analog input: within ±0.5% of the max output frequency (-10°C to +40°C)

**Frequency Setting Resolution**
- Digital inputs: 0.01 Hz
- Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign)

**Output Frequency Resolution**
- 0.001 Hz

**Frequency Setting Methods**
- −10 to +10 V, 0 to +10 V, 4 to 20 mA

**Starting Torque**
- V/f: 130% at 3 Hz, OLV: 130% at 0.3 Hz, CLV: 130% at 0 r/min

**Speed Control Range**
- V/f: 1:20, OLV: 1:100, CLV: 1:1000

**Speed Control Accuracy**
- V/f: ± 2 to 3%, OLV: ± 0.5%, (25 °C ± 10 °C), CLV: ± 0.02% (25 °C ± 10 °C)

**Speed Response**
- OLV: 10 Hz, CLV: 50 Hz

**Accel/Decel Time**
- 0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)

**Motor Protection**
- Electronic thermal overload relay

**Momentary Overcurrent Protection**
- Drive stops when output current exceeds 132%

**Overload Protection**
- Drive stops after 60 s at 110% of rated output current

**Overvoltage Protection**
- Power Cell VPN > 1035 VDC

**Undervoltage Protection**
- Power Cell VPN < 300 VDC

**Momentary Power Loss Ride-Thru**
- Resumes operation if power loss is less than 2 s (standard) (UPS Required)

**Overheat Protection**
- Power Cell = Thermistor, Transformer = PT100 and Thermal Switch

**Ground Fault Protection**
- Electronic circuit protection

**Ambient Temperature**
- -5 to +40°C (up to +50°C with output current derate)

**Humidity**
- 95% RH or less (no condensation)

**Storage Temperature**
- -25 to +60°C (short-term temperature during transportation)

**Altitude**
- Up to 2000 m without derating, up to 4000 m with output current and voltage derating

**Communications Protocols (Optional)**
- EtherNet/IP, DeviceNet, Modbus TCP/IP, Modbus RTU, PROFIBUS DP, and PROFINET

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**Specifications**

**Input Switchgear**
- A: without input switchgear
- B: with input switchgear

**Control Option**
- A: 220 V Control
- B: 240/120 V Control

**Environmental Spec.**
- E1: IP40 (NEMA Type 1)

**Control Options**
- A: 220 V Control
- B: 240/120 V Control

**Note:** All input voltages are not necessarily compatible with all output voltage classes.

**Output Current**

<table>
<thead>
<tr>
<th>2.3 kV Units</th>
<th>4.16 kV Units</th>
<th>3.3 kV Units</th>
<th>6.6 kV Units</th>
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**11 kV models also available. Please consult Yaskawa.**
## Models & Ratings

### 2.3 kV Models

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<thead>
<tr>
<th>Model Number</th>
<th>Nominal Capacity</th>
<th>Output Rating</th>
<th>Overload Ratings</th>
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<tbody>
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<td>Motor Capacity</td>
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Overload Ratings:
- Three-Phase: 2400 V
- Sine wave, proportional to input voltage
- 110% of rated output current for 60 sec.
- 120% of rated output current for 15 sec.

### 3.3 kV Models

<table>
<thead>
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Overload Ratings:
- Three-Phase: 3000 V or 3300 V
- Sine wave, proportional to input voltage
- 110% of rated output current for 60 sec.
- 120% of rated output current for 15 sec.
## Models & Ratings

### 4.16 kV Models

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### 6.6 kV Models

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Three-Phase: 4160 V
Sine wave, proportional to input voltage

Three-Phase: 6000 V or 6600 V
Sine wave, proportional to input voltage

110% of rated output current for 60 sec.
120% of rated output current for 15 sec.
Yaskawa is the leading global manufacturer of low and medium voltage variable frequency drives, servo systems, machine controllers and industrial robots. Our standard products, as well as tailor-made solutions, are well known and have a high reputation for outstanding quality and reliability.