

**YASKAWA**

# 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

## 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  
(The world's first general-purpose drive employing three-level control)

**1000 series**  
(J1000/V1000/A1000/P1000/U1000)

## Medium-voltage drive

**VS-686HV5** ● 1996

Medium-voltage drive with multiple outputs connected in series (first commercial product in Japan)

**VS-686HV5S** ● 1998

**VS-686HV5SD** ● 2002

**MV1S** ● 2005

**MV1000**

# Our Commitment to You

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.



## 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

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

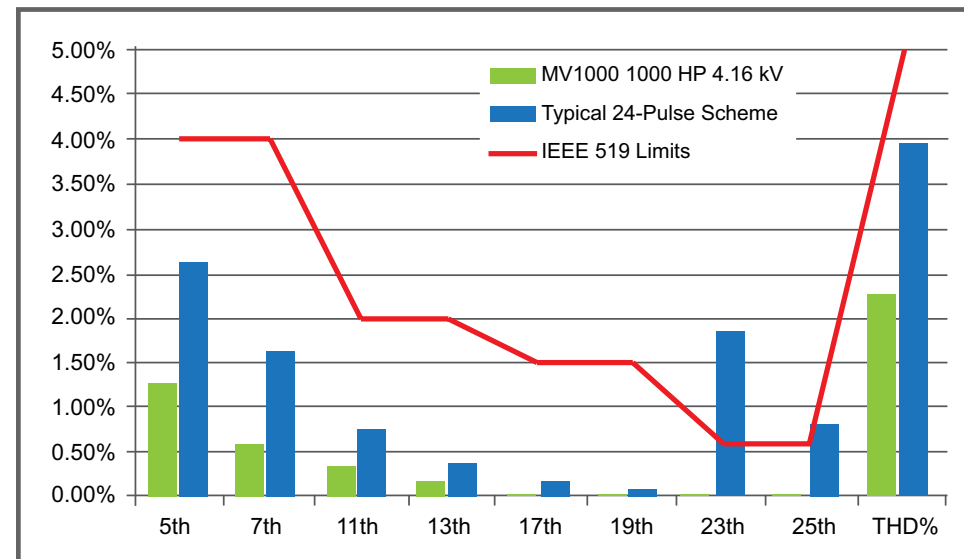
11 kV Models:  
Consult Yaskawa

# Application Friendly

Reduced input harmonics combined with motor friendly output

Yaskawa Smart Harmonics™ Technology and PWM Control  
Input Total Harmonic Distortion (THD) < 2.5% without filters!

## 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.

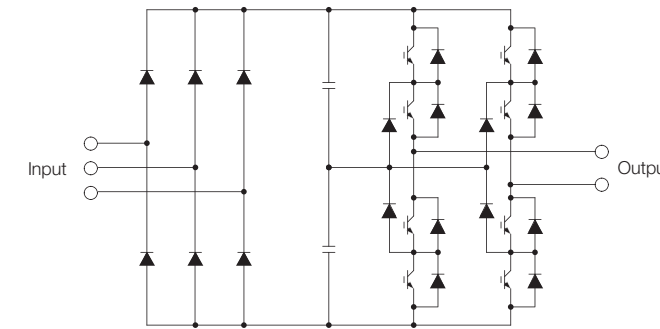
No input filter is necessary.

## Measured Harmonics and Input Current

Harmonic	5th	7th	11th	13th	17th	19th	23rd	25th	THD
IEEE 519 Limits	4.00%	4.00%	2.00%	2.00%	1.50%	1.50%	0.60%	0.60%	5%
MV1000 1000 HP 4.16 kV	1.28%	0.56%	0.34%	0.16%	0.03%	0.04%	0.01%	0.01%	2.26%
Typical 24-Pulse Scheme	2.60%	1.60%	0.70%	0.40%	0.20%	0.10%	1.90%	0.80%	3.80%

## 9/17 Level Output Waveform using Enhanced Cascaded H Bridge (CHB) Configuration

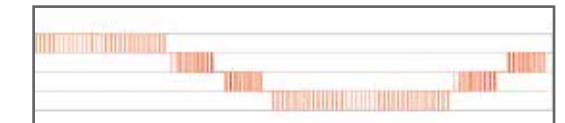
### Configuration of One Power Cell



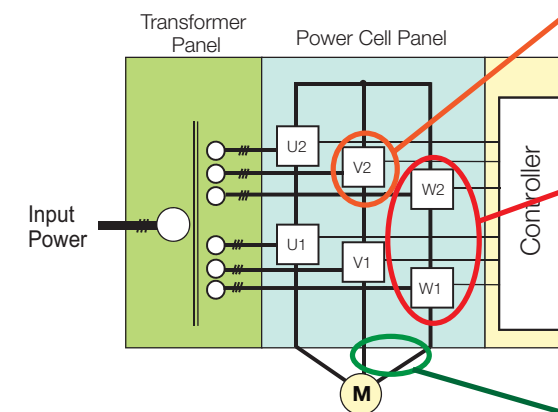
MV1000 uses multiple 3-level power cells and requires only 2 power cells per phase at 4.16 kV.

### Cell Waveform

Output voltage of single power cell

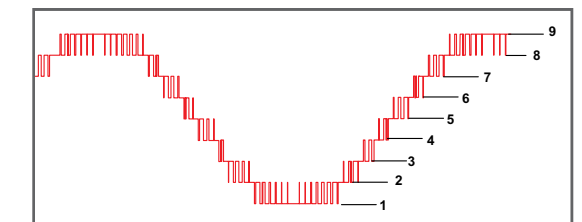


### Configuration of Complete Drive



### Phase Waveform

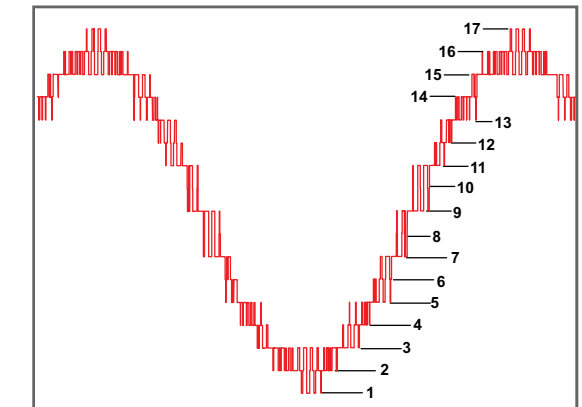
Line to neutral voltage for 4.16 kV drive



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

### PWM control with Enhanced CHB outputs a near sinusoidal waveform

- Minimal surge voltage (reflected wave phenomenon) protects motor insulation.
- Low torque ripple - smooth mechanical power transmission
- Low audible noise

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

# Proven Reliability

## 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:

- $FIT = \text{Qty of Failures} / [(30 \text{ days} \times 24 \text{ hours per day}) \times (\text{total qty of units shipped})] \times 109$ . 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**

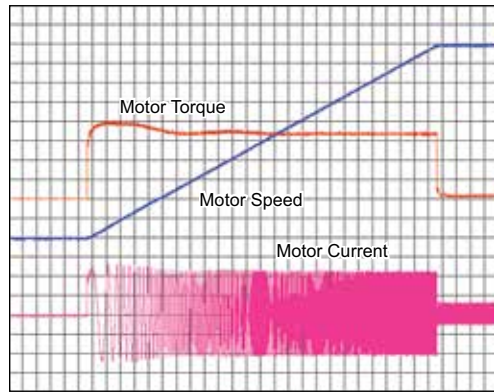
Our internal assembly failure rate is 0.01% (assembly errors found in the actual assembly process)

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

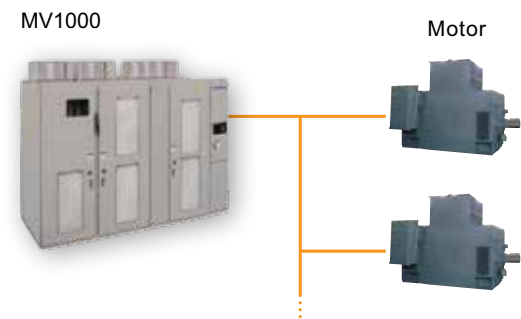
Open Loop Vector control enables smooth acceleration from low speed without using an encoder. Operation is stable, unaffected by fluctuations in load. The high performance vector control can be applied to synchronous motors as well as induction motors.



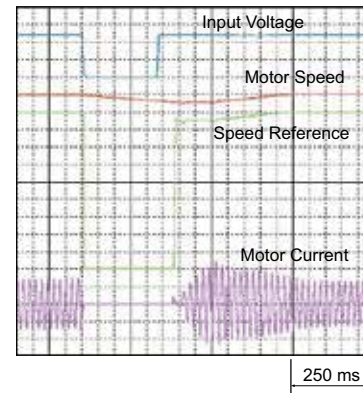
Starting Characteristics

## 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.

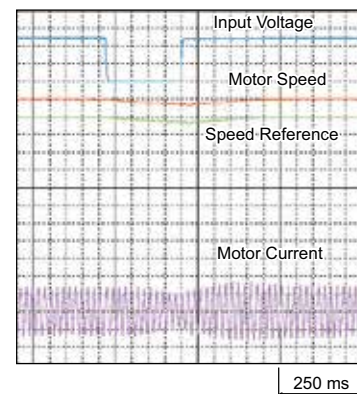


## Speed Search Function



250 ms

## Kinetic Energy Braking (KEB) Function



250 ms

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)

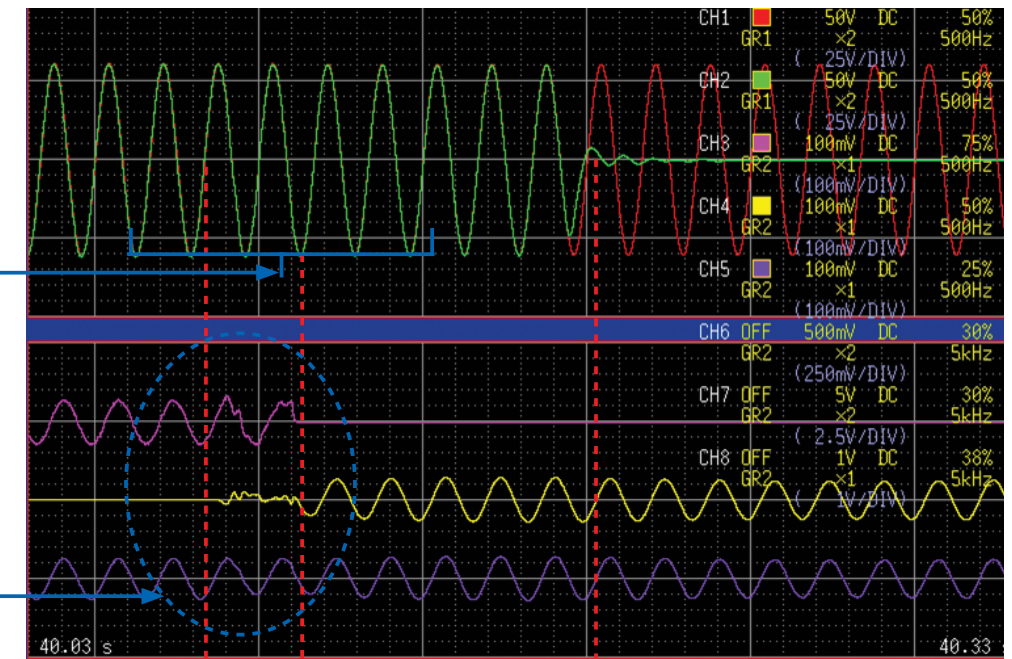
### Utility and Drive Synchronized

### Current Waveform Display

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

### No Disturbance to Motor Current During Transition

Transition from utility power to drive also available.



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

### 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

# Optimal Packaging Design

Modular design with optimal footprint and maintainability

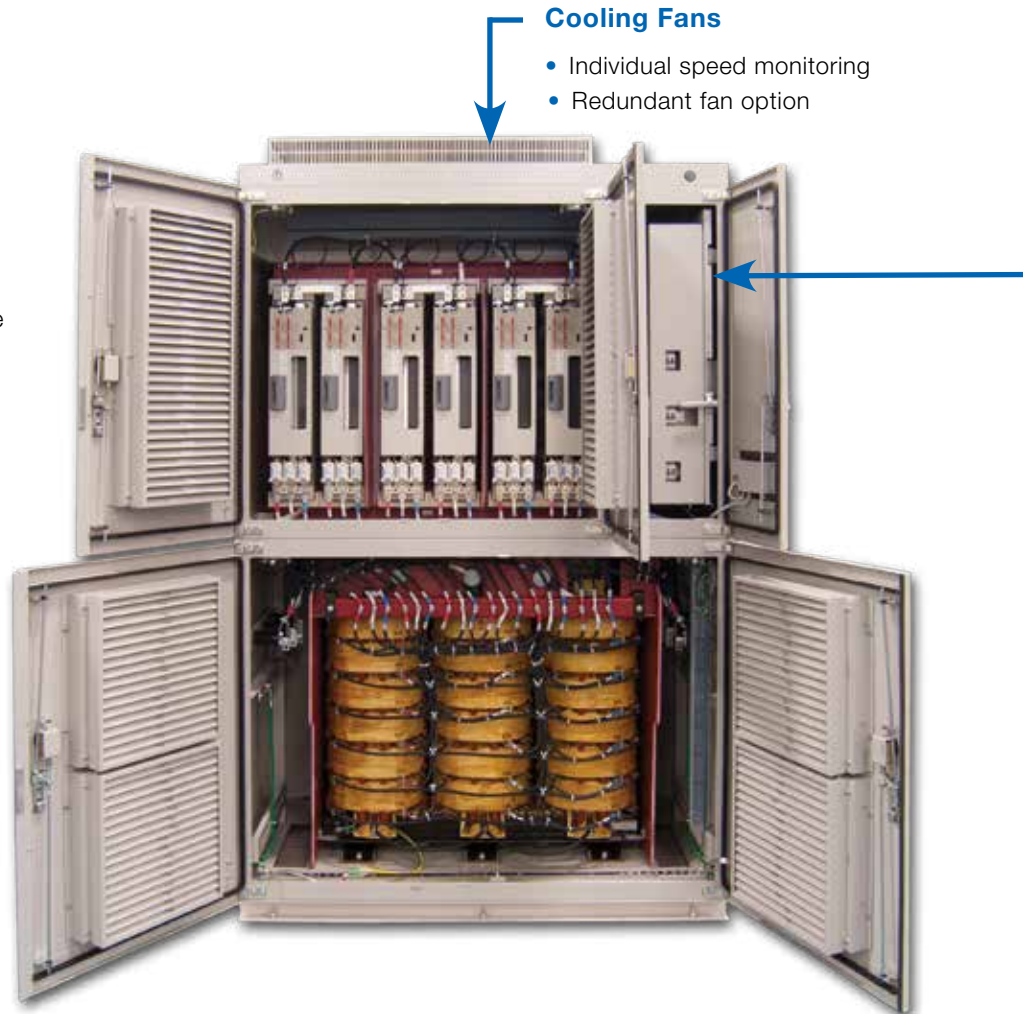
## Typical Configuration of 1000 HP MV1000

### 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



### Cooling Fans

- Individual speed monitoring
- Redundant fan option



### Control Section

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

## 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



• Multi-pulse transformer

• Two power cells per phase



10,000 HP, 4.16 kV



3,000 HP, 4.16 kV



5,000 HP, 4.16 kV

# User Friendly

Simple operation, adjustment and maintenance

## Same User Interfaces as Yaskawa 1000 Series Low Voltage Drives

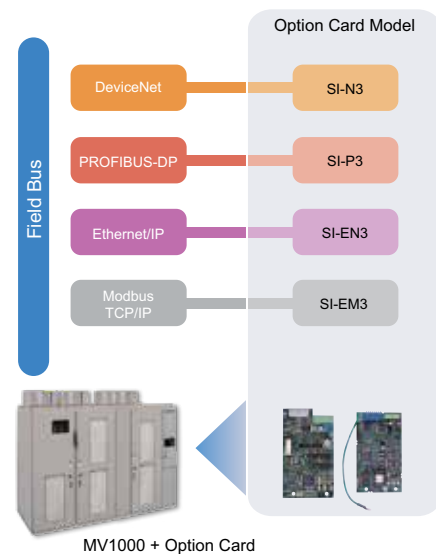
### Digital Operator

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

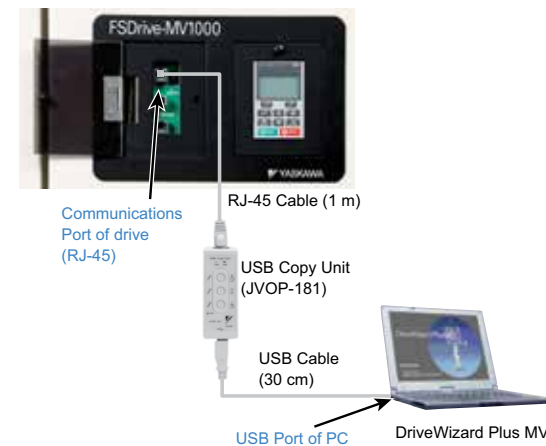
The RS-485 communication function (Modbus protocol) is installed as standard. By adding an optional communication card, major network protocols can be supported.



### 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



## DriveWizard Plus MV Programming Software

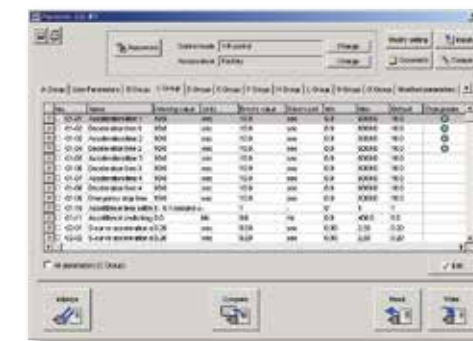
Provides support for a variety of adjustment and maintenance tasks



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.

### Parameter Edit

Displays and edits drive parameters



### Autotuning

Automatically adjusts the motor-related parameters



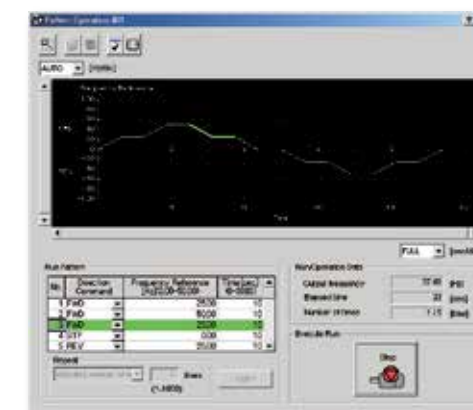
### Troubleshooting

Traces fault status and displays corrective action



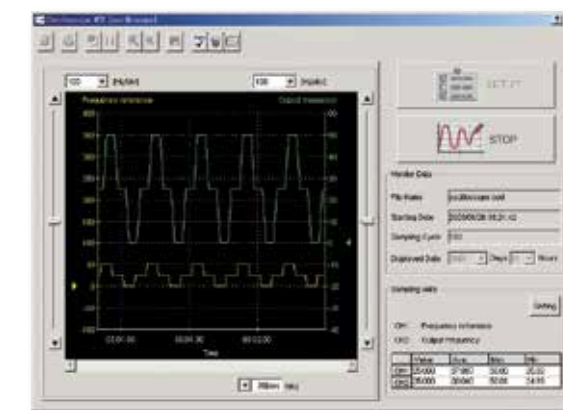
### Pattern Operation

Runs the drive automatically in the preset patterns



### Oscilloscope

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



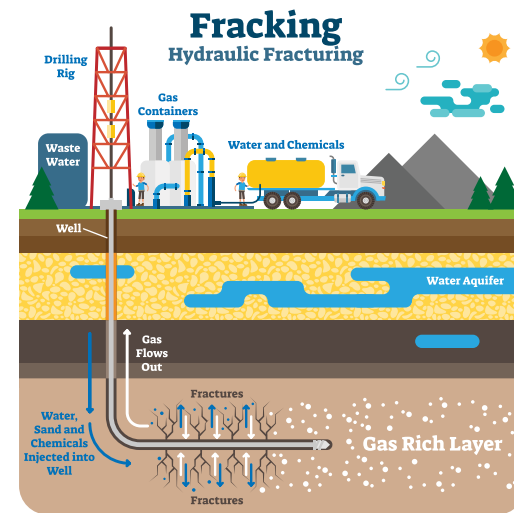
# Industries/Applications



## Oil/Gas

### Applications:

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



## Mining

### Applications:

- Slurry Pumps
- Ventilation Fans
- Conveyors



## Power Generation

### Applications:

- ID and FD Fans
- Conveyors
- Ball Mills
- Bag House Fans



## Water/Wastewater Treatment

### Applications:

- Pumps
- Aeration
- Fans



## Cement

### Applications:

- Conveyors
- Fans
- Rotary Kilns



## Tire/Rubber

### Applications:

- Banbury Mixers
- Extract Fans
- Conveyors



## 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](http://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](mailto: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.

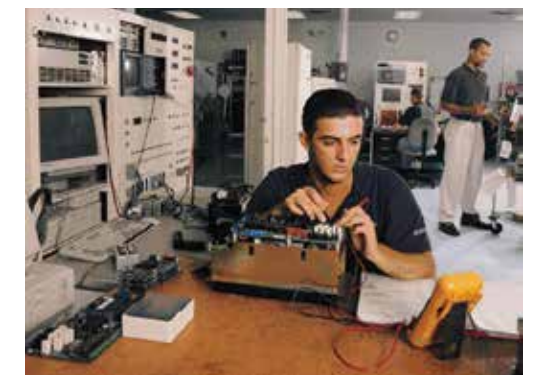
Our goal is to provide an online center where you can quickly find support solutions managed by our technical support teams along with documentation already available on [yaskawa.com](http://yaskawa.com).

Check it out at [solutioncenter.yaskawa.com](http://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](http://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.

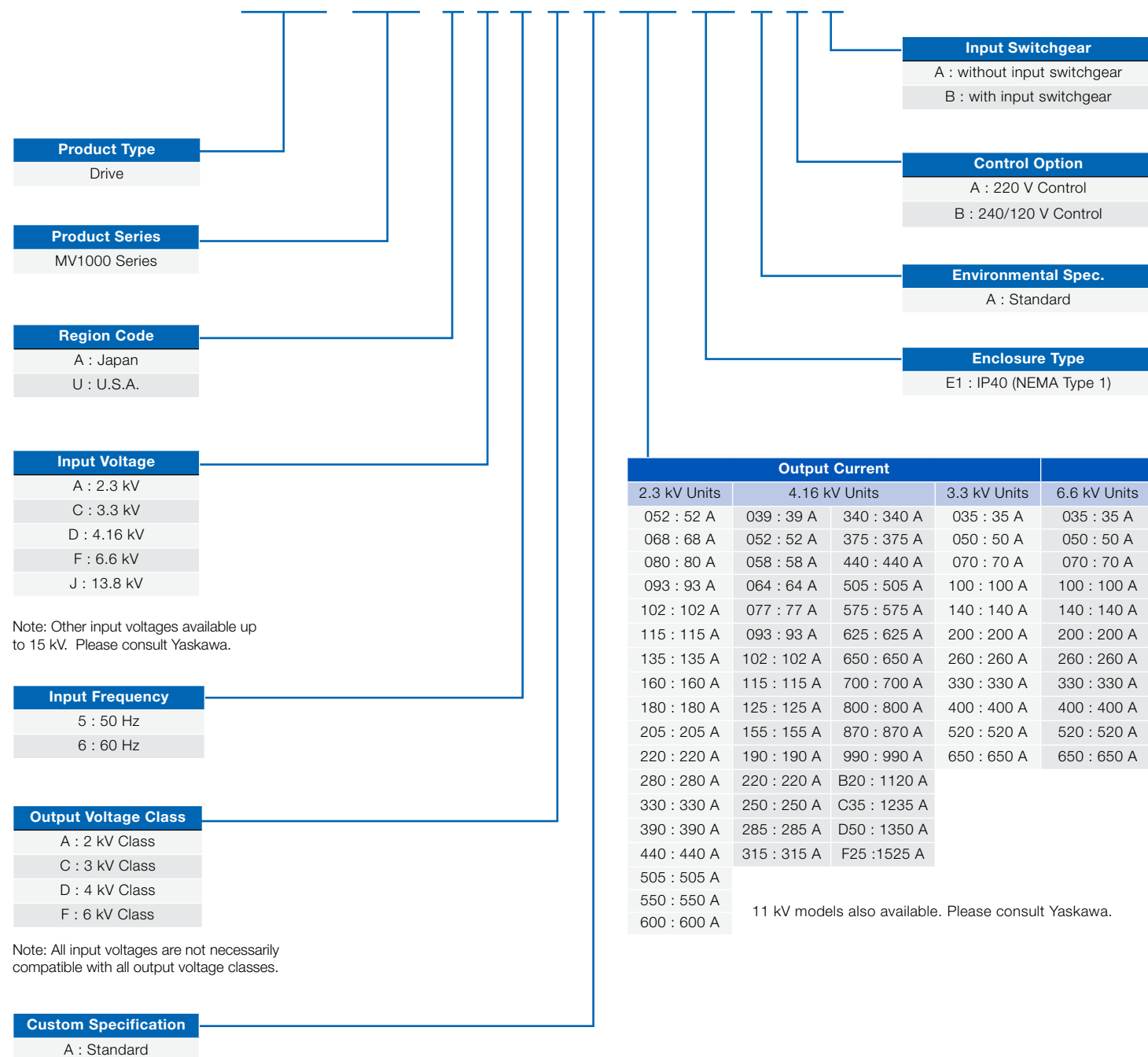
## Parts Inventory

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

# Specifications

**CIMR-MV2 U A 6 A A 052 E1 A B A**



## Common Specifications

Item		Specifications
Control Characteristics	Control Methods	V/f Control (V/f), Open Loop Vector Control (OLV), Closed Loop Vector Control (CLV)
	Frequency Control Range	0.01 to 120 Hz
	Frequency Accuracy (Temperature Fluctuation)	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 ± 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
Protection Function	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)
Operating Environment	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)
Comm. Options	Storage Temperature	-20 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

# Models & Ratings

## Ratings

### 2.3 kV Models

Model Number	Nominal Capacity		Output Rating		
	Motor Capacity	2.3 kV Output	Rated Output Current	Rated Output Voltage	Overload Ratings
	HP	kVA	A	V	
052	200	220	52	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.
068	300	280	68		
080	350	330	80		
093	400	390	93		
102	450	420	102		
115	500	480	115		
135	600	560	135		
160	700	670	160		
180	800	750	180		
205	900	850	205		
220	1000	920	220		
280	1250	1160	280		
330	1500	1370	330		
390	1750	1620	390		
440	2000	1820	440		
505	2250	2100	505		
550	2500	2300	550		
600	2750	2500	600		

### 3.3 kV Models

Model Number	Nominal Capacity		Output Rating		
	Motor Capacity	3.3 kV Output	Rated Output Current	Rated Output Voltage	Overload Ratings
	HP	kVA	A	V	
035	175	200	35	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.
050	250	285	50		
070	400	400	70		
100	500	570	100		
140	750	800	140		
200	1000	1150	200		
260	1500	1500	260		
330	2000	1900	330		
400	2500	2300	400		
520	3500	3000	520		
650	4000	3700	650		

# Models & Ratings

## 4.16 kV Models

Model Number	Nominal Capacity		Output Rating		
	Motor Capacity	4.16 kV Output	Rated Output Current	Rated Output Voltage	Overload Ratings
	HP	kVA	A	V	
039	300	280	39	Three-Phase: 4160 V Sine wave, proportional to input voltage	110% of rated output current for 60 sec.
052	400	375	52		
058	450	420	58		
064	500	460	64		
077	600	550	77		
093	700	670	93		
102	800	735	102		
115	900	830	115		
125	1000	900	125		
155	1250	1120	155		
190	1500	1370	190		
220	1750	1590	220		
250	2000	1800	250		
285	2250	2050	285		
315	2500	2270	315		
340	2750	2500	340		
375	3000	2700	375		
440	3500	3170	440		
505	4000	3640	505		
575	4500	4140	575		
625	5000	4500	625		
650	5200	4680	650		
700	5500	5040	700		
800	6000	5760	800		
870	7000	6120	870		
990	8000	7130	990		
B20	9000	8070	1120		
C35	10,000	8900	1235		
D50	11,000	9725	1350		
F25	12,000	10,985	1525		

## 6.6 kV Models

Model Number	Nominal Capacity		Output Rating		
	Motor Capacity	6.6 kV Output	Rated Output Current	Rated Output Voltage	Overload Ratings
	HP	kVA	A	V	
035	350	400	35	Three-Phase: 6000 V or 6600 V	110% of rated output current for 60 sec.
050	500	570	50		
070	800	800	70		
100	1250	1150	100		
140	1750	1600	140		
200	2500	2300	200		
260	3250	3000	260		
330	4000	3800	330		
400	5000	4600	400		
520	6500	6000	520		
650	8000	7500	650	Sine wave, proportional to input voltage	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.