YASKAWA

Super Energy-Saving Medium-Voltage AC Drive

FSDrive-MV1000

3 kV Class, 200 kVA to 3700 kVA
6 kV Class, 400 kVA to 7500 kVA
11 kV Class, 660 kVA to 5000 kVA

MV

World's smallest MV drive

Global Standard

Completely New: World's Smallest Medium-Voltage AC Drive Complies with Main Global Standards

Compact, High-Performance, Energy-Saving, and User Friendly, delivers outstanding value.

In 1996, Yaskawa introduced Japan's first commercially produced medium-voltage drives with multiple outputs connected in series and continues development of energy saving and high-reliability technologies until today.
Yaskawa has led the industry in the field of low-voltage drives since our launch of the world's first transistor drive in 1974 by coming up with a series of groundbreaking technologies.
Now we are introducing completely new medium-voltage drives to our lineup, following the concept of amalgamating a medium-voltage drive with multiple outputs connected in series and a low-voltage drive.
These new drives comply with the main global standards and help energy-saving all over the world.
Like a four-leaf clover that brings good luck, the FSDrive-MV1000 offers the four benefits of compactness, high performance, energy savings, and user friendliness.

Note: The smallest available 3/4/6 kV class products (according to survey by Yaskawa)

An amalgamation of our accumulated technical capabilities and reliability.

Low-voltage drive

G7 7th generation low-voltage drive (The world' s first general-purpose drive employing three-level control)

1000series (J1000/V1000/A1000)

FSDrive-MV1000

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

FSDrive-MV1S 2005

CONTENTS

Compact Design

1

Significant downsizing and a draw-out design help this power cell facilitate transportation, installation, and maintenance.

Long-life and highly reliable parts have been stringently selected, and the circuit design simplified for compactness.
Drives have evolved into more reliable and space saving FSDrive-MV1000 drives.

High Performance

2

Offering better performance, functionality, and reliability in low-and medium-voltage drives, and enabling stable continuous operation.

Equipped with functions unaffected by fluctuations in power supply and load. Input and output are both sinusoidal waves.
FSDrive-MV1000 can be easily introduced into either new or existing facilities without any qualms.

Energy Saving

3

Promotes energy saving with highly efficient operation.

FSDrive-MV1000 realizes the highest levels of efficiency and power factor in the industry.
Significant energy saving effects can be achieved.

User Friendly

4

Operation, adjustment, maintenance, and management are very easy, as with Yaskawa low-voltage drives.

FSDrive-MV1000 focuses on ease of use.
Adopting the same user interface as Yaskawa low-voltage drives has made it easier to check the operating status and manage parameters.

Global Standard

FSDrive-MV1000 provides an I/O voltage range from 2.4 kV to 11 kV and has been certified as being in accordance with the following global standards:
UL*1, CE*2 , AS(Australian Standards)*2, NK*3

*1 : For local production only.
*2 : For production dedicated to meet standards.
*3 : Requires NK certification to be obtained for each order.
Contact Yaskawa for information on compliance with NK certification.

Superior Energy-saving Machinery

FSDrive-MV1000 (3-level medium-voltage drive with multiple outputs connected in series) have received Chairman's Award for Superior Energy-saving Machinery of the Japan Machinery Federation in the 34th Award for Superior Energy-saving Machinery 2013 hosted by the Japan Machinery Federation.

MV Compact Design

Significant downsizing and a draw-out design facilitates transportation, installation, and maintenance.

6 kV class Example Configuration of FSDrive-MV1000

4 Cooling Fan
- Long-life thin cooling fans adopted

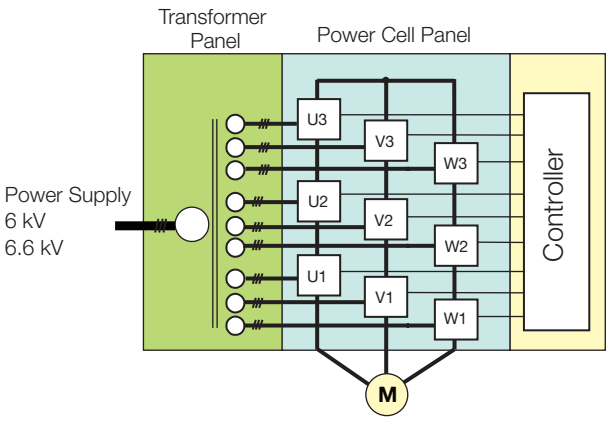
3 Control Section
- Houses the control board for PWM control.
- Communicates with power cells through noise-resistant optical communications.

1 Transformer Panel
- Houses the power supply lead-in terminal and secondary multi-winding transformer.

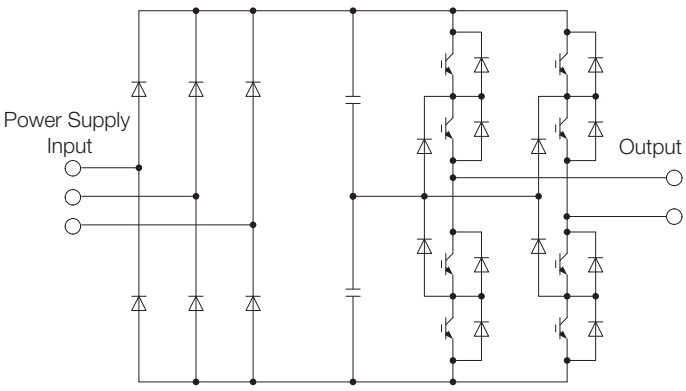
2 Power Cell Panel
- Three cells connected in series per single output phase.
- Output phase star-connected to output 6 kV class directly.
- Each individual power cell can be drawn out for maintenance.

Circuit Configuration

6 kV class



● Configuration of One Power Cell

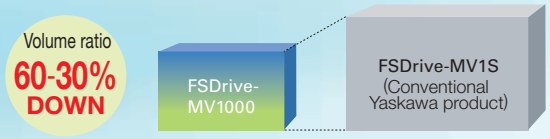


Optimized Component Selection and Arrangement Reduces Volume Occupied by up to 60%!

Minimal Height and Small Footprint

The compact design realized by developing thin power cells with three-level single phase output, and adopting a simple circuit configuration, a draw-out control panel and thin cooling fans, has resulted in a significant volume reduction of 30 to 60% when compared to the conventional Yaskawa product. The unit can even fit in a standard container for transportation*.

*: Restrictions might apply. Please contact Yaskawa for details.



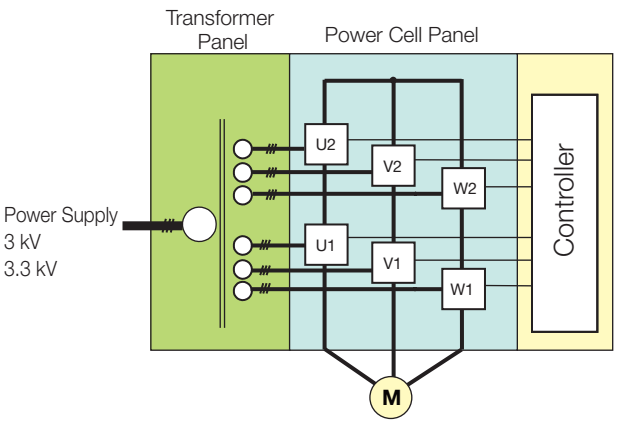
Everything has been done to achieve a small footprint, especially for 3 kV class drives (800 kVA or less), with the transformers located in the bottom of the panel and the power cells and controller at the top.

Maintenance of Individual Power Cells

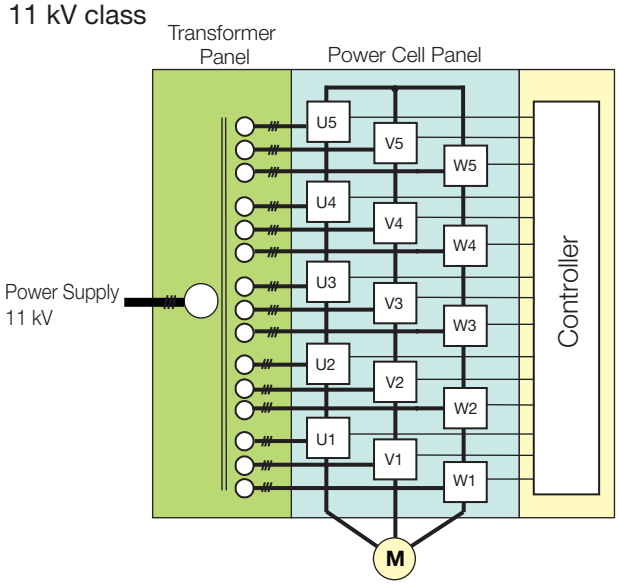
Power cells can be replaced and maintained individually. The construction designed for single-action mounting and removal reduces the replacement time and facilitates maintenance operations.

Power Cell

3 kV class



11 kV class



MV High Performance

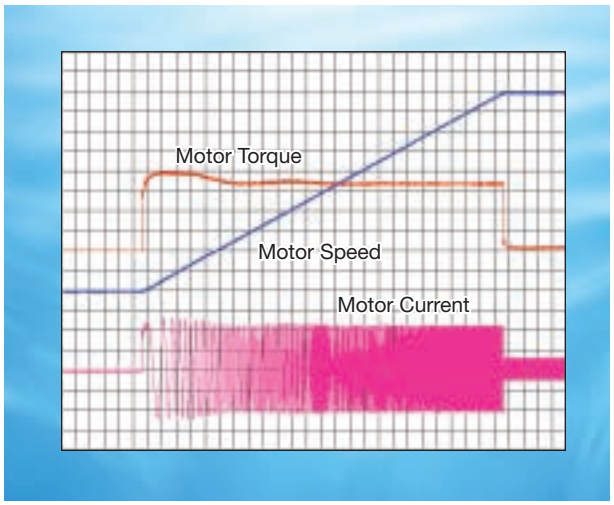
Offering better performance, functionality, and reliability in low- and medium-voltage drives, and enabling stable continuous operation.

Employs Open Loop Vector Control. Highly Resistant to Fluctuations in Power Supply and Load!

High-level Control

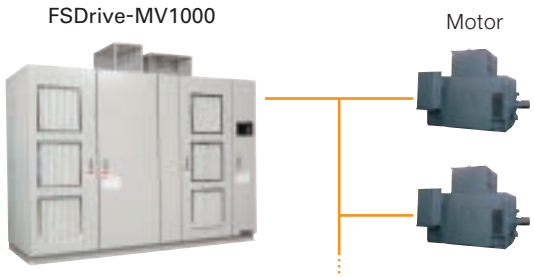
Open Loop Vector control enables smooth acceleration from a low-speed range without using a speed detector. Operation is stable, unaffected by fluctuations in load. The high performance vector control drives synchronous motors as well as induction motors.

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.



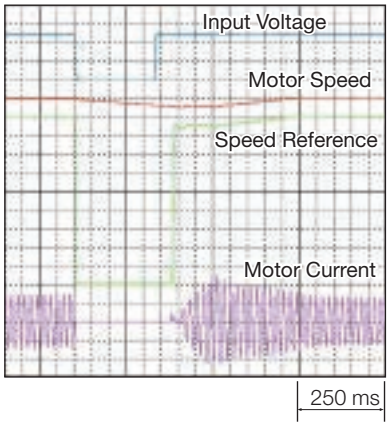
Note: When running multiple motor operations, a protective device is required on each motor.

Controlled and Secure Operation at Momentary Power Loss

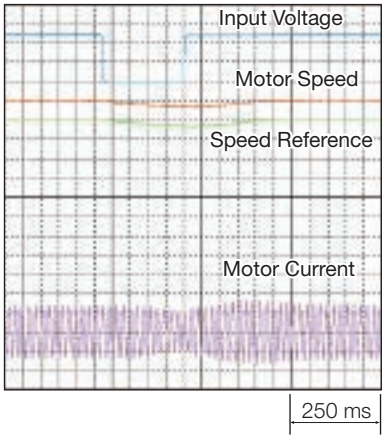
FSDrive-MV1000 continues to operate for a number of cycles*1 when a momentary power loss occurs, and re-accelerates to the reference speed immediately after the power is restored to ensure a smooth system start-up.

*1: The retention time varies depending on the types of load and operation status.

Speed Search Function



KEB Function*2



*2: KEB (Kinetic Energy Back-up) Function: Function to continue operation without baseblocking during a momentary power loss.

Incorporates Yaskawa's Smart Harmonics Technology and PWM Control with Multiple Outputs Connected in Series. Sinusoidal Input and Output Waves Ensure Easy Introduction at Facilities!

Minimized Harmonics Comply with Guidelines

Yaskawa's original smart harmonics technology incorporated in FSDrive-MV1000 drastically cuts input harmonics. The resulting input waveform is sinusoidal, making it possible to clear the harmonics control guideline specified by the Ministry of Economy, Trade and Industry, and by IEEE519-1992, as an individual drive. This means that no harmonics filter or active filter is necessary.
(Conducted a harmonics test in the presence of an authority from a global certification organization.)

Measured Harmonics in Input Current

(For 3.3 kV, 630 kW, 60 Hz, full-load contract demand of 630 kW)

	5th	7th	11th	13th	17th	19th	23rd	25th	29th	31st
IEEE519	4.00	4.00	2.00	2.00	1.50	1.50	0.60	0.60	0.60	0.60
Guideline*	4.00	2.80	1.80	1.50	1.10	1.00	0.90	0.80	0.80	0.80
FSDrive-MV1000 Measured Value	1.00	0.60	1.40	0.90	0.10	0.20	0.40	0.20	0.30	0.10

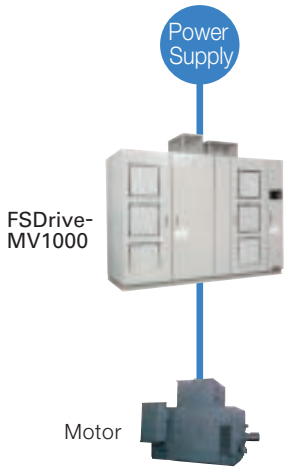
*: Guideline of the Ministry of Economy, Trade and Industry (Unit: %)

Easily Applicable to Existing Motors

PWM control with multiple outputs connected in a series outputs sinusoidal wave voltage.
This has the following benefits:

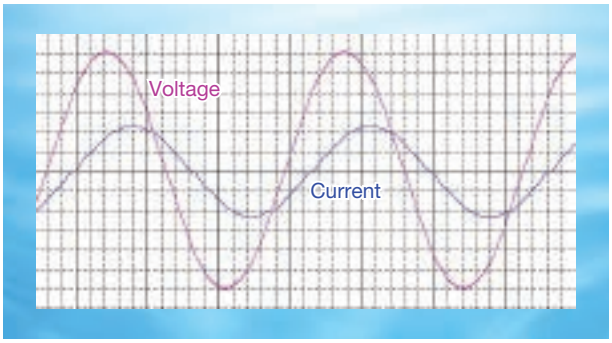
- Free from oscillation surge voltage affecting the motor
- Low torque ripple, easing the load
- Noise as low as commercial power supply operation

These benefits make it possible to use the existing motors and wiring cables without adding filters or other modifications.



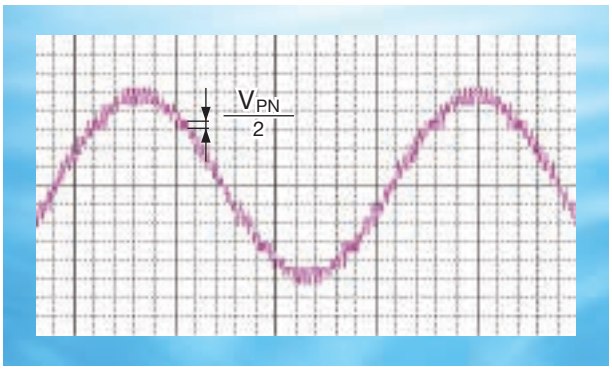
The simple configuration for running standard high voltage motors directly realizes highly efficient operation with minimal loss due to input/output voltage transformers.

Input Waveform

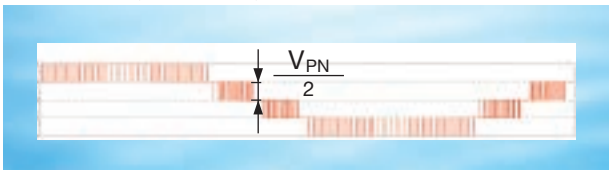


Output Waveform

Line-to-Line Voltage (for 6 kV Class Drives)



Phase Voltage (For Single Power Cell)



Note: V_{PN}: DC bus voltage for a single power cell

MV Energy Saving

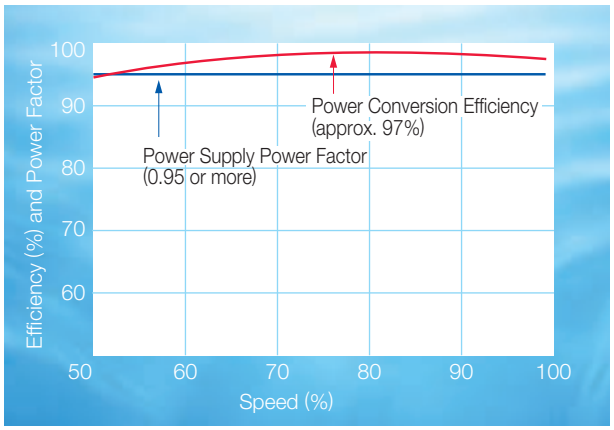
Promotes energy saving
with highly efficient operation.

World's Highest Standard of Performance Reduces Power Wastage!

High Efficiency and High Power Factor

Since FSDrive-MV1000 is a direct medium-voltage drive that does not need an output transformer, it can maintain a power conversion efficiency of approximately 97% over a wide speed range and secure a power supply factor of 0.95 (at rated load), avoiding energy wastage.

Power Conversion Efficiency Ratio



Energy Saving by Speed Control

The shaft power of wind and hydraulic machines such as fans, blowers, and pumps is proportional to the cube of the rotational speed.
Since drives maintain high efficiency even at low speed, a significant energy saving effect can be expected by using drives for wind and hydraulic machines and operating them at lower speeds.

Example: Calculation Formulae for Energy Saving Effects with Fans and Blowers

Power Consumption with Damper Control

$$P_d\,(kW) = \frac{P_0}{\eta_{f0}\,\eta_{m0}}$$

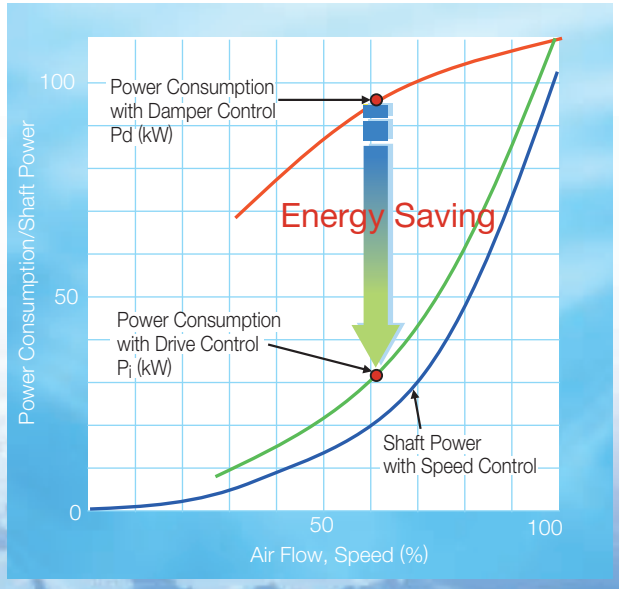
P_0 : Motor rated power
η_{f0} : Fan rated efficiency
η_{m0} : Motor rated efficiency

Power Consumption with Drive Control

$$P_i\,(kW) = \frac{\left(\frac{Q}{Q_0}\right)^3}{\eta_f\,\eta_m\,\eta_i}\,P_0$$

Q/Q_0 : Ratio of air flow to fan rating
P_0 : Motor rated power
η_f : Fan efficiency
η_m : Motor efficiency
η_i : Drive efficiency

Power Consumption Characteristic Curve



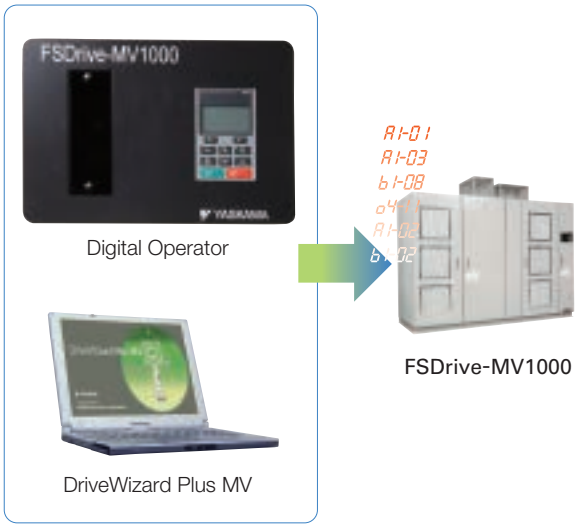
MV User Friendly

Operation, adjustment, maintenance, and management are very easy, as with Yaskawa low-voltage drives.

Employs the Same User Interfaces as Yaskawa's 1000 Series Low-voltage Drives

Easy-to-use User Interfaces

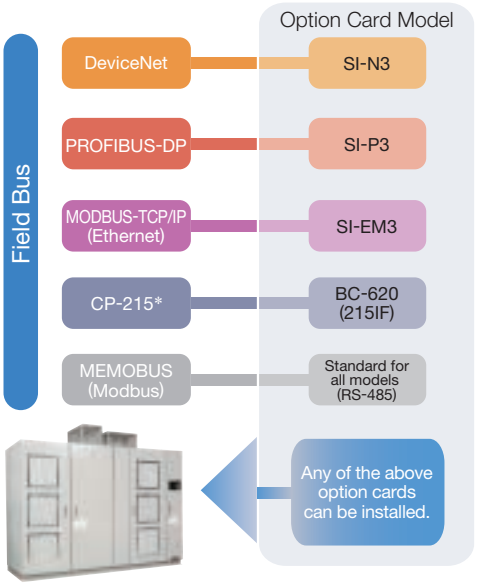
A Digital Operator with an easy-to-view LCD display (the same as used on Yaskawa's 1000 series low-voltage drives) is provided on the front panel as standard, making it easy to operate and set the drive.
The engineering tool DriveWizard Plus MV enables consolidated management of the parameters for each drive and makes for easy adjustment and maintenance.



➡Refer to pages 10 and 11 for details.

Compatible with World's Major Field Network Protocols

The RS-485 communication function (MEMOBUS/Modbus protocol) is installed as standard. By adding an optional communication card, the major field network protocols can be supported. Achieve centralized control of production equipment and fewer connecting cables by connecting the drive to host computer or PLC.



FSDrive-MV1000 + Option Card

✻: Yaskawa's dedicated communication protocol

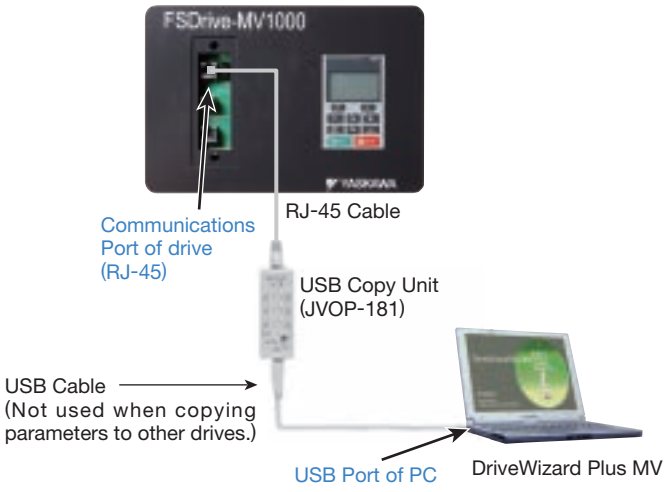
Note: Product names are trademarks or registered trademarks of the companies concerned.

USB Copy Unit (Model: JVOP-181)

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 an drive and a USB port of a PC.

Note: Because the FSDrive-MV1000 has a USB port, a PC to use DriveWizard Plus MV can be directly connected to it with a USB cable.

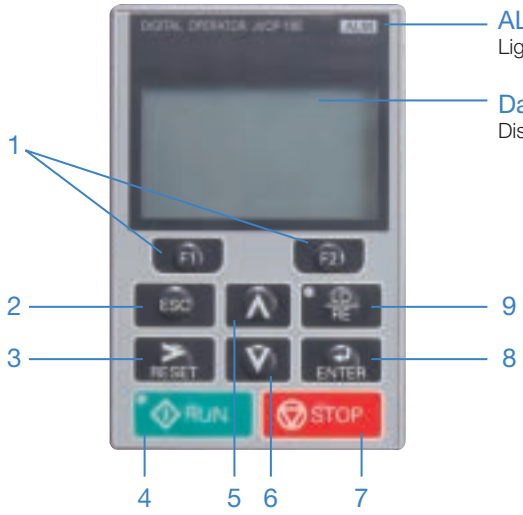
Connection



MV User Friendly

An “Digital Operator” is Installed as Standard to Facilitate Configuration, Operation, and Monitoring.

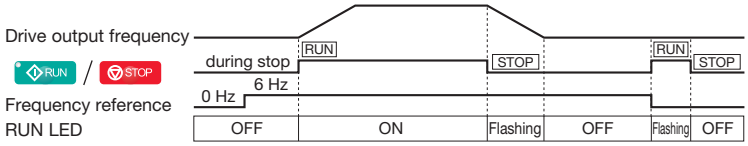
User-friendly Digital Operator



Key Names and Functions

No.	Key	Name	Function
1	F1 / F2	Function Key (F1/F2)	The functions assigned to F1 and F2 vary depending on the currently displayed menu. The name of each function appears in the lower half of the LCD display window.
2	ESC	ESC Key	• Returns to the previous display. • Moves the cursor one digit to the left when setting parameter numbers. • Pressing and holding this button returns to the Frequency Reference display.
3	RESET	RESET Key	• Moves the cursor one digit to the right when setting parameter values, etc. • Resets the drive to clear a fault situation.
4	RUN	RUN Key	Starts drive operation.
		RUN LED	Lit or flashing while the drive is running.
5	∧	Up Arrow Key	• Scrolls up to display the next item. • Increments the parameter number or the setting value.
6	∨	Down Arrow Key	• Scrolls down to display the previous item. • Decrements the parameter number or the setting value.
7	STOP	STOP Key	Stops drive operation. Note: The drive can be stopped in an emergency stop status by pressing STOP when danger is detected even if the drive is operating in the REMOTE mode in accordance with Run commands other than from the digital operator. To disable emergency stop operation using STOP, set parameter o2-02 (STOP key function selection) to 0 (disabled).
8	ENTER	ENTER Key	• Enters the selected operation mode, parameter number and setting value. • Selects a menu item to move between displays.
9	LO/RE	LO/RE Selection Key	Switches the control of the drive between the digital operator (LOCAL mode) and an external source (REMOTE mode) for the Run command and frequency reference. Note: When there is a danger that the operation of the drive may be disrupted by erroneously switching the operation mode from REMOTE to LOCAL, disable LO/RE by setting parameter o2-01 (LO/RE selection key function selection) to 0 (disabled).
		LO/RE LED	Lit while the operator is selected to run the drive (LOCAL mode).

Drive operation status and relevant RUN LED indications



"DriveWizard Plus MV" Supports Adjustment and Maintenance Tasks.

Providing Support with a Variety of Functions

DriveWizard Plus MV enables consolidated management of the parameters for each drive on your 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 trouble.

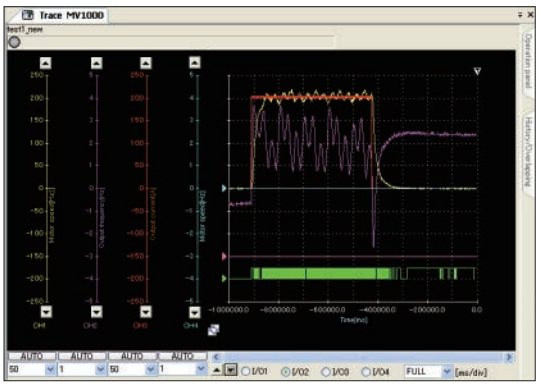
■ Connection

System Requirements

PC	IBM PC compatible computers Note: Operation on NEC PC9821 series computers is not guaranteed.
CPU	Pentium 1GHz or higher (1.6 GHz recommended) Note: Pentium is a trademark of Intel Corporation.
Main Memory	1 GB or greater
Available Hard Disk Space	In the standard setup configuration: • 100 MB or greater (400 MB or greater recommended at time of installation)
Display Resolution	XGA monitor (Use resolution of 1024×768 or higher and 100% magnification.) Note: The full operation screen may not be displayed if the above specifications are not used.
Number of Colors	65535 colors (16 bits) or greater
OS	Japanese operating system • OS compatible with 32-bit memory: Windows XP, Windows Vista • OS compatible with 32-bit and 64-bit memory: Windows 7, Windows 10 Note: Windows is a trademark of the Microsoft Corporation.
Others	More than one USB port, or RS-232C CD-ROM drive (only for installation) Adobe Reader 6.0 or later Note: Adobe Reader is required to display the help information. Adobe is a trademark of Adobe System Incorporated.

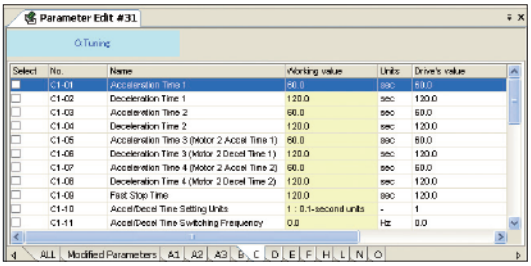
Trace

The Trace function acquires the drive data under the set conditions and displays it in graph form.
You can investigate the drive operations in detail.



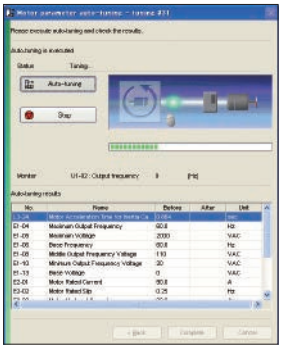
Parameter Edit

Displays and edits drive parameters.



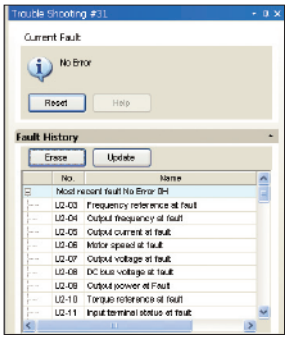
Auto-tuning

Automatically adjusts the motor-related parameters.



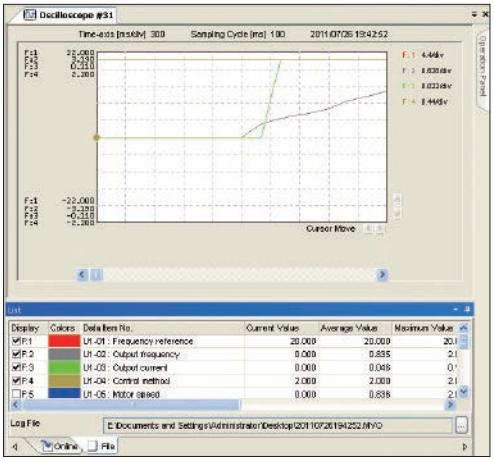
Troubleshooting

Checks the faults that have occurred on the drive. Causes are quickly investigated by tracing fault status and the corrective actions are displayed.



Oscilloscope

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



Specifications

Model-Specific Specifications

Model	CIMR-MV2AC□C□		035	050	070	100	140	200	260	330	400	520	650
Nominal Capacity	3 kV Class Output	kVA	200	285	400	570	800	1150	1500	1900	2300	3000	3700
	Max. Applicable Motor Capacity	kW	132	200	315	450	630	900	1250	1500	1800	2500	3000
Output Rating	Rated Output Current	A	35	50	70	100	140	200	260	330	400	520	650
	Rated Output Voltage	V	Three-phase, 3000 V or 3300 V (Sine wave, proportional to input voltage)										
Power Supply	Main Circuit		Three-phase, 3000 V (50 Hz ± 5%) or 3300 V (50/60 Hz ± 5%) −20% to +10%										
	Control Circuit		Single-phase, 200/220 V −10% to +10% (50Hz or 60Hz±5%)										
Model	CIMR-MV2AF□F□		035	050	070	100	140	200	260	330	400	520	650
Nominal Capacity	6 kV Class Output	kVA	400	570	800	1150	1600	2300	3000	3800	4600	6000	7500
	Max. Applicable Motor Capacity	kW	250	400	630	900	1250	1800	2500	3000	3600	5000	6000
Output Rating	Rated Output Current*	A	35	50	70	100	140	200	260	330	400	520	650
	Rated Output Voltage	V	Three-phase, 6000 V or 6600 V (Sine wave, proportional to input voltage)										
Power Supply	Main Circuit		Three-phase, 6000 V (50 Hz ± 5%) or 6600 V (50/60 Hz ± 5%) −20% to +10%										
	Control Circuit		Single-phase, 200/220 V −10% to +10% (50Hz or 60Hz±5%)										
Model	CIMR-MV2AH□H□		035	050	070	100	140	200	260				
Nominal Capacity	11 kV Class Output	kVA	660	950	1300	1900	2650	3800	5000				
	Max. Applicable Motor Capacity	kW	530	760	1070	1520	2130	3050	3960				
Output Rating	Rated Output Current	A	35	50	70	100	140	200	260				
	Rated Output Voltage	V	Three-phase, 10000 V, 10500 V or 11000 V (Sine wave, proportional to input voltage)										
Power Supply	Main Circuit		Three-phase, 10000 V, 10500 V or 11000 V (50/60 Hz ± 5%) −20% to +10%										
	Control Circuit		Single-phase, 200/220 V −10% to +10% (50Hz or 60Hz±5%)										

*: Derating may be required for products that meet NK certification to maintain an ambient temperature of 45°C.
Contact your Yaskawa representative for details.

Common Specifications

Efficiency		Approx. 97% (At rated motor speed, 100% load)
Power Factor		Min. 0.95 (At motor rated speed, 100% load)
Cooling Method		Forced air-cooling by fan (with failure detection of exhaust fan)
Control Specifications	Control Method	Open-loop vector control, Closed loop vector control, V/f control (for multiple motor operation), Closed loop control for SM (option)
	Main Circuit	Voltage-type PWM control with multiple outputs connected in series (power cell: 3-level output)
	Freq. Control Range	0.01 to 120 Hz
	Freq. Control Accuracy	±0.5%
	Analog Input Resolution	0.03 Hz
	Accel/Decel Time	0.1 to 6000 s
	Torque Accuracy*1	±5% (open-loop vector control), ±3% (closed loop vector control)
	Overload Tolerance	Continuous rated current 100%, overload tolerance 110% for 1 minute and 120% for 15 seconds
	Momentary Power Loss Compensation Time*2	Max. 2 seconds
	Main Control Functions	Torque control, Droop control, Speed/torque control switch, Momentary power loss compensation, Speed search, Overtorque detection, Torque limit, 17-step speed (max.), Accel/decel time switch, S-curve accel/decel, Auto-tuning (rotational, stationary), Dwell, Cooling fan on/off, Slip compensation, Torque compensation, Frequency jump, Upper/lower limits for frequency reference, DC injection braking at start and stop, High slip braking, PID control (with sleep function), Energy saving control, MEMOBUS communication (RS-485, max. 115.2 kbps), Fault retry
Protective Functions		Overcurrent, Overvoltage, Undervoltage, Output ground fault, Output open-phase, Overload, Cooling-fan error, Transformer overheat, Motor overheat, etc.
PLC Functions (optional)		Expansion PLC board
Communications (optional)*3		・RS-485: MEMOBUS (Modbus) ・Any one of PROFIBUS-DP, DeviceNet, Modbus TCP/IP (Ethernet), or CP-215 can be installed.
Input Transformer		Class H dry type, −5%/N/+5% tap, secondary multi-phase winding
Temperature Protection		Power cells: protected by thermistor for temperature Transformer: protected by temperature monitor (PT100 Ω) and thermo switches
Maintainability/ Environmental Specifications	Control Panel	Status display, Fault display, Parameter setting, Parameter reference
	Main Circuit	Power cell construction
	Protection Design	IP40 (simplified dustproof type)
	Ambient Temperature, Relative Humidity	−5°C to +40°C, 85%RH max. (no condensing)
	Storage Temperature	−20°C to +60°C (for very short term when handling)
	Atmosphere	General environmental conditions, free from dust and corrosive gases Altitude: Max. 2000 m
Panel Specifications	Painting	5Y7/1 semi-gloss both for inner and outer faces
	Form	Made of enclosing steel sheets, vertical standalone type, front maintenance type
Applicable Standards		JIS, JEM, JEC

*1: Adjustments, e.g. to parameters, are required after auto-tuning.
*2: When the momentary power loss compensation function is used, an uninterruptible power supply unit for the control power supply is needed (this is an option).
*3: To use the communications function, additional wiring and the installation of an option card must be done. For CP-215 communication, an optional expansion PLC board is required.
Note: Contact Yaskawa regarding 2.4 kV/4.16 kV power supply for the main circuit.

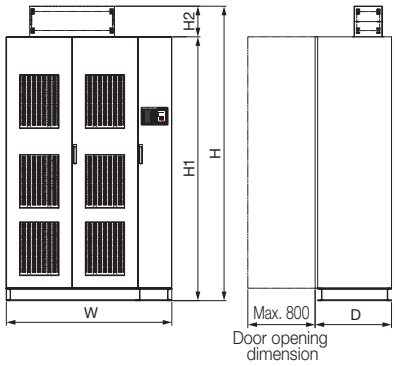


Fig.1

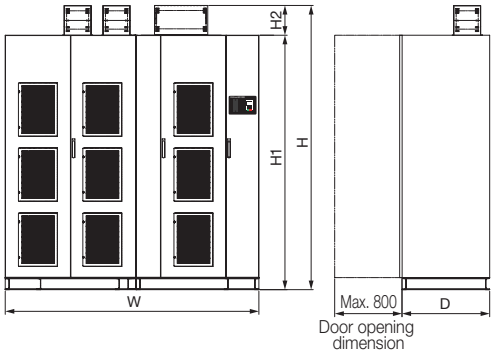


Fig.2

Voltage Class kV	Model CIMR-MV2A	Capacity kVA	Current A	Dimensions mm Width W	Depth D	Height H	Height H1	Height H2	Approx. Mass kg	Figure
3	C□C□035	200	35	1950	1000	2550	2150	400	2100	Fig.1
	C□C□050	285	50	1950	1000	2550	2150	400	2300	
	C□C□070	400	70	1950	1000	2550	2150	400	2400	
	C□C□100	570	100	1950	1000	2550	2150	400	2600	
	C□C□140	800	140	1950	1000	2550	2150	400	2900	
	C□C□200	1150	200	3000*	1100	2550	2150	400	4100	Fig.2
	C□C□260	1500	260	3500*	1200	2550	2150	400	4800	
	C□C□330	1900	330	4100*	1600	2550	2150	400	6000	
	C□C□400	2300	400	4100*	1600	2550	2150	400	6700	
	C□C□520	3000	520	5300*	1600	2800	2400	400	7900	
	C□C□650	3700	650	5600*	1600	2800	2400	400	8700	
6	F□F□035	400	35	3100*	1100	2550	2150	400	3200	Fig.2
	F□F□050	570	50	3100*	1100	2550	2150	400	3400	
	F□F□070	800	70	3100*	1100	2550	2150	400	3700	
	F□F□100	1150	100	3100*	1100	2550	2150	400	4100	
	F□F□140	1600	140	3100*	1100	2550	2150	400	4600	
	F□F□200	2300	200	4500*	1300	2550	2150	400	6000	
	F□F□260	3000	260	5500*	1300	2550	2150	400	7100	
	F□F□330	3800	330	6300*	1600	2800	2400	400	9900	
	F□F□400	4600	400	6300*	1600	2800	2400	400	10600	
	F□F□520	6000	520	7100*	1600	2800	2400	400	13200	
	F□F□650	7500	650	7300*	1600	2800	2400	400	15200	
11	H□H□035	660	35	5100*	1400	2700	2400	300	4800	Fig.2
	H□H□050	950	50	5100*	1400	2700	2400	300	5300	
	H□H□070	1300	70	5100*	1400	2700	2400	300	5800	
	H□H□100	1900	100	5100*	1400	2700	2400	300	6200	
	H□H□140	2650	140	5100*	1400	2700	2400	300	7200	
	H□H□200	3800	200	6900*	1500	2700	2400	300	9700	
	H□H□260	5000	260	7300*	1500	2700	2400	300	11200	

∗: Block construction
Note: The dimensions and masses may be changed.

Model Numbers

CIMR – MV2 A C 5 C A 035 E1 A A

Drive

FSDrive-MV1000 Series

Region Code
A : Standard

Input Voltage
C : 3.3 kV
F : 6.6 kV
H : 11 kV

Input Frequency
5 : 50 Hz
6 : 60 Hz

Output Voltage Class
C : 3 kV class
F : 6 kV class
H : 11 kV class

Factory Control Number
A, B, C ...

Output Current
035 : 35 A
050 : 50 A
070 : 70 A
100 : 100 A
140 : 140 A
200 : 200 A
260 : 260 A
330 : 330 A
400 : 400 A
520 : 520 A
650 : 650 A

Enclosure Type
E1 : IP40

Environmental Specifications
A : Standard

Design Revision Order
A, B, C ...

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

Options

Type		Name	Function	Manual No.
Built-in Type (connected to connector)	Speed (Frequency) Reference Card	Analog Input AI-A3	Allows high precision, high resolution analog reference input. · Input channels: 2 · Voltage input: −10 to 10 VDC (20 kΩ), 13 bit signed · Current input: 4 to 20 mA or 0 to 20 mA (250 Ω), 12 bit	TOEPC71068703
		Digital Input DI-A3	Used to set the frequency reference by digital inputs. · Input channels: 18 (including SET signal and SIGN signal) · Input signal type: BCD 16 bit (4 digit), 12 bit (3 digit), 8 bit (2 digit) · Input signal: 24 VDC, 8 mA	TOEPC71068703
	Communications Card*1	DeviceNet Interface SI-N3	Connects to a DeviceNet network.	TOEPC71068703 SIEPC71068704
		PROFIBUS-DP Interface SI-P3	Connects to a PROFIBUS-DP network.	TOEPC71068703 SIEPC71068705
		Modbus TCP/IP (Ethernet) SI-EM3	Connects to a Modbus TCP/IP network.	TOEPC71068703 SIEPC71068706
	Monitor Card	Analog Monitor AO-A3	Provides extra multi-function analog output terminals. · Output channels: 2 · Output voltage: −10 to 10 V, 11 bit (signed)	TOEPC71068703
		Digital Output DO-A3	Provides extra insulated multi-function digital outputs. · Photocoupler relays: 6 (48 V, up to 50 mA) · Contact relays: 2 (250 VAC/up to 1 A, 30 VDC/up to 1 A)	TOEPC71068703
	PG Speed Controller Card*2	Complementary Type PG Interface PG-B3	For speed feedback input by connecting a motor encoder. · Input: 3 track (can be used with one or two tracks), for HTL encoder connection, 50 kHz max · Encoder power supply: 12 V, max current 200 mA	TOEPC71068703
		Line Driver PG Interface PG-X3	For speed feedback input by connecting a motor encoder. · Input: 3 track (can be used with one or two tracks), line driver, 300 kHz max · Encoder power supply: 5 V or 12 V, max current 200 mA	TOEPC71068703
	PLC Function*1	Expansion PLC Board BC-620	Supplements PLC functions required to customize the drive. · Program memory capacity: Equivalent to 8,000 steps · Execution speed: 1,000 steps/1 ms · Language: Ladder language · Communications: CP-215	SIEPC71068709
Panel Housed Type	Momentary Power Loss Compensation	Uninterruptible Power Supply Unit	UPS is installed inside the panel and backs up a control power supply when momentary power losses occur. This option is required to implement measures against momentary power loss (for the speed search function or KEB function).	–
	Measures for Colder Regions	Space Heater	A space heater circuit has been added to suppress condensation inside the panel. Note: This option may not always prevent condensation.	–
	Panel Door Open Interlock		Detects opening of the panel door by adding a limit switch. Medium-voltage power shutdown command is output on detecting opening.	–
Separate Installation Type	USB Copy Unit JVOP-181		Allows the user to copy and verify parameter settings between drives. Can also be used as an adapter to connect the drive to the USB port on a PC.	–
	Lifter for Replacing Power Cells		Facilitates power cell replacement.	–
	Inrush Current Suppression Circuit		Suppresses the inrush current on turning the drive power on by adding a suppression circuit.	TOEPC71068703
Engineering Tool DriveWizard Plus MV*3			DriveWizard Plus MV is an engineering tool to support everything from setup to test runs and maintenance of AC Drives.	TOEPC87072200

*1: Only one optional communication card or expansion PLC board can be selected.
*2: To apply PG control, the PG speed control card must be selected. Contact Yaskawa regarding pulse monitor output.
*3: Enable .Net Framework 3.5 when using Windows 10. DriveWizard Plus MV will not start if .Net Framework 3.5 is disabled. To enable .Net Framework 3.5, connect to the Internet or prepare Windows 10 installation media.

Fans, Blowers, Pump Equipment (Variable Torque Load)

Advantages

1. Energy-saving operation

- Switching operation from conventional damper (valve) control using a commercial power supply to frequency control with FSDrive-MV1000 saves a large amount of energy.
- Even bigger energy savings are possible with machines with standby operation (under normal duty conditions).

2. Stable operation

- The speed can be retrieved quickly by speed search function in response to momentary power losses.*
- KEB function allows operation to continue without base-blocking even when momentary power losses occur.
- When priority is given to continuing operation, fault restart function enables FSDrive-MV1000 to continue running even if an unexpected error is detected.

*: A UPS unit is required in addition to supply control power.

3. Achievement of ideal operation patterns

- Because the airflow (flow rate) is controlled directly by the drive output frequency, with none of the pressure loss by dampers (valves), the ideal operation pattern can be achieved easily.
- The machine can be started and stopped frequently.
- With speed search function, operation can be smoothly restarted even when fans are coasting.
- Minimum frequency setting function prevents pumps from failing to supply, meaning that stable supply can be maintained.

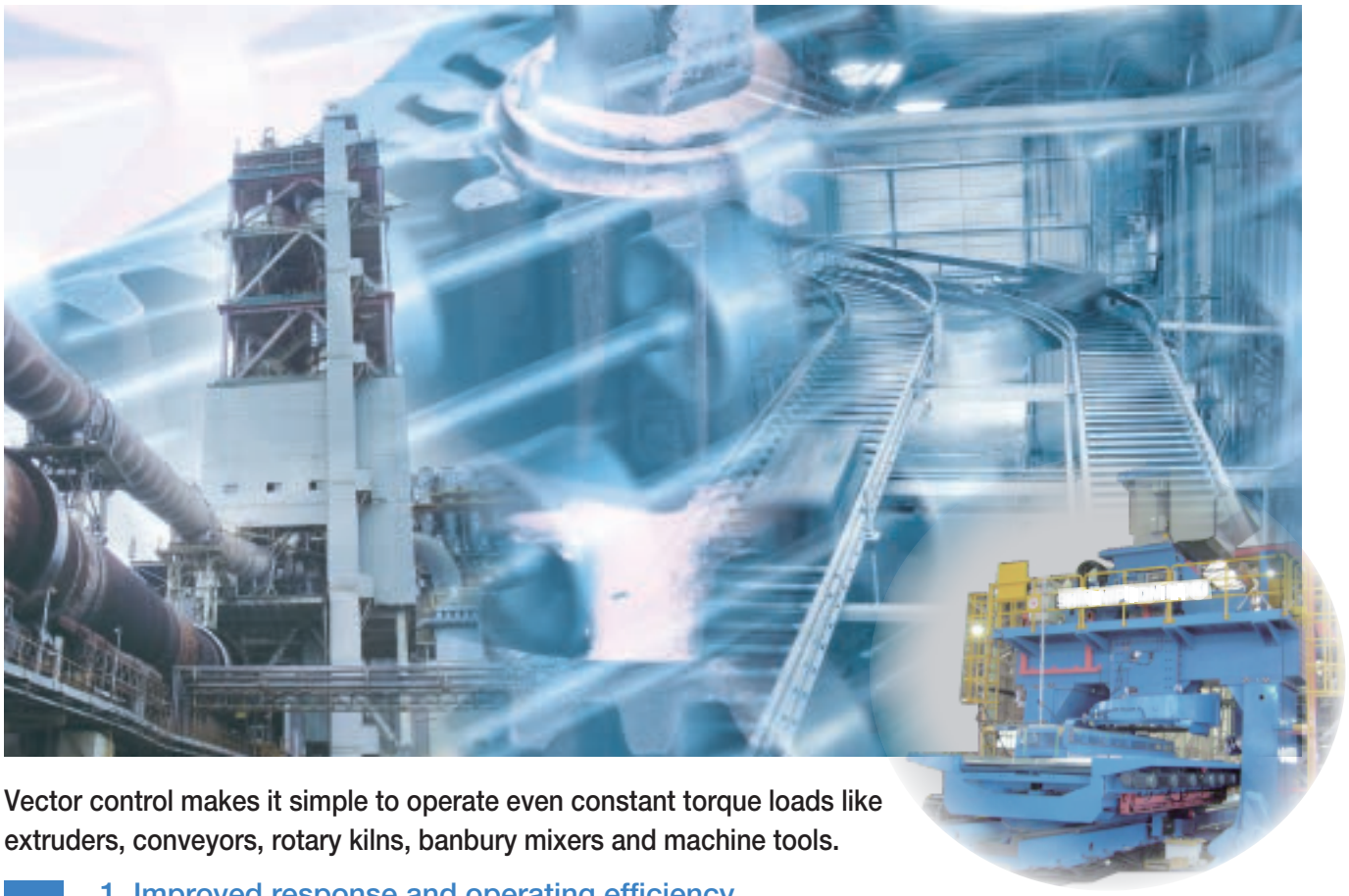
4. Extended machine life

- The machine runs at low speed during no-load operation, helping to prolong its life.
- Machine life can be further extended by operation methods that minimized impact on the machine by using FSDrive-MV1000 to attain soft starting and soft stopping.

5. Reduced power supply capacity

- With FSDrive-MV1000 the accel/decel time can be set as required, and the starting current can be cut substantially. This means that power supply capacity can be reduced.

General Industrial Machinery (Constant Torque Load)



Vector control makes it simple to operate even constant torque loads like extruders, conveyors, rotary kilns, banbury mixers and machine tools.

Advantages

1. Improved response and operating efficiency

- High starting torque required for operation is provided.
- Vector control improves response against load fluctuations, enabling stable operation.
- Starting current can be kept lower than with direct-on-line, enabling frequent stopping and starting and efficient operation.

2. Improved speed control accuracy

- High-accuracy speed control allows application to machines that demand accuracy, which was difficult with variable speed systems using conventional rotor resistance control.

3. Energy-saving effects

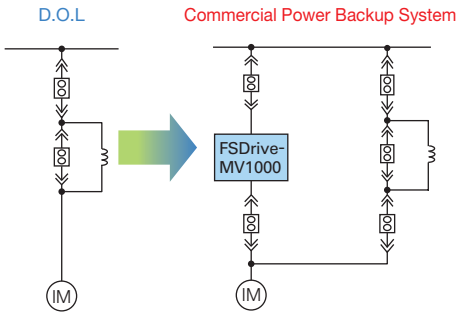
- Using frequency control instead of rotor resistance control of conventional fluid-coupling and wound rotor motors eliminates loss in low-speed operations and saves energy.

4. Better maintainability

- Using a squirrel-cage motor with drive control enables better maintainability than conventional wound rotor motors with rotor resistance control.
- Using drives instead of fluid couplings simplifies the drive system and considerably reduces mechanical maintenance.

Others

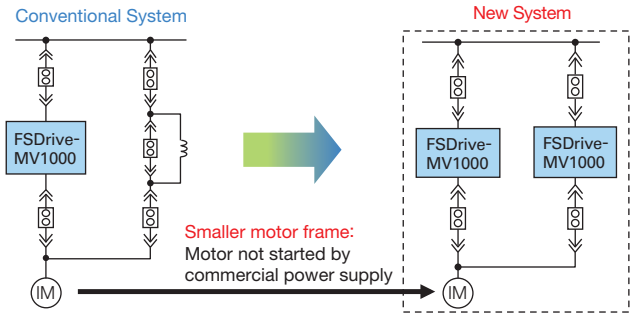
Example 1: Commercial power backup system



Introduce a drive with existing equipment.

- The existing equipment (breakers, cables, etc.) for commercial power operation can be reused as a backup circuit.
  (For new installations, switchgears and reactors are available from Yaskawa.

Example 2: Drive backup system



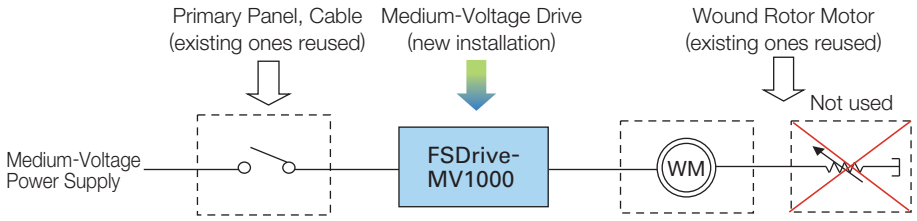
For machine with large GD², the total cost is reduced with drive backup

- The motor is not started by commercial power, so the size of the motor frame is smaller, enabling cost reductions and space savings.
- The system can be run by the backup drive in an emergency. (When using commercial power operation for an application of large GD², a substantial motor fame is needed and this increases the cost.)

Example 3: Achieving variable speed control of an existing wound rotor motor

System of existing wound rotor motor + medium-voltage drive

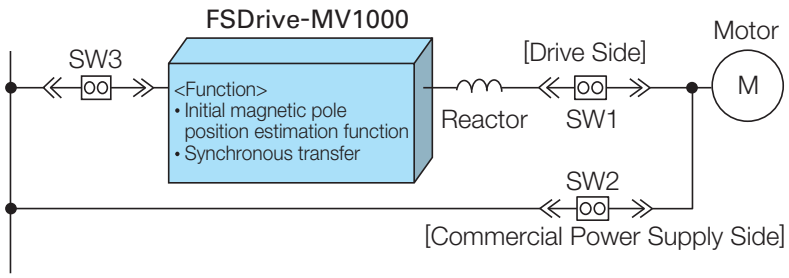
Drives can be put to use with wound rotor motors too.



- Achieves energy savings.
- The existing motor and cables are reused.
- Maintenance of motor brushes and resistors is not necessary.

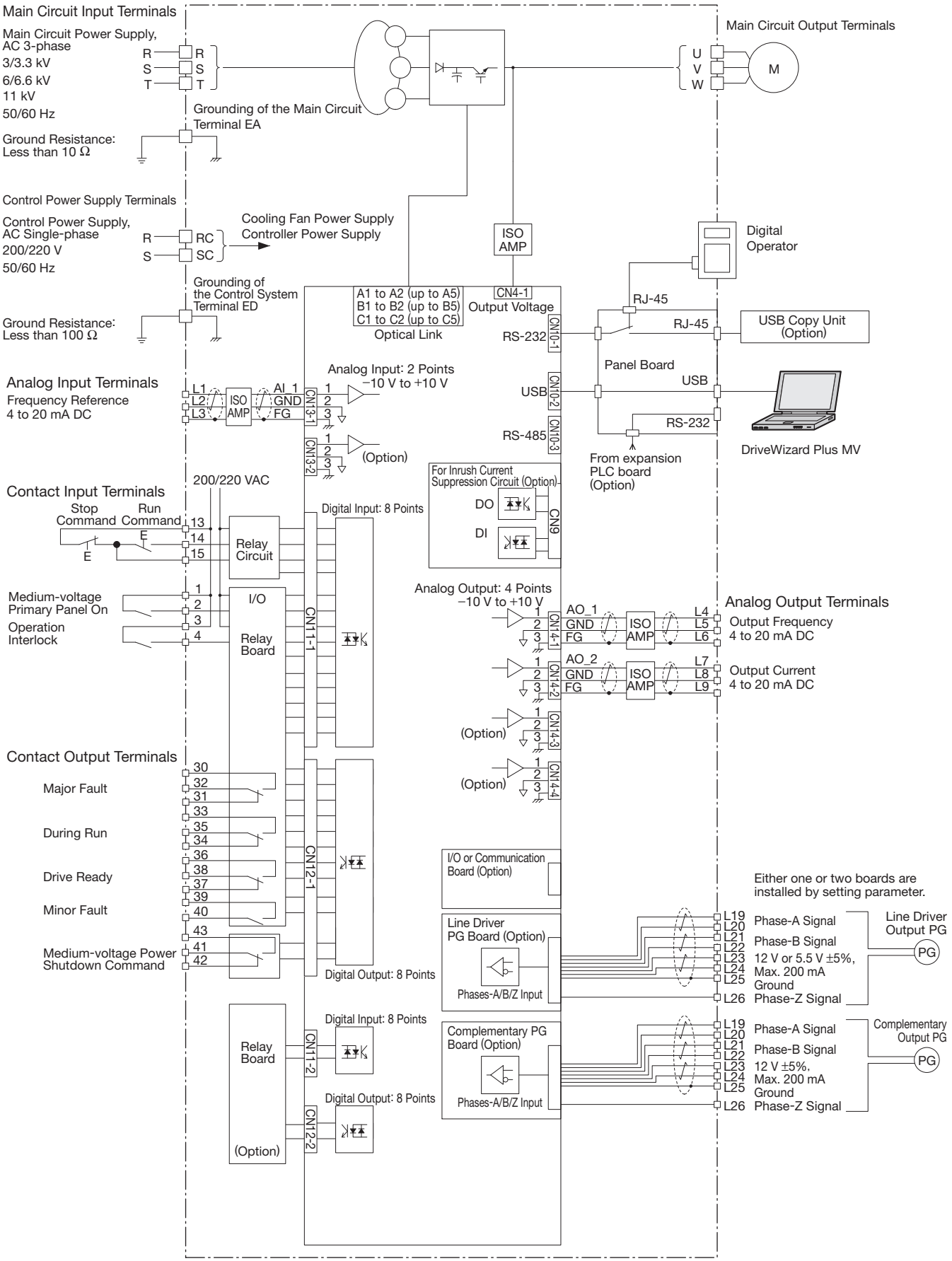
Short the secondary side of the existing wound rotor motor.

Example 4: Synchronization switching system for synchronous motors



Application to motors is possible.
This system uses a drive to start a motor and switches shocklessly to the commercial power operation after acceleration is completed. After reaching the rated motor speed, the voltage phase and amplitude of the drive output are matched before switching to the commercial power supply.

Standard Connections Diagram



Main Circuit Terminals (Common to all models)

Type	Terminal No.	Terminal Function
Main Circuit Input Terminals	R	3000/3300 VAC, 6000/6600 VAC, 10000 VAC/10500 VAC/11000 VAC 50/60 Hz
	S	
	T	
Main Circuit Output Terminals	U	3000/3300 VAC, 6000/6600 VAC, 10000 VAC/10500 VAC/11000 VAC 50/60 Hz
	V	
	W	
Ground Terminal	EA	Grounding of the main circuit
Control Power Supply Input Terminal	RC	200/220 VAC 50/60 Hz
	SC	
Ground Terminal	ED	Grounding of the control system

Control Circuit Terminals (Common to all models)

Type	Terminal No.	Signal Name	Signal Level	Terminal Function
Analog Input Terminals	L1	Frequency Reference	4 to 20 mA DC/0 to 60 Hz	Frequency reference input signal
	L2			Ground
	L3			Shield ground
Analog Output Terminals	L4	Output Frequency	4 to 20 mA DC/0 to 60 Hz	Output frequency reference output signal
	L5			Ground
	L6			Shield ground
	L7	Output Current	4 to 20 mA DC/0 to 150%	Output current reference output signal
	L8			Ground
	L9			Shield ground
Contact Input Terminals	1	Medium-Voltage Primary Panel On	Contact input 220 VAC/8 mA	ON: Turning on (closed at default)
	2			
	3	Operation Interlock	Contact input 220 VAC/8 mA	ON: Established (closed at default)
	4			
	13	Run Command/ Stop Command	Contact input 220 VAC/8 mA	ON: Run
	14			
	15			OFF: Stop
Contact Output Terminals	30	Major Fault	Form-C contact output relay 220 VAC/7 A, 110 VAC/15 A, 24 VDC/15 A	Open: Major fault (32-31) Closed: Major fault (32-30)
	31			
	32			
	33	During run	Form-C contact output relay 220 VAC/7 A, 110 VAC/15 A, 24 VDC/15 A	Closed: During run (35-33) Open: During run (35-34)
	34			
	35			
	36	Drive Ready	Form-C contact output relay 220 VAC/3 A, 110 VAC/3 A, 24 VDC/3 A	Closed: Drive ready (38-36) Open: Drive ready (38-37)
	37			
	38			
	39	Minor Fault	N.O. contact relay output 220 VAC/7 A, 110 VAC/15 A, 24 VDC/15 A	Closed: Minor fault
	40			
	41	Medium-Voltage Power Shutdown Command	Form-C contact output relay 220 VAC/55 A, 110 VAC/60 A 220 VDC/1.5 A, 110 VDC/5 A	Closed: Power turning OFF (41-42) Open: Power turning OFF (41-43)
	42			
	43			

Software Functions

Loaded with a variety of software functions, enabling system optimization to your application

NEW New Function Indicates software functions new to FSDrive-MV1000, contrasting them with the existing FSDrive-MV1S.

Note: Only major functions are presented here.

Functions at Start and Stop

Optimal Deceleration

Optimal deceleration without needing to set the deceleration time.

Drive slows the application smoothly controlling DC bus voltage.

NEW High Slip Braking

Suitable for applications with occasional stopping, such as emergency stopping of large-inertia loads

Reduces the deceleration time at emergency stops.

Note: The result may vary depending on conditions such as motor characteristics.

Speed Search

Start a coasting motor.

Automatically brings a coasting motor back to the target frequency without using a motor encoder.

NEW Dwell Function

Accelerate and decelerate smoothly with large inertia loads.

Drive prevents speed loss by holding the output frequency at a constant level during acceleration and deceleration.

Accel/Decel Time Switch

Switch easily between accel/decel times.

Switch acceleration and deceleration rates when running two motors from the same drive, or assign specific accel/decel rates when operating at high speed or at low speed.

Direct Current Braking at Start

Braking the motor by applying direct current when starting

Enables stopping of a coasting motor for restarting or quickly generating motor magnetic flux (initial excitation) to obtain high starting torque.

Reference Functions

Frequency Reference Upper/Lower Limits

Limit motor speed.

Set speed limits and eliminate the need for extra peripheral devices and extraneous hardware.

Frequency Jump

Skip over troublesome resonant frequencies.

Drive can be programmed to avoid machine resonance problems by avoiding constant speed operation at certain speeds.

Frequency Reference Hold

Improved operability.

Momentarily hold the operating frequency during acceleration or deceleration as the load is lowered or raised.

NEW Droop Control

Balances the load automatically between motors.

Calculates the ratio of the load torque and adjusts motor speed accordingly.

Functions for Top Performance

NEW IM/SM Compatible

Supporting both IMs and SMs

Runs wound rotor synchronous motors (SM) as well as induction motors (IM).

Line/Drive Transfer

Transfer from line to drive, drive to line*

Perform transfer operation from line to drive and drive to line without stopping motors

*: An input voltage/current detector needs to be added.

Energy Saving

Automatically runs at top efficiency.

The drive supplies voltage to the motor relative to the speed and load so that the application is for operating at the most efficient level.

Current Vector Control

Achieve high levels of performance.

The drive comes with current vector control capabilities for high performance applications.

Multi-speed Operation

Multi-speed operation is possible.

Enables speed selection in up to 17 steps. Speed selection is even possible during operation by using multi-function digital inputs.

NEW
PID Control

Automatic PID control

The internal PID controller fine-tunes the output frequency for precise control of pressure, flow, or other variables.

NEW
Motor 2 Switch

One drive runs two motors.

Use a single drive to operate two different motors. Cannot be used with PM motors.

V/f Control (Multi-motor Drive)

Controlling multiple motors

Runs multiple motors simultaneously in parallel.

Overtorque Detection

Improving reliability in continuous operation while protecting the system

Shuts off the overtorque signal when the motor torque goes beyond the overtorque detection level. This signal can be utilized as an interlock signal to protect the system.

Torque Limit

Improving reliability in continuous operation while protecting the system

Helps protect the system by restricting motor torque to a preset level. The output frequency is controlled according to the overload status.

NEW
Timer Function

No need for extra hardware

Control timing by opening and closing the output signal relative to the input signal.

Continuos Run during Reference Loss

Keeps the application running

Maintains continuous operation even if the controller fails and the frequency reference is lost.

Fault Retry

Improving reliability in continuous operation

Resets the system automatically after performing self-diagnostics when the drive detects an error. A number of retries up to 10 can be selected.

Protective Functions

Momentary Power Loss Compensation

Keep running even during a momentary power loss*

Automatically restarts the motor and keeps the application running even during a momentary power loss.

*: A UPS unit is required in addition to supply control power.

Excessive Deceleration Prevention

Preventing motor stall due to overvoltage

Controls the deceleration rate automatically by monitoring the DC-bus voltage to prevent overvoltage during deceleration.

Load Speed Display

Monitor actual speed of the motor and load.

Monitors let the user keep track of motor rotations and line speed.

NEW
Copy Function

Save parameter setting to the digital operator.

Copy all parameter settings to the operator keypad, and then transfer those settings to another drive. Saves valuable setup and maintenance time.

KEB Function

Continuous operation even during a momentary power loss without base-blocking*

Uses regenerated energy from the motor to bring the application to a stop rather than simply letting it coast.

*: A UPS unit is required in addition to supply control power.

Protective Functions

Drive Faults

Fault	Display	Meaning
DC Bus Undervoltage	Uv1	The average DC voltage of the main circuit for power cells fell lower than the value set in L2-05 (main circuit undervoltage (Uv) detection level).
Power Supply Undervoltage	IUV	Power voltage has dropped for all power cell's during drive operation (voltage output).
Ground Fault	GF	The ground-fault current at the drive output side exceeded 50% of the rated output current of the drive.
Voltage Unbalance	VUB	The total value of the output voltage for the three phases exceeded the detection level for longer than the stipulated time.
Output Phase Loss	LF	An open-phase occurred at the drive output. (Detected when L8-07 is set to 1 or 2.)
Output Overvoltage	OOV	The output voltage exceeded the detection level for longer than the stipulated time.
Transformer Temperature Fault	TME	The temperature input from the transformer exceeded the operation level.
Fan Fault	FAn	A fault on the drive cooling fan has been detected.
Motor Overload	oL1	The motor overload protection function has operated based on the internal electronic thermal value.
Drive Overload	oL2	The drive overload protection function has operated based on the internal electronic thermal value.
Overtorque Detection 1	oL3	There has been a current greater than the setting in L6-02 (overtorque/undertorque detection level 1) for longer than the time set in L6-03 (overtorque/undertorque detection time 1).
Overtorque Detection 2	oL4	There has been a current greater than the setting in L6-05 (overtorque/undertorque detection level 2) for longer than the time set in L6-06 (overtorque/undertorque detection time 2).
Undertorque Detection 1	UL3	There has been a current below the setting in L6-02 (overtorque/undertorque detection level 1) for longer than the time set in L6-03 (overtorque/undertorque detection time 1).
Undertorque Detection 2	UL4	There has been a current below the setting in L6-05 (overtorque/undertorque detection level 2) for longer than the time set in L6-06 (overtorque/undertorque detection time 2).
Overspeed	oS	The speed detection value based on pulse inputs exceeded the value set in F1-08 (overspeed detection level).
PG Disconnect	PGo	The speed detection value based on pulse inputs stayed at 0 for the time set in F1-14 (PG disconnection detection time).
PG Hardware Fault (detected when using a PG-X3 option card)	PGoH	Disconnection of the PG cable has been detected (only when equipped with PG-X3).
Speed Deviation	dEv	The deviation between the speed detection value based on pulse inputs and the speed reference exceeded the value set in F1-10 (excessive speed deviation detection level) for longer than the time set in F1-11 (excessive speed deviation detection time).
Control Fault	CF	The torque limit has been reached continuously for 3 seconds or longer during deceleration to a stop under open-loop vector control.
PID Feedback Loss	FbL	The PID feedback input went below the fault detection level for longer than the set time (detected when b5-12 is set to 2).
Too Many Speed Search Restarts	SEr	The number of speed search restarts exceeded the number set to b3-19.
External Fault	EF□□	An external fault signal has been input from a multi-function contact input terminal (S□□). (□□: External input number)
MEMOBUS/Modbus Communication Error	CE	Control data has not been received for longer than the time set in H5-09 (CE detection time) after being successfully received once.
Option Card Connection Error	oF□□□	A fault related to an option card has been detected. (□□: fault number, details of the fault)
Control Circuit Error	CPF□□	A fault related to the controller has been detected. (□□: fault number, details of the fault)
Digital Operator Connection Fault	oPr	The connection to the digital operator was broken during operation in response to a run command from the digital operator.
CCB-MB Communications Error (Link fault)	□□ : LIN	Response data from power cells have not been detected for longer than the set detection time.
Soft-Charge Bypass Circuit Fault	Uv3	The soft-charge bypass circuit has failed.
Initial Magnetic Pole Position Detection Fault	MGP	Initial magnetic pole position estimation was not completed after the Initial magnetic pole position estimation was sterted and after N8-04[ms] × 50 elapsed.
Synchronous Motor-Related Fault	dv□	dv1 to 3: Synchronous motor control-related fault has been detected.
Commercial Synchronous Switching Error	SYNC	An error was detected during commercial synchronous switching. (The synchronous switching signal is ON)

Power Cell Faults

Fault	Display	Meaning
Overcurrent	CFA □□ : OC	An output current greater than the specified overcurrent level has been detected.
Overvoltage	CFA □□ : OV, □□ : OV2	The DC voltage at the P side or N side of the main circuit exceeded the overvoltage detection level.
Undervoltage	CFA □□ : CUV	The DC voltage at the P side or N side of the main circuit fell below the undervoltage detection level.
IGBT Overheating	CFA □□ : OH, □□ : OH1	The temperature detection value exceeded the fault detection level.
Main Circuit Capacitor Neutral Point Potential Error	CFA □□ : VCF_OV	The DC voltage at the P side or N side of the main circuit became unbalanced.
IGBT Fault	CFA □□ : IGBT_FLT	An IGBT fault (arm short-circuit, output short-circuit, or circuit fault) has been detected.
Fuse Blowout	CFA □□ : FU	Blowout of a main circuit fuse or open-phase in the input voltage has been detected.

□□: fault power cell number

Examination of capacity 1
For blower motor

When commercial power operation method is changed to speed control method, the applicable drive capacity is determined as follows.
Example: Motor rating: 500 kW, 4P, 3 kV at 50 Hz
Assuming that:
- Motor rated current : 120 A
- Maximum value of actual operation load current : 95 A

For this applicable drive capacity, rated current 100A (nominal capacity 570 kVA) should be selected.
(100 A > 95 A)

Examination of capacity 2
For extruder motor

Example: Motor rating: 400 kW, 6P, 3.3 kV at 60 Hz
Assuming that:
- Motor rated current: 88 A
- Required overload tolerance: 120% for 60 seconds

The applicable drive tolerance is shown below considering the allowance of 10%:
88 A × 1.3 = 115 A
Therefore, for this applicable drive capacity, rated current 140 A (nominal capacity 800 kVA) should be selected.
(140 A > 115 A)

Examination of capacity 3
For cement kiln motor

Example: Motor rating: 500 kW, 6P, 6.6 kV at 60 Hz
Assuming that:
- Motor rated current: 53 A
- Required overload tolerance: 250% for 60 seconds

The applicable drive capacity is shown below considering the allowance of 10%:
53 A × 2.6 = 138 A
Therefore, for this applicable drive capacity, rated current 140 A (nominal capacity 1600 kVA) should be selected.
(140 A > 138 A)

Motors for Medium-Voltage Drives

The rated output described in the following table is when a motor with 4 poles and 60 Hz is selected.

Structure and Model	Protective Structure, Cooling Method	Rated Voltage	Rated Output (kW) 110 – 1,000 – 5,000 – 10,000
Variable Torque Series: Self-ventilated Type			
Dripproof Protected Type BDK-I	IP-22, IC-01	6kV	315 – 7,100
		3kV	450 – 8,000
Totally-enclosed Fan-cooled Type FEK-I	IP-44, IC-411	6kV	55 – 1,250
		3kV	37 – 1,400
Totally-enclosed Internally-cooled, with Motor-mounted Air-cooled Heat Exchanger Type HEK-I	IP-44, IC-611	6kV	355 – 5,600
		3kV	560 – 6,300
Constant Torque Series*: Externally Fan-cooled Type			
Dripproof Protected Type BDK-IKM	IP-22, IC-06	6kV	315 – 7,100
		3kV	450 – 8,000
Totally-enclosed Fan-cooled Type FEK-IKM	IP-44, IC-416	6kV	250 – 1,250
		3kV	315 – 1,400
Totally-enclosed Internally-cooled, with Motor-mounted Air-cooled Heat Exchanger Type EKK-IM	IP-44, IC-666	6kV	355 – 5,600
		3kV	560 – 6,300

✻ : The motors of constant torque series include a PLG or a motor using a forced-air cooling fan.

Accessories (Option)

- Stator winding temperature detectors: Resistance temperature detector (RTD)
- Bearing temperature detectors: Dial thermometer, Resistance temperature detector (RTD)
- Space heater

Totally-enclosed, fan-cooled type
FYT series
For details, refer to the catalog No. KAEPC26020000.

Totally-enclosed internally-cooled, with motor-mounted air-cooled heat exchanger type
NB series
For details, refer to the catalog No. KA-C280-4 (English version).

Notes on Using Drives

Selection

■ Power Supply Capacity

The main circuit power supply to be connected to the drive should have a capacity larger than the power required by the drive with the power factor and efficiency taken into account. When connecting multiple drives to a single power supply, select a power supply with a capacity larger than the sum of the power required by all the drives to be connected. Even when the power supply has sufficient capacity, the power supply voltage may drop when the power is turned on. This may cause malfunction of devices connected to the same power supply system if the power supply has a large power impedance.

■ Drive Capacity

When running multiple induction motors in parallel using a single drive, the capacity of the drive should be larger than 1.1 times the total motor rated current.

■ Starting Torque

The overload current rating of the drive determines the starting and acceleration characteristics of the motor. Generally, lower torque characteristics on starting are expected when compared to using a commercial power supply. For applications that require high starting torque, select an drive with a larger capacity.

■ Emergency Stop

When the drive faults out, a protective function is activated and drive output is shut off. This, however, does not stop the motor immediately. Some type of mechanical brake may be needed if it is necessary to halt the motor faster than the Fast Stop function is able to.

Installation

■ Ambient Environment

Keep the drive in a clean environment that is free from airborne oil mist, corrosive gas, flammable gas, lint and dust. Install the fan cover at the top of the panel before starting operation. Any modification to the drive panel's cooling fan, such as connecting air exhaust duct, may reduce air flow for cooling and cause overheating and faults. Do not connect air exhaust duct.

■ Drive Storage

When storing the drive as is in a storage facility or in the installed state, observe the following points to maintain its reliability.

- Short term storage of the drive
  Short term storage refers to cases where the drive is stored for up to one month after unpacking or up to three months after shipping. Secure a storage environment that satisfies the conditions cited for the drive's environmental specification. Note that an ambient temperature of up to 60˚C is acceptable.
- Long term storage of the drive
  Long term storage refers to cases where the drive is stored for more than one month after unpacking or more than three months after shipping. Contact Yaskawa if long term storage is required. Note that an ambient temperature of up to 50˚C is acceptable.
- Store the spare parts without unpacking them. For details, refer to the storage method described in the Instruction Manual.

■ Grounding Specification

Provide a dedicated grounding (EA) of less than 10 Ω or grounding (ED) of less than 100 Ω for the drive.

■ Compliance with local laws

Please comply with the law of the relevant country when you install this product.

■ Effects of Distortion in Power Supply

When the power supply voltage is originally distorted, or when multiple devices and the drive are connected to the same power supply, drive harmonics from the power supply system flow into the drive, resulting in high relative harmonic content.

Settings

■ Use V/f control when running multiple induction motors using a single drive.

■ Upper Limits

The drive is capable of running the motor at up to 120 Hz. Incorrect settings might result in dangerous operating conditions, so be sure to set the upper limit for the frequency to control the maximum speed. (The maximum output frequency for operation by external input signals is set to 60 Hz by default.)

■ Accel/Decel Times

Accel and decel times are determined by the torque that the motor generates, the load torque and the inertia moment (GD^2). Set a longer accel/decel time when the stall prevention function is activated during accel/decel. When the stall prevention function is activated, the accel/decel time is extended to cover the time that the function operates. To achieve even faster acceleration and deceleration, select motors, and a drive, with greater capacity.

General Handling

■ Wiring Check

Never short the output terminals of the drive or apply voltage from the power supply to the output terminals (U, V, W). This will damage the drive. Carry out wiring that conforms to the wire sizes and tightening torques described in the Instruction Manual. Conduct a thorough check of wiring errors before turning the power on.

■ Breaker/Magnetic Contactor Selection and Installation

Select a breaker with sufficient capacity for the main circuit power supply side of the drive, taking the inrush current from the transformer into account. Avoid using the breaker or magnetic contactor for frequent starting/stopping. This may damage the drive. Do not switch the breaker or magnetic contactor ON/OFF more than twice a day. If it is switched ON/OFF more frequently, install an optional inrush current suppression circuit between the main circuit power supply and the drive.
Use a low-surge type vacuum circuit breaker for the main circuit power supply breaker.
The medium-voltage power shutdown command is output from contact output terminals if the drive is damaged. Be sure to shut down the medium-voltage power using the signal from these terminals.

■ Inspection and Maintenance

Even after shutting off the drive, it takes some time to discharge of internal capacitors. Make sure that the CHARGE light has gone out completely before performing any inspection or maintenance work. With residual electric charge in the capacitors, the resulting high voltage in the power cell and on its surface can cause electric shock.
The heatsink of the power cell can become quite hot during operation, and proper precautions should be taken to prevent burns.
When replacing the cooling fan, shut off the main circuit's power and then wait at least 15 minutes. Then, shut off the control circuit's power and make sure that the cooling fan has fully stopped before starting the work.

■ Transportation/Installation

- Never steam clean the drive.
- During transportation and installation, the drive must never be exposed to an atmosphere containing a halogen gas such as fluorine, chlorine, bromine, or iodine.
- Prevent liquid, such as water, from leaking into the drive. This may cause the drive to malfunction.
- If liquid leaks into the drive, contact Yaskawa.

■ Hoisting

With some large capacity drives, the transformer, rather than the transformer panel itself, must be hoisted directly. The drive may deform or fall down if the drive panel frame is hoisted. For details, refer to the installation method described in the Instruction Manual.

■ Radio Frequency Interference

Inputs and outputs of the drive (main circuit) contain harmonic components that may adversely affect communication devices, such as AM radios, used in the vicinity. Use high-voltage cables and ground any shielded cables. Separate cables for control from high-current circuits (main circuit and relay sequence circuits) to avoid induction from peripheral devices. (It is advisable to separate them by a distance of 30 cm or more.)

■ Leakage Current

Harmonic leakage current passes through stray capacitance between the drive power lines, ground and the motor lines. Consider taking measures against this leakage current.

■ Power Supply Capacity and Drive Capacity

When the power supply capacity is larger than the drive capacity, an inrush current suppression circuit may be required. Contact your Yaskawa representative for details.

Notes on Motor Operation

Application to Existing Standard Motors

■ Insulation Tolerance

Consider voltage tolerance levels and insulation in applications with high input voltage or particularly long wiring distances.
Contact Yaskawa for consultation.

■ High Speed Operation

Running a motor beyond its rated speed may lead to problems imposed by vibration or the durability of motor bearings. Contact the manufacturer of the motor for details.

■ Torque Characteristics

When driven by a drive, the torque characteristics of the motor differ from when it is driven with a commercial power supply. Therefore, the load torque characteristics that the motor drives need to be confirmed.

■ Vibration and Shock

The PWM control with multiple outputs connected in series of FSDrive-MV1000 reduces motor oscillation to the same level as in operation by commercial power supply. However, the motor oscillation is slightly larger due to the following factors.

(1) Resonance with the natural frequency of the mechanical system

Take particular caution when using a variable speed drive for an application that is conventionally run by commercial power at a constant speed. Installing shock absorbing rubber under the base of the motor and using Frequency Jump function can be effective measures.

(2) Residual unbalance of the rotating motor

Particular care is required when running the motor beyond its rated speed.

(3) Subsynchronous Resonance

Subsynchronous resonance may occur in fans, blowers, turbines, and other applications with high load inertia, as well as in motors with a relatively long shaft.
Yaskawa recommends using the closed loop vector control for such applications.

Inquiry Form

Please specify the following information when inquiry.

1	Name of facility or application		
2	Name of load	☐ Pump ☐ Fan ☐ Blower ☐ Compressor ☐ Extruder ☐ Others	
3	Load characteristics	☐ Variable torque ☐ Proportional torque ☐ Constant torque ☐ Constant output	GD² kg·m²
4	Operation conditions	Motor Current A Operation time Annual hours	
5	Motor model to be driven	☐ Squirrel-cage motor ☐ Wound rotor motor ☐ Synchronous motor	☐ Existing ☐ New
6	Motor specifications	Output kW Voltage V Frequency Hz Number of poles p Speed min⁻¹ Rated current A Efficiency % Power factor	
7	Speed control range	Minimum min⁻¹ to Maximum min⁻¹ or Minimum Hz to Maximum Hz	
8	Speed setting procedure	☐ Process signal 4 to 20 mA operation ☐ Manual rotating speed adjusting operation ☐ UP/DOWN signal adjusting operation ☐ Multi-step speed signal changeover operation	
9	Pattern operation (with/without)	☐ Acceleration time Second(s)/ min⁻¹ ☐ Deceleration time Second(s)/ min⁻¹	
10	Overload tolerance	%/ Second(s)	
11	Commercial power supply by-pass operation circuit	☐ Not needed ☐ Needed <Drive to line ☐ Automatic changing method ☐ Manual changing method>	
12	Power supply specifications	Main circuit power supply capacity kVA Main circuit voltage V Frequency Hz Control circuit voltage ☐ 200/220V ☐ 400/440V	
13	Ambient conditions	Indoors ☐ Ambient temperature ˚C to ˚C ☐ Humidity % or less ☐ Air-conditioning facility (Provided/Not provided)	

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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