



Super Energy-Saving Medium-Voltage AC Drive FSDrive-MV1000

3 kV 200 kVA to 3700 kVA (Under development for 1500 kVA or higher)

6 kV 400 kVA to 7500 kVA (Under development for 3000 kVA or higher)

11 kV 660 kVA to 12000 kVA (Under development)



EN

DE

ES

FR

IT

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Global Service Network

Completely New: World's Smallest Medium-Voltage AC Drive

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

With the new FSDrive-MV1000 Yaskawa presents the 4th generation of medium voltage drives with power cells connected in series.

The concept of series connected power cells was first introduced back in 1996 with the VS-686HV5 drive. But time has not stopped. Driven by the incentive of creating better and better, more and more efficient, high-performance drives, Yaskawa has been continuously coming up with groundbreaking technologies, which are the foundation of today's Yaskawa products. The youngest child of those developments is the FSDrive-MV1000 series. It is the combination of long medium voltage drive experience, multi-level control technology well known from the Yaskawa G7 drive series, bundled with the ease of use of the 1000 series low voltage drives.

An ultra compact design, outstanding performance, remarkable energy saving capabilities, and easy operation and handling make the FSDrive-MV1000 the first choice for cost effective medium voltage solutions.

Compact Design

- ▶ 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

- ▶ 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

- 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

- 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

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
1000series
1000series



Medium -voltage drive

VS-686HV5 1996

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

VS-686HV5S 1998

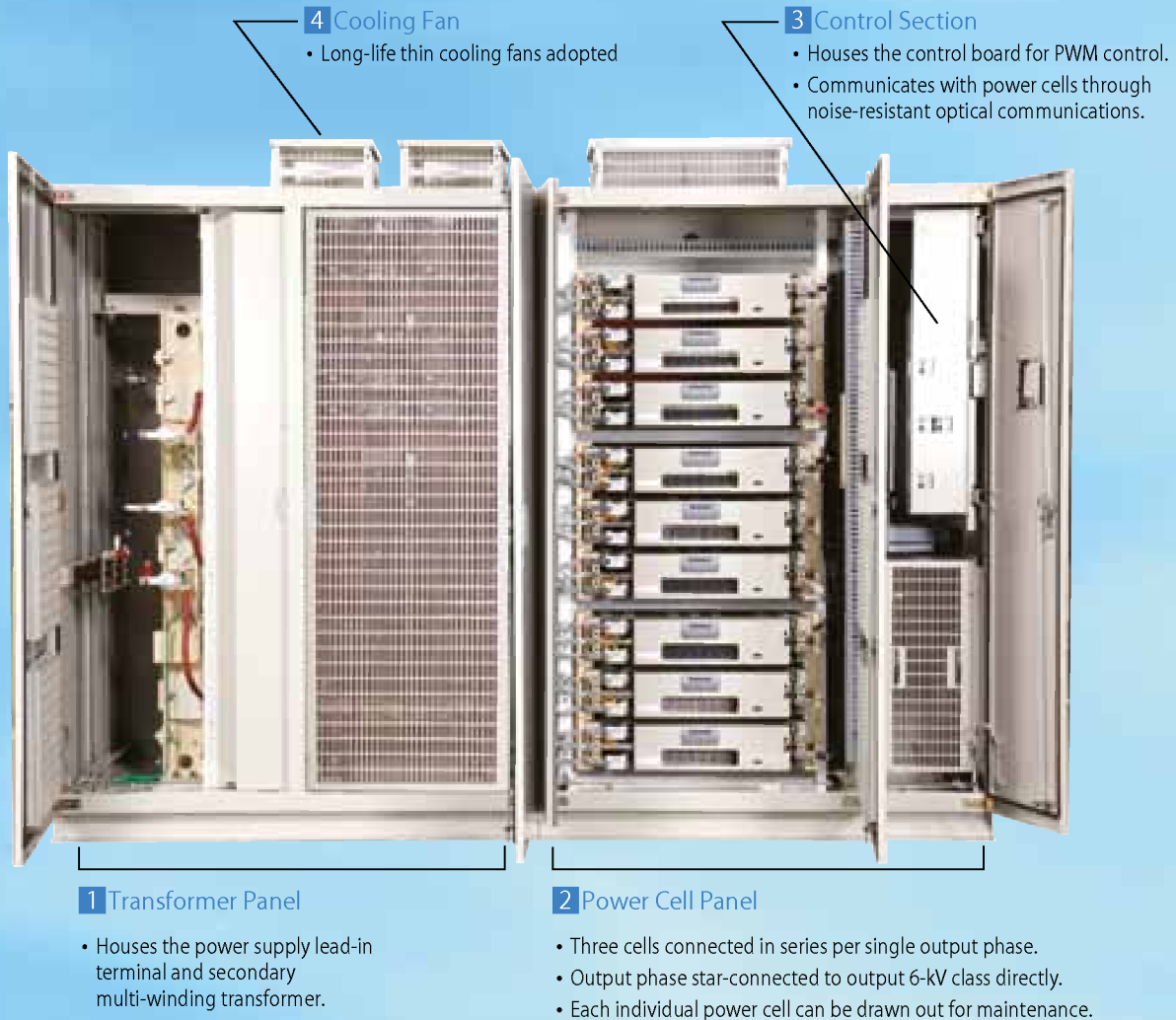
VS-686HV5SD 2002

FSDrive-MV1S 2005

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

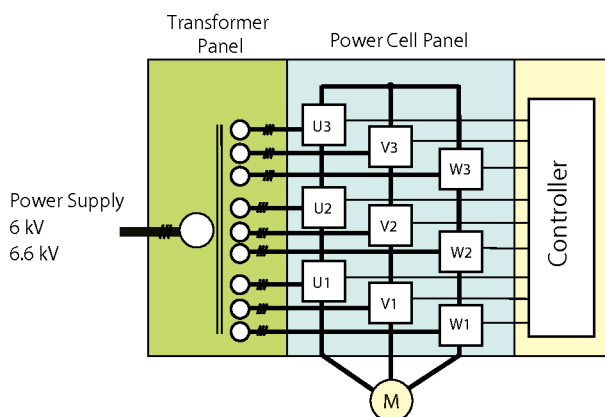
Compact Design

6-kV class Example Configuration of FSDrive-MV1000

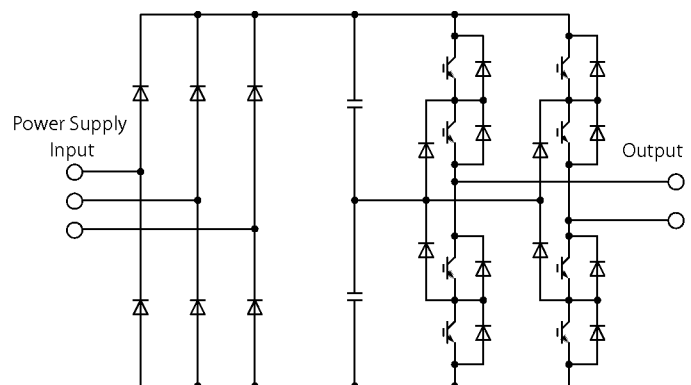


Circuit Configuration

6-kV class



● Configuration of One Power Cell

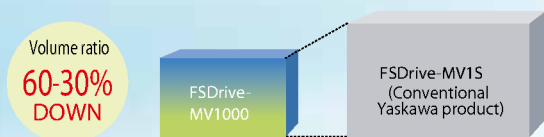


Optimized Component Selection and Arrangement Reduces Volume Occupied by up to 60%!

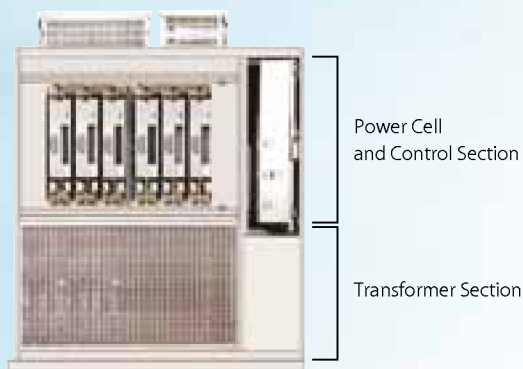
Minimal Height and Small Footprint

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, with the transformers located in the bottom of the panel and the power cells and controller at the top.



Maintenance of Individual Power Cells

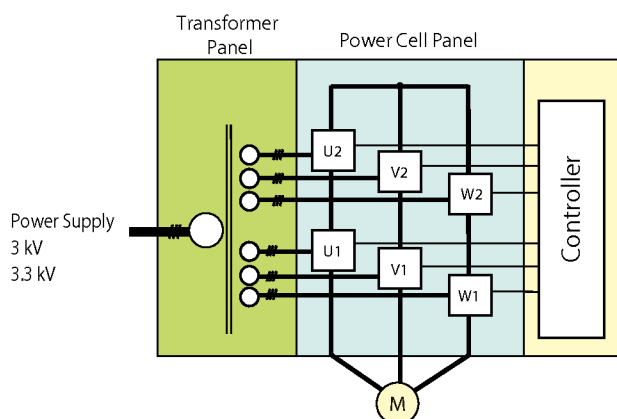
Power cells can be replaced and maintained individually. The construction designed for single-action mounting and removal reduces the replacement time and facilitates maintenance operations.



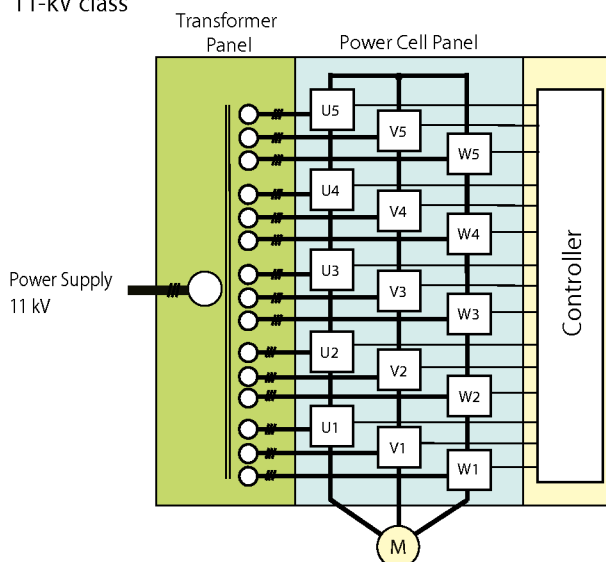
Power Cell



3-kV class



11-kV class



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

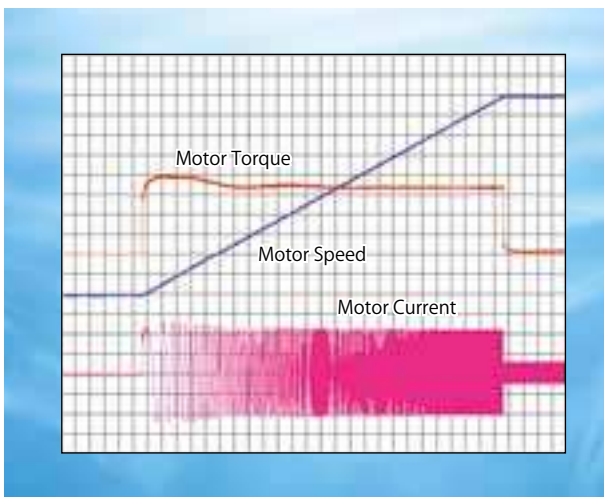
High Performance

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

High-level Control

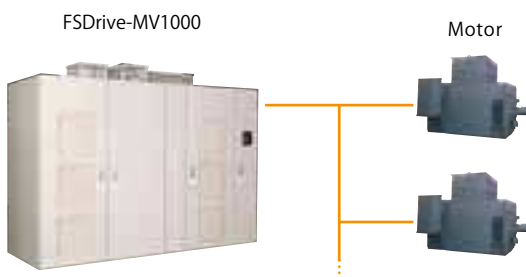
Open Loop Vector control enables smooth acceleration from a low-speed range without using a speed detector. Operation is stable, unaffected by fluctuations in load. The high performance vector control drives synchronous motors as well as induction motors.

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.



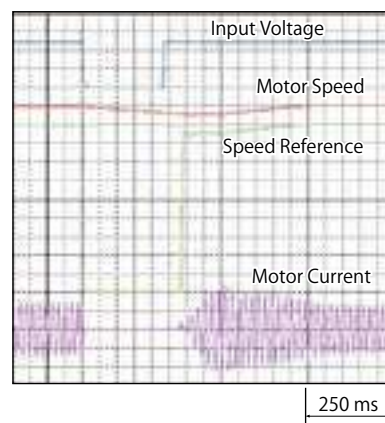
Note: When running multiple motor operations, a protective device is required on each motor.

Controlled and Secure Operation at Momentary Power Loss

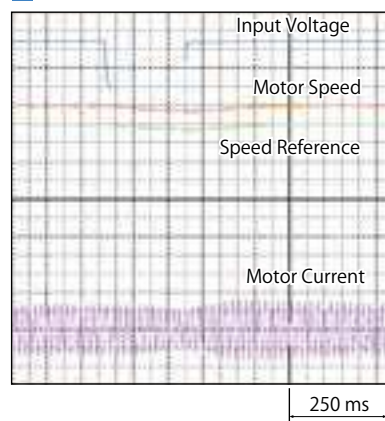
FSDrive-MV1000 continues to operate for a number of cycles*1 when a momentary power loss occurs, and re-accelerates to the reference speed immediately after the power is restored to ensure a smooth system start-up.

*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 IEEE519-1992, as an individual drive. This means that no harmonics filter or active filter is necessary.

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
FSDrive-MV1000 Measured Value	1.00	0.60	1.40	0.90	0.10	0.20	0.40	0.20	0.30	0.10

(Unit: %)

Easily Applicable to Existing Motors

PWM control with multiple power cells connected in series outputs sinusoidal wave voltage.

This has the following benefits:

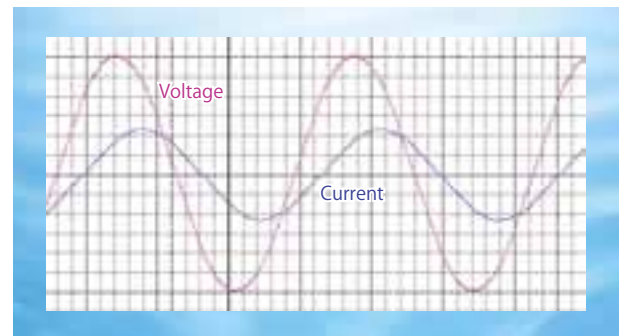
- Free from oscillation surge voltage affecting the motor
- Low torque ripple, easing the load
- Noise as low as commercial power supply operation

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



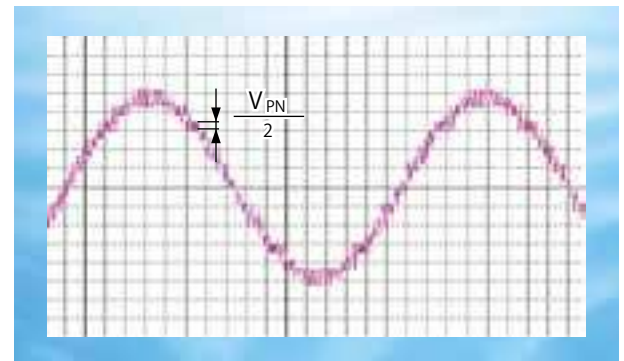
The simple configuration for running standard high voltage motors directly realizes highly efficient operation with minimal loss due to input/output voltage transformers.

Input Waveform

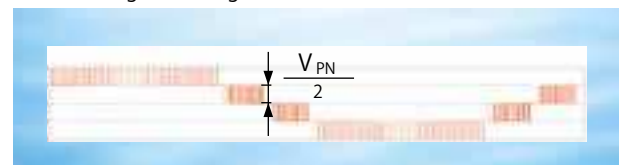


Output Waveform

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

Promotes energy saving
with highly efficient operation.

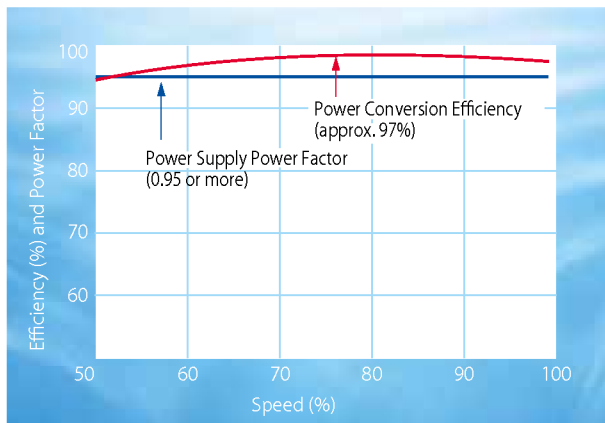
Energy Saving

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 power factor of 0.95 (at rated load), avoiding energy wastage.

Power Conversion Efficiency Ratio

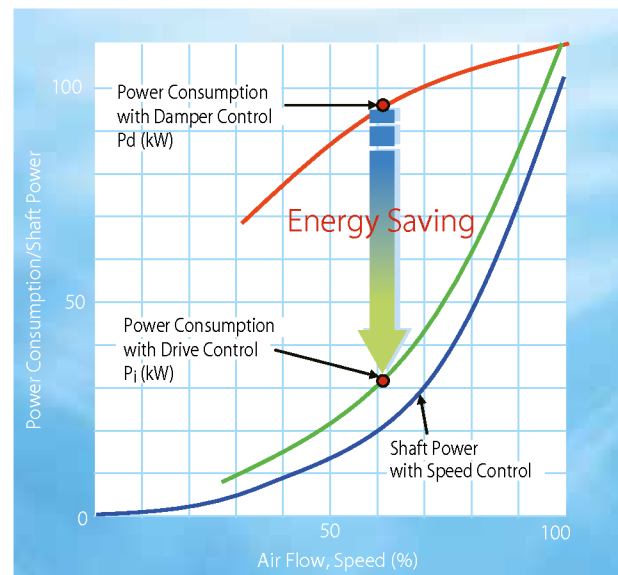


Energy Saving by Speed Control

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.

Power Consumption Characteristic Curve



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

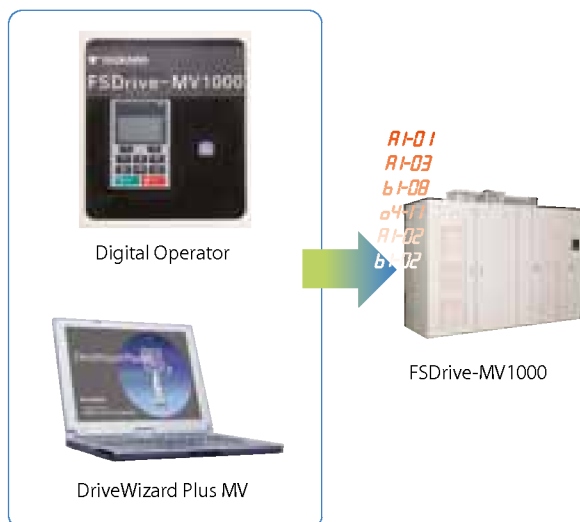
User Friendly

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.

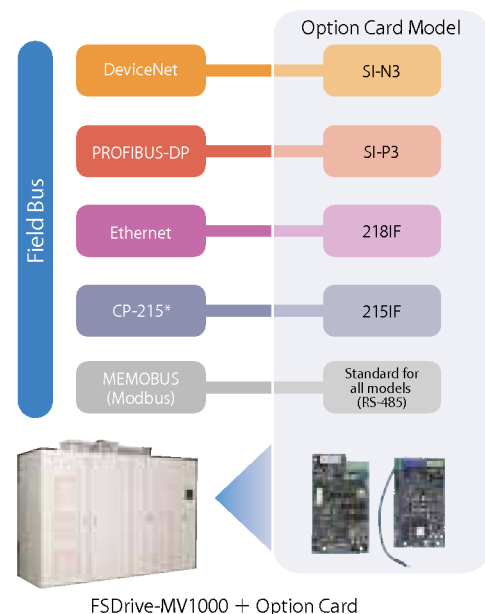
The engineering tool DriveWizard Plus MV enables consolidated management of the parameters for each drive and makes for easy adjustment and maintenance.



➡ 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.



*: Yaskawa's dedicated communication protocol

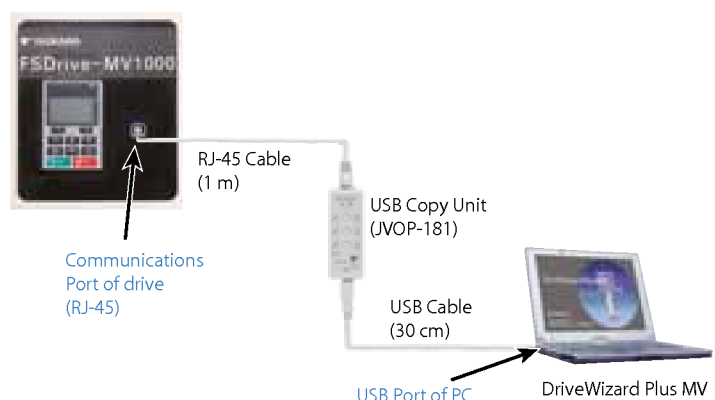
Note: Product names are trademarks or registered trademarks of the companies concerned.

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

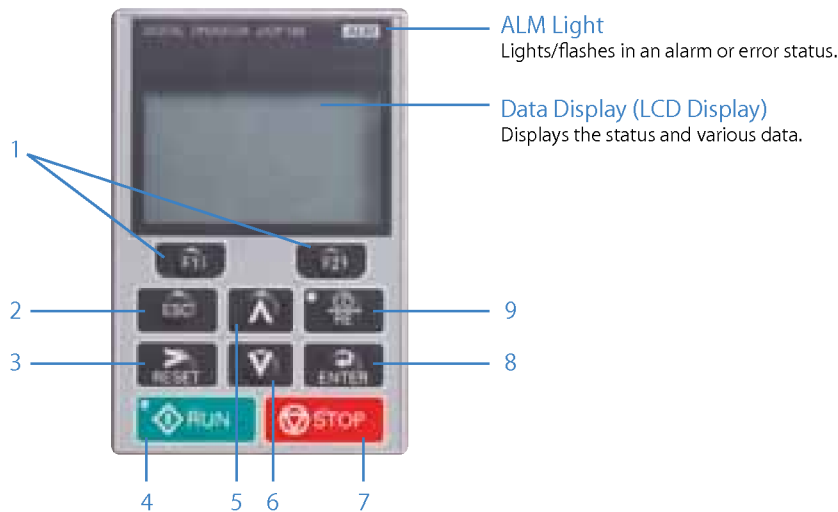
Connection



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

User Friendly

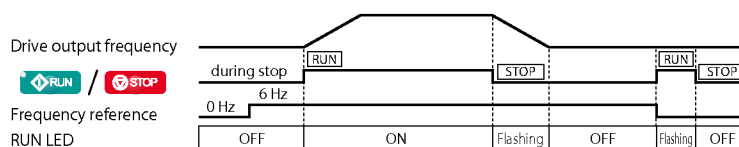
Full Text LCD Operator



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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	Up Arrow Key	<ul style="list-style-type: none"> Scrolls up to display the next item. Increments the parameter number or the setting value.
6	Down Arrow	Down Arrow Key	<ul style="list-style-type: none"> 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 STOP 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	<ul style="list-style-type: none"> 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.



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)
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 (1024 × 768 or higher, use “Small Fonts”.)
Number of Colors	65535 colors (16 bits) or greater
OS	English or Japanese operating system (32-bit OS only) • Windows 2000 Service Pack 1 or later • Windows XP • Windows Vista • Windows 7
Others	More than one RS-232, RS-485 or USB port CD-ROM drive (only for installation) Adobe Reader 6.0 or later Note: Adobe Reader is required to display the help information.

Note: Pentium is a registered trademark of Intel Corporation.
Windows 2000/XP/Vista/7 are registered trademarks of Microsoft Corporation.

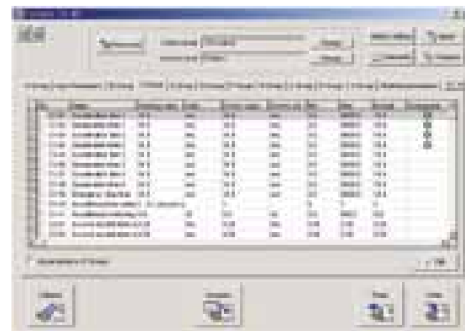
■ Pattern Operation

Runs the drive automatically in the preset patterns.



■ Parameter Edit

Displays and edits drive parameters.



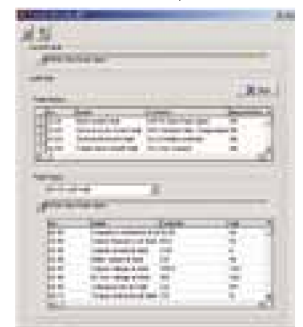
■ Auto-tuning

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-MV2A □□□□	035	050	070	100	140	200	260 *	330 *	400 *	520 *	650 *
Nominal Capacity	3.0kV/3.3 kV Output	kVA	200	285	400	570	800	1150	1500	1900	2300	3700
	Max. Applicable Motor Capacity	kW	132	200	315	450	630	900	1250	1500	1800	3000
Output Rating	Rated Output Current	A	35	50	70	100	140	200	260	330	400	650
	Rated Output Voltage	V	Three-phase, 3000 V or 3300 V (sinusoidal wave, proportional to input voltage)									
Power Supply	Main Circuit		Three-phase, 3000 V (50 Hz \pm 5 Hz) or 3300 V (50/60 Hz \pm 5 Hz) —20% to +10%									
	Control Circuit		Single-phase, 200/220 V 50/60 Hz \pm 5%									
Model	CIMR-MV2A □□□□	035	050	070	100	140	200	260 *	330 *	400 *	520 *	650 *
Nominal Capacity	6.0 kV/6.6 kV Output	kVA	400	570	800	1150	1600	2300	3000	3800	4600	7500
	Max. Applicable Motor Capacity	kW	250	400	630	900	1250	1800	2500	3000	3600	6000
Output Rating	Rated Output Current	A	35	50	70	100	140	200	260	330	400	650
	Rated Output Voltage	V	Three-phase, 6000 V or 6600 V (sinusoidal wave, proportional to input voltage)									
Power Supply	Main Circuit		Three-phase, 6000 V (50 Hz \pm 5 Hz) or 6600 V (50/60 Hz \pm 5 Hz) —20% to +10%									
	Control Circuit		Single-phase, 200/220 V 50/60 Hz \pm 5%									
Model	CIMR-MV2A □□□□	035 *	050 *	070 *	100 *	140 *	200 *	260 *	330 *	400 *	520 *	650 *
Nominal Capacity	10 kV/10.5 kV/11 kV Output	kVA	660	950	1300	1900	2600	3800	5000	6200	7600	12000
	Max. Applicable Motor Capacity	kW	530	760	1070	1520	2130	3050	3960	5030	6100	9910
Output Rating	Rated Output Current	A	35	50	70	100	140	200	260	330	400	650
	Rated Output Voltage	V	Three-phase, 10000 V, 10500 V or 11000 V (sinusoidal wave, proportional to input voltage)									
Power Supply	Main Circuit		Three-phase, 10000 V, 10500 V or 11000 V (50/60 Hz \pm 5 Hz) —20% to +10%									
	Control Circuit		Single-phase, 200/220 V 50/60 Hz \pm 5%									

*: Under development

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)
Control Specifications	Control Method	Open-loop vector control, Closed loop vector control, V/f control (for multiple motor operation), Closed loop vector 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	\pm 0.5%
	Analog Input Resolution	0.03 Hz
	Accel/Decel Time	0.1 to 6000 s
	Torque Accuracy *1	\pm 0.5% (open-loop vector control), \pm 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, 3-wire sequence, 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		Expansion PLC board (option)
Standard Communication Functions		RS-232: Digital operator RS-485: MEMOBUS (Modbus) USB : DriveWizard Plus MV
Communications (optional) *3		Any one of PROFIBUS-DP, DeviceNet, 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 thermometer PT100 Ω
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)
Panel Specifications	Atmosphere	General environmental conditions, free from dust and corrosive gases Altitude: Max. 2000 m
	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 implement the communication function, an option card needs to be installed. For Ethernet or CP-215 communication, an optional expansion PLC board is required.

Note: Contact Yaskawa regarding 2-kV/4-kV power supply for the main circuit.

Dimensions and Model Numbers

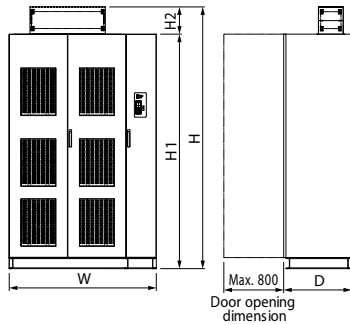


Fig.1

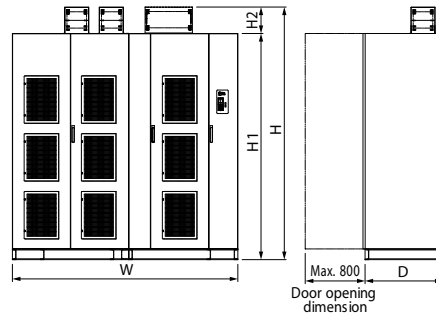


Fig.2

Power Supply	Model CIMR-MV2A	Capacity kVA	Current A	Dimensions *3 mm					Approx. Mass *3 kg	Figure
				Width	Depth	Height	Height	Height		
				W	D	H	H1	H2		
3kV	C □ CA035	200	35	1950	1000	2550	2150	400	2100	Fig.1
	C □ CA050	285	50	1950	1000	2550	2150	400	2200	
	C □ CA070	400	70	1950	1000	2550	2150	400	2400	
	C □ CA100	570	100	1950	1000	2550	2150	400	2600	
	C □ CA140	800	140	1950	1000	2550	2150	400	2800	
	C □ CA200	1150	200	2800*1	1000	2550	2150	400	4100	Fig.2
	C □ CA260 *2	1500	260	2800*1	1000	2550	2150	400	4600	
	C □ CA330 *2	1900	330	3250*1	1200	2550	2150	400	5700	
	C □ CA400 *2	2300	400	3250*1	1200	2550	2150	400	6700	
	C □ CA520 *2	3000	520	4400*1	1400	2550	2150	400	8800	
6kV	F □ FA035	400	35	3100*1	1100	2550	2150	400	3000	Fig.2
	F □ FA050	570	50	3100*1	1100	2550	2150	400	3300	
	F □ FA070	800	70	3100*1	1100	2550	2150	400	3600	
	F □ FA100	1150	100	3100*1	1100	2550	2150	400	3900	
	F □ FA140	1600	140	3100*1	1100	2550	2150	400	4200	
	F □ FA200	2300	200	4500*1	1300	2550	2150	400	6600	
	F □ FA260 *2	3000	260	4550*1	1300	2550	2150	400	8400	
	F □ FA330 *2	3800	330	5000*1	1400	2550	2150	400	10100	
	F □ FA400 *2	4600	400	5000*1	1400	2550	2150	400	11000	
	F □ FA520 *2	6000	520	5700*1	1500	2650	2150	500	14500	
11kV	H □ HA035 *2	660	35	4600*1	1400	2650	2250	400	7600	Fig.2
	H □ HA050 *2	950	50	4600*1	1400	2650	2250	400	7800	
	H □ HA070 *2	1300	70	4600*1	1400	2650	2250	400	8000	
	H □ HA100 *2	1900	100	4600*1	1400	2650	2250	400	8200	
	H □ HA140 *2	2600	140	4600*1	1400	2650	2250	400	8400	
	H □ HA200 *2	3800	200	5800*1	1400	2650	2250	400	10500	
	H □ HA260 *2	5000	260	6250*1	1600	2650	2250	400	13200	
	H □ HA330 *2	6200	330	7000*1	1600	2900	2400	500	16000	
	H □ HA400 *2	7600	400	7400*1	1600	2900	2400	500	17000	
	H □ HA520 *2	9900	520	9100*1	1600	2900	2400	500	22000	
	H □ HA650 *2	12000	650	9500*1	1600	2900	2400	500	25000	

*1: Block construction

*2: Under development

*3: The dimensions and masses may be changed.

Model Numbers

Drive	CIMR - MV2	A A	5	A A	035	E1	A A	
FSDrive-MV1000 Series								Design Revision Order A, B, C, ...
Region Code								Environmental Specifications A : Standard
Input Voltage Class								Enclosure Type E1 : IP40
A : 2.4 kV *	E : 6.0 kV							Output Current
B : 3.0 kV	F : 6.6 kV							035 : 35 A
C : 3.3 kV	G : 10 kV, 10.5 kV *	Input Frequency						260* : 260 A
D : 4.16 kV *	H : 11 kV *	5 : 50 Hz						330* : 330 A
		6 : 60 Hz						400* : 400 A
Output Voltage								100 : 100 A
A : 2.4 kV *	F : 6.6 kV							520* : 520 A
C : 3.3 kV	H : 11 kV *							140 : 140 A
D : 4.16 kV *								650* : 650 A
								200 : 200 A
								Customized Specifications A : Standard model

*: Under development

Options

Type	Name	Function	Manual No.
Built-in Type (connected to connector)	Speed (Frequency) Reference Card	Analog Input AI-A3 Enables high-precision and high-resolution analog speed reference setting. • Input signal level: — 10 to +10 Vdc (20 k Ω) 4 to 20 mA (500 Ω) • Input channels: 3 channels (DIP switch for input voltage/input current selection) • Input resolution: Input voltage 13 bit signed (1/8192) Input current 1/6554	TOBPC73060038
		Digital Input DI-A3 Enables 16-bit digital speed reference setting. • Input signal: 16 bit binary, 4 digit BCD + sign signal + set signal • Input voltage: +24 V (isolated) • Input current: 8 mA User-set: 8 bit, 12 bit, 16 bit	TOBPC73060039
	Communications Card *1	DeviceNet Interface SI-N3 Used for running or stopping the drive, setting or referencing parameters, and monitoring output frequency, output current, or similar items through DeviceNet communication with the host controller.	TOBPC73060043 SIJPC73060043
		PROFIBUS-DP Interface SI-P3 Used for running or stopping the drive, setting or referencing parameters, and monitoring output frequency, output current, or similar items through PROFIBUS-DP communication with the host controller.	TOBPC73060042 SIJPC73060042
		CP-215 Interface 215IF Used for running or stopping the drive, setting or viewing parameters, and monitoring output frequency, output current, etc. through CP-215 communication with the host controller. CP-215 communication system is a high-speed, real-time, N: N network with shared-memory and handling both cyclic and message transmissions. An expansion PLC board is needed to use the CP-215.	Under development
		Ethernet (CP-218) Interface 218IF Used for running or stopping the drive, setting or viewing parameters, and monitoring output frequency, output current, etc. through CP-218 communication with the host controller. CP-218 communication system is a type of Ethernet that supports communication with the MEMOBUS protocol, non-protocol, or MELSEC protocol. An expansion PLC board is needed to use the CP-218.	Under development
	Monitor Card	Analog Monitor AO-A3 Outputs analog signal for monitoring drive output state (output freq., output current etc.). • Output resolution: 11 bit signed (1/2048) • Output voltage: — 10 to +10 Vdc (non-isolated) • Terminals: 2 analog outputs	TOBPC73060040
		Digital Output DO-A3 Outputs isolated type digital signal for monitoring drive run state (alarm signal, zero speed detection, etc.). • Terminals: 6 photocoupler outputs (48 V, 50 mA or less) 2 relay contact outputs (250 Vac, 1 A or less 30 Vdc, 1 A or less)	TOBPC73060041
	PG Speed Controller Card *2	Complementary Type PG Interface PG-B3 For control modes requiring a PG encoder for motor feedback. • Phase A, B, and Z pulse (3-phase) inputs (complementary type) • Max. input frequency: 50 kHz • Pulse monitor output: Open collector, +24 V, max. current 30 mA • Power supply output for PG: +12 V, max. current 200 mA	TOBPC73060036
		Line Driver PG Interface PG-X3 For control modes requiring a PG encoder for motor feedback. • Phase A, B, and Z pulse (differential pulse) inputs (RS-422) • Max. input frequency: 300 kHz • Pulse monitor output: RS-422 • Power supply output for PG: +5 V or +12 V, max. current 200 mA	TOBPC73060037
	PLC Function	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, textual language	Under development
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).	—
	Backup Cooling Fan	Automatically enables continued operation of the drive in case of one of the cooling fans fails to operate. (N + 1 backup system)	Under development
	Space Heater	Suppresses dew condensation inside the panel by adding a space heater circuit. Note: This option does not always prevent dew condensation. Use the drive in an environment with no dew 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	Enables the copying and transfer of parameters between drives using (one-touch) 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 running DriveWizard Plus MV. This option comprises a copy unit with USB interface, an RJ-45 cable and a USB cable.	Under development
	Lifter for Replacing Power Cells	Facilitates power cell replacement.	EZZ010925
	Inrush Current Suppression Circuit	Suppresses the inrush current on turning the drive power on by adding a suppression circuit.	Under development

*1: Only one optional communication card can be selected.

*2: To apply PG control, the PG speed control card must be selected.

Application Examples

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.

Application Examples

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.

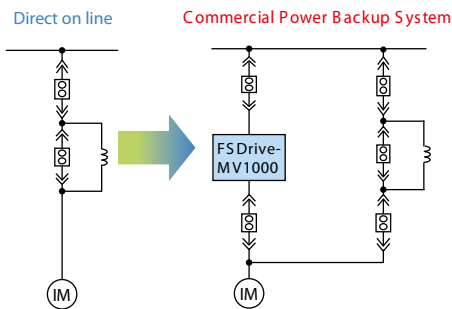
4. Better maintainability

- 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



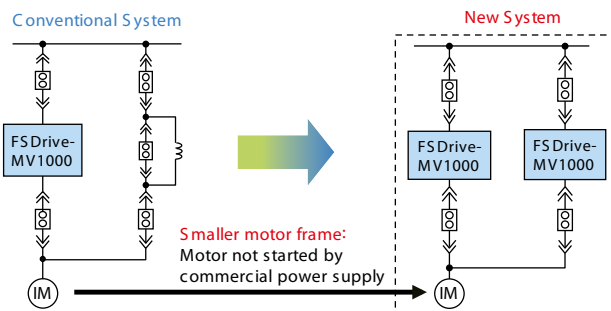
Example 1: Commercial power backup system



Introduce a drive with existing equipment.

- The existing equipment (breakers, cables, etc.) for commercial power operation can be reused as a backup circuit.

Example 2: Drive backup system



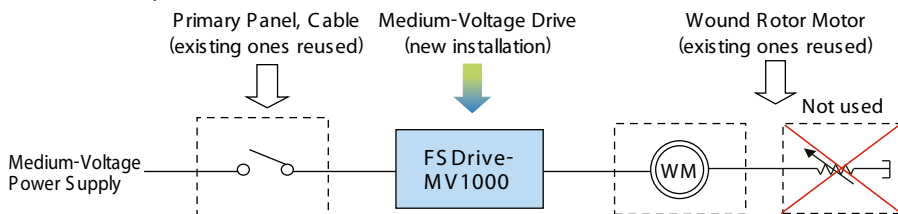
For machine with large inertia, the total cost is reduced with drive backup

- 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 inertia a substantial motor frame 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

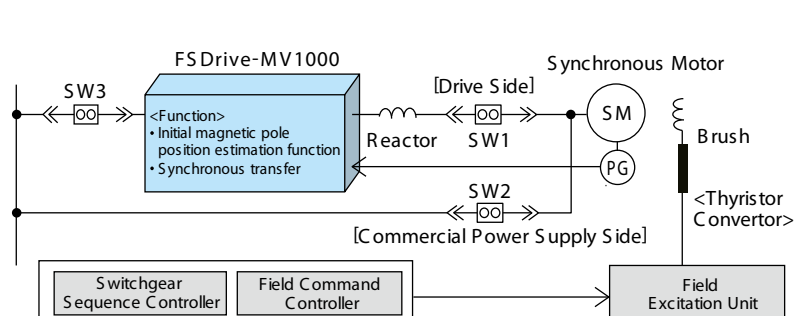
Drives can be put to use with wound rotor motors too.



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

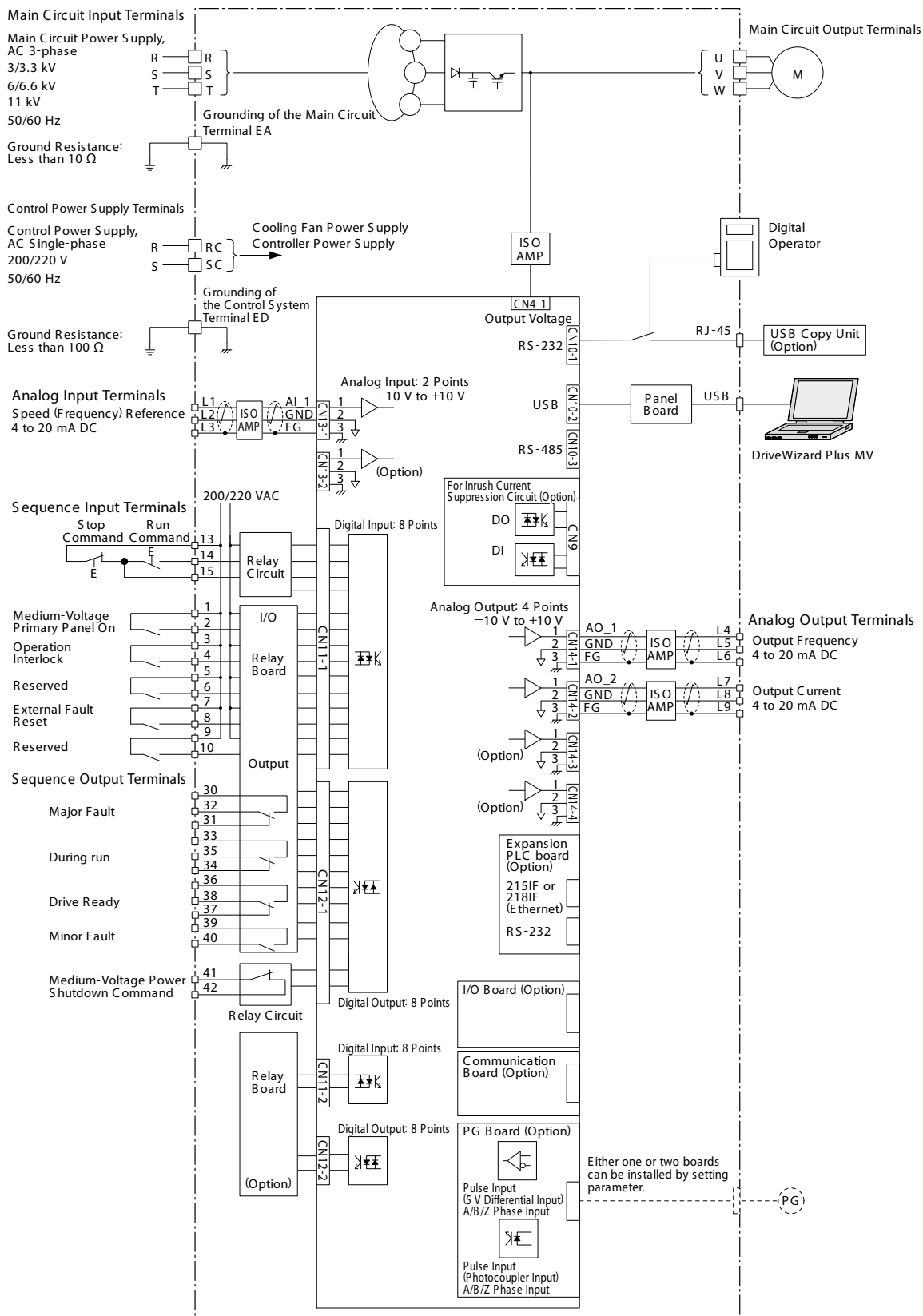
Short the secondary side of the existing wound rotor motor.

Example 4: Synchronization switching system for synchronous motors



Application to synchronous motors is possible. This system uses a drive to start a synchronous motor and switches shocklessly to the commercial power operation after acceleration is completed. The magnetic pole position is detected before starting the synchronous motor. After reaching the rated motor speed, the voltage phase and amplitude of the drive output are matched before switching to the commercial power supply. (This transfer system can also be applied to induction motors.)

Standard Connections Diagram



Terminal Functions

Main Circuit Terminals (Common to all models)

Type	Terminal No.	Terminal Function
Main Circuit Input Terminals	R	3000/3300 VAC, 6000/6600 VAC, 11000 VAC 50/60 Hz
	S	
	T	
Main Circuit Output Terminals	U	3000/3300 VAC, 6000/6600 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
	SC	50/60 Hz
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	Speed (Frequency) Reference	4 to 20 mA DC/0 to 60 Hz	Speed (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
Sequence 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			
	5	Reserved	—	—
	6			
	7	External Fault Reset	Contact input 220 VAC/8 mA	ON: Reset
	8			
	9	Reserved	—	—
	10			
	13	Run Command/ Stop Command	Contact input 220 VAC/8 mA	ON: Run
	14			OFF: Stop
Sequence Output Terminals	30	Major Fault	Transfer contact relay, output relay board 220 VAC/15 A, 110 VAC/15 A, 24 VDC/15 A	Open: Major Fault
	31			
	32			
	33	During run	Transfer contact relay, output relay board 220 VAC/15 A, 110 VAC/15 A, 24 VDC/15 A	Closed: During run
	34			
	35			
	36	Drive Ready	Transfer contact relay, output relay board 220 VAC/15 A, 110 VAC/15 A, 24 VDC/15 A	Closed: Drive Ready
	37			
	38			
	39	Minor Fault	N.O. contact relay, output relay board 220 VAC/15 A, 110 VAC/15 A, 24 VDC/15 A	Closed: Minor Fault
	40			
	41	Medium-Voltage Power Shutdown Command	N.C. contact output 220 VAC/10 A, 24 VDC/10 A	Closed (N.C.) : Turning off (closed when power is off)
	42			

Software Functions

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



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 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.

Continuous 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.

Drive Capacity Selection

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%:

$88 \text{ A} \times 1.3 = 115 \text{ A}$

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%:

$53 \text{ A} \times 2.6 = 138 \text{ A}$

Therefore, for this applicable drive capacity, rated current

140 A (nominal capacity 1600 kVA) should be selected.

(140 A > 138 A)

Inquiry Form

Please specify the following information when inquiry.

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

Global Service Network



Region	Service Area	Service Location	Service Agency	Telephone/Fax
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