YASKAWA

SUPER ENERGY-SAVING MEDIUM-VOLTAGE
MATRIX CONVERTER WITH POWER REGENERATION

FSDrive-MX1S

3 kV 200 to 3000 kVA
6 kV 400 to 6000 kVA

Certified for
ISO9001 and
ISO14001

JQA-2800 JQA-EM0498

The Great Leap Forward for Variable-speed Drives

The FSDrive-MX1S matrix converter is a drive system that employs the world's first matrix converter technology to eliminate all of the problems found in conventional medium-voltage motor drives.
The FSDrive-MX1S demonstrates unbelievable energy savings due to its power regeneration as well as the optimum control of all medium-voltage motors due to sinusoidal waveforms of the power supply and output signals.

Matrix Converter

World's First

High Performance P.3
High Reliability P.4
Advanced Functions P.5

Applications

◆Wind/Water Force Machines

Blowers
- Dust blowers
- Incinerators
- Boilers IDF

Applications that require quick response to sudden changes in acceleration and deceleration

Pumps
- Descaling pumps
- Roll cooling water pumps
- Rainwater pumps
- Sewage pumps
- Drain pumps
- Warter pumps

◆General Industrial Machines (Constant Torque)

- Extruders
- Mixers
- Kilns
- Banbury mixers
- Dynamo testing devices

The FSDrive-MX1S is the optimum drive for applications that require operation at low speeds or quick response to deceleration.
For the following applications, Yaskawa recommends a high-performance medium-voltage matrix converter, the FSDrive-MX1H:

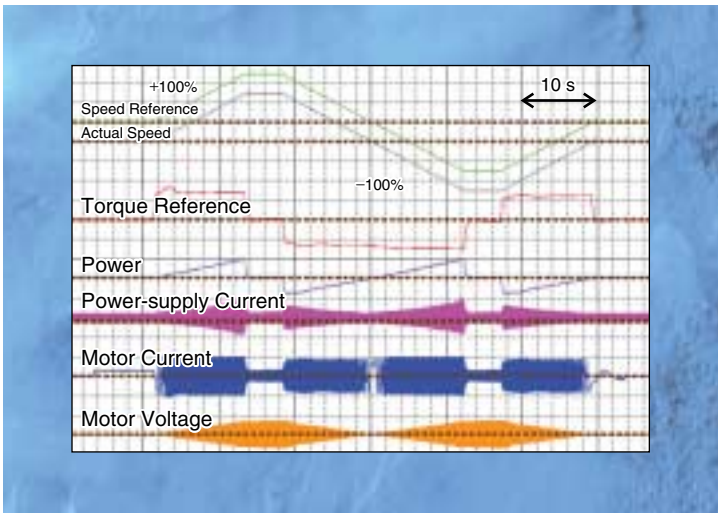
- With heavy loads that require high regenerative energy such as steel-manufacturing process lines, unloaders, and cargo-handling machinery.
- With the need for continuous power regeneration over a long time period such as winders for paper or film.

High Performance

Matrix Converter for Lightning-quick Acceleration/Deceleration with Less Power

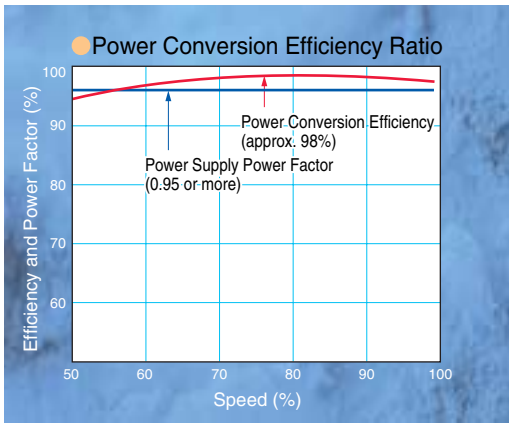
Dynamic Operation at Variable Speeds

With the power regeneration function that returns energy to the power supply when the motor decelerates, your machinery can quickly respond to sudden changes in acceleration or deceleration. The FSDrive-MX1S is designed for applications that require low-speed operation and quick deceleration because the FSDrive-MX1S requires no capacity margin when operating at low speeds.



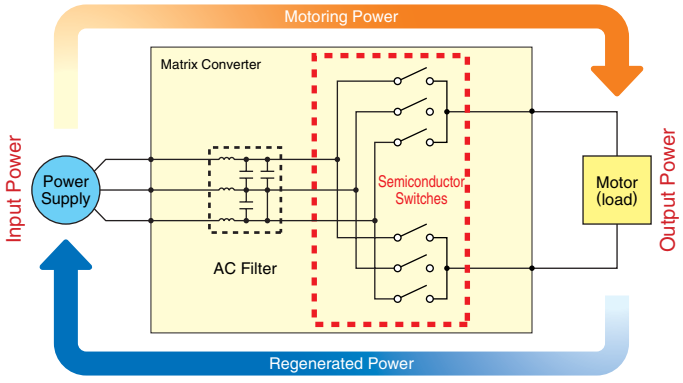
Outstanding Energy Savings

The power factor is always kept at 0.95. Because the power factor remains unchanged regardless of operation speed, no energy is wasted. The FSDrive-MX1S requires no output transformer because the AC voltage is directly output from an AC power supply and maintains a power conversion efficiency of approximately 98%. These features together with the power regeneration improve energy savings by at least 20% in comparison with conventional medium-voltage inverters (according to Yaskawa's test report).



Matrix Converter Principles

The power output from the power supply to the motor and the power regenerated from the motor and returned to the power supply can be freely controlled by turning the semiconductor switches on and off in Pulse Width Modulation (PWM) control.
Because AC voltage is directly output from an AC power supply to drive a motor, regenerative energy can be returned from the motor to the power supply.

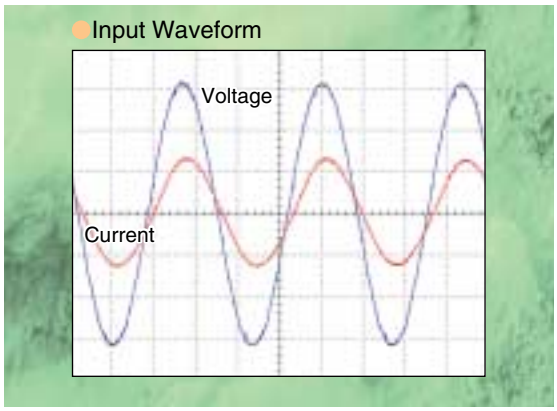


High Reliability

The PWM Control with Multi-output Connected in a Series for Sensitive Environments with Reduced Footprint and Wiring

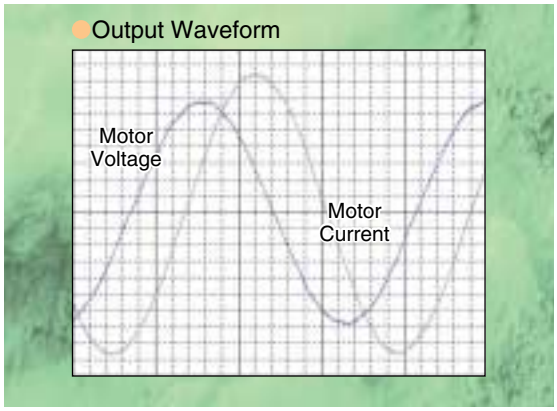
No Harmonic Measure with Sinusoidal Input Waveform

The input waveform is sinusoidal wave and rarely contains harmonics.
Therefore, the medium-voltage matrix converter single-unit has cleared the harmonics control guideline specified by the Ministry of Economy, Trade and Industry (former ministry of International Trade and Industry) so that any harmonics filter or active filter is not needed.



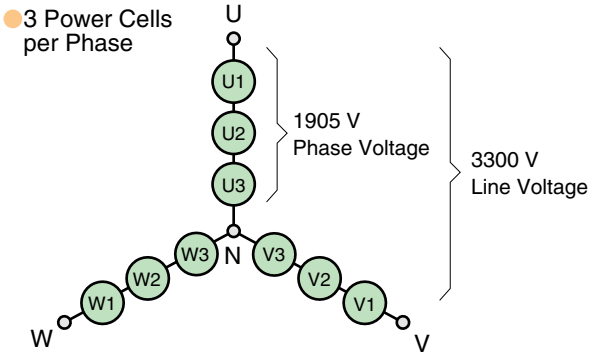
Applicable with Existing Motors with the Quasi-sinusoidal Waveforms

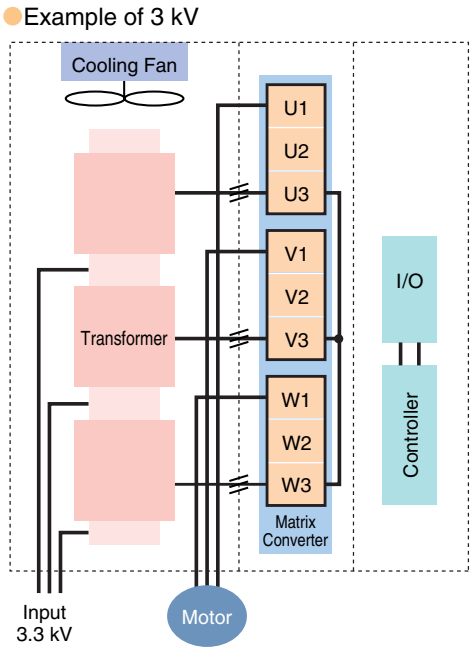
The output waveform is quasi-sinusoidal and generates no harmful surge voltage. So, existing motors or cables can be used without modification.



Low Initial Setup and Wiring Costs with Simple Configuration

The revolutionary technology used in the FSDrive-MX1S results in improved performance and eliminates the need for many peripheral devices such as capacitors to improve the power factor, devices to prevent harmonics, braking units, and input transformers. As a result, the system configuration is so simple that the initial setup and wiring costs are greatly reduced.
The main circuit does not have an electrolytic capacitor with limited product lives so less maintenance is required.



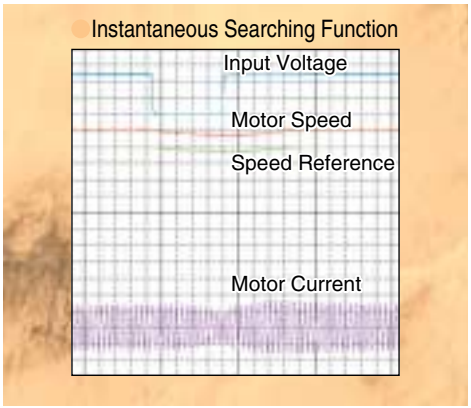


Advanced Functions

Intelligent and Stable Operation with the Latest Technology

Stable Operation

The matrix converter re-accelerates to the reference speed almost at the same time as the power is restored to ensure that the drive starts smoothly during a momentary power loss of two seconds.



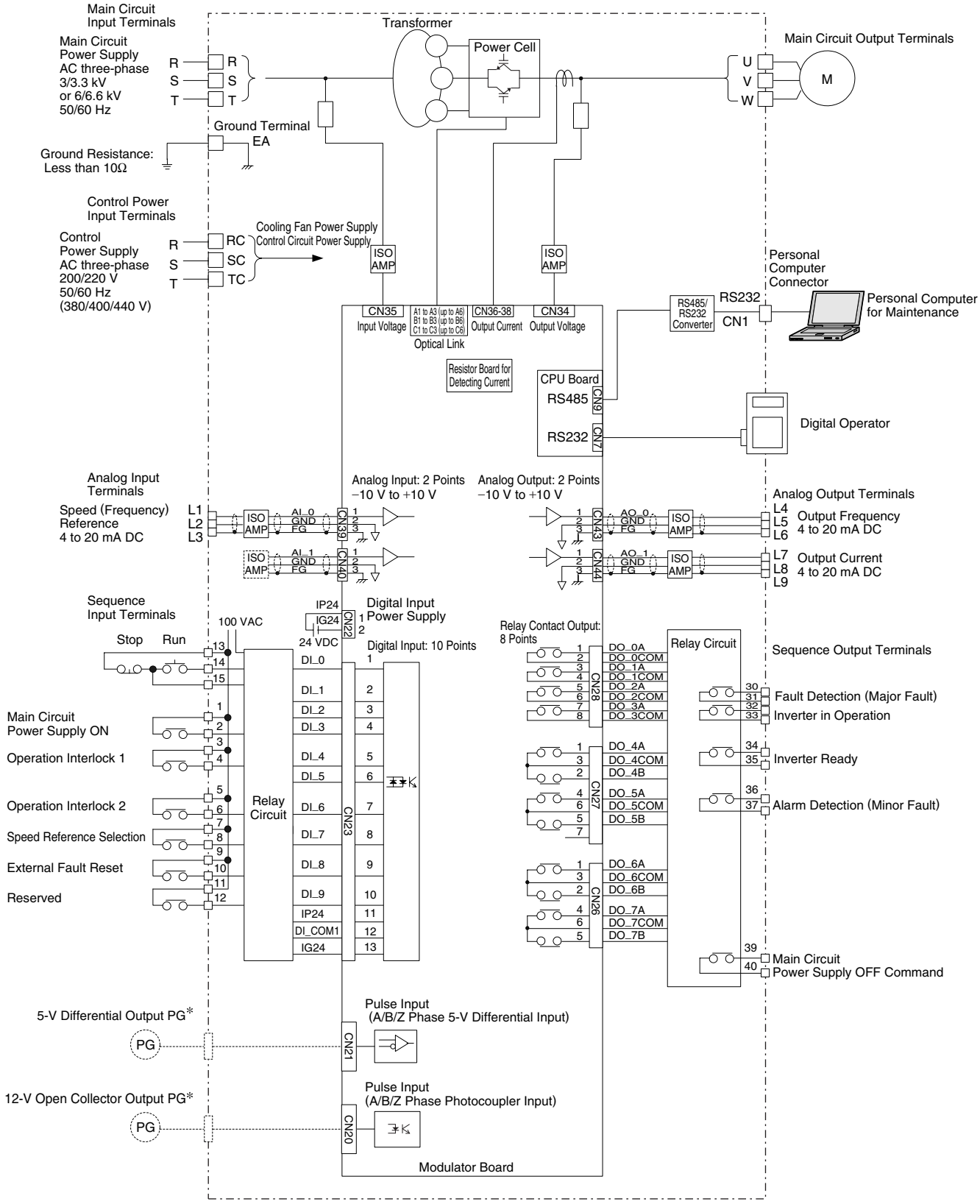
PLC Cards

By inserting a PLC card into the control section, you can easily load a ladder program. The FSDrive-MX1S effectively and optimally drives and controls a medium-voltage motor using your own program.

Excellent Monitoring

The enhanced trace function and LAN compatibility enable you to easily monitor the operation status for protective maintenance and quick intervention.

Connections



*: Either one can be selected.

Terminal Functions

Main Circuit (For all models)

Terminal Code	Specifications
R	Main circuit AC three-phase inputs
S	3/3.3 kV AC or 6/6.6 kV AC 50/60 Hz
T	
U	Main circuit three-phase outputs
V	
W	
EA	Ground Resistance: Less than 10Ω
RC	Control power supply: AC, three-phase input
SC	200/220 V (380/400/440 V) 50/60 Hz
TC	

Control Circuit (For all models)

Type	Terminal Code	Signal Name	Signal Level	Terminal Function
Analog Input Terminals	L1	Speed (frequency) reference	4 mA DC to 20 mA DC, 0Hz to 60Hz	Speed (frequency) reference input signal
	L2			Ground
	L3			Shield ground
Analog Output Terminals	L4	Output frequency	4 mA DC to 20 mA DC, 0Hz to 60Hz	Output frequency output signal
	L5			Ground
	L6			Shield ground
	L7	Output current	4 mA DC to 20 mA DC, 0% to 150%	Output current output signal
	L8			Ground
	L9			Shield ground
Sequence Input Terminals	1	Main circuit power supply ON	Contact input 110 VAC, 15 mA	ON: Power ON
	2			
	3	Operation interlock 1	Contact input 110 VAC, 15 mA	ON: Interlock established
	4			
	5	Operation interlock 2	Contact input 110 VAC, 15 mA	ON: Interlock established
	6			
	7	Speed reference selection	Contact input 110 VAC, 15 mA	ON: Fixed speed selection
	8			OFF: External input reference
	9	External fault reset	Contact input 110 VAC, 15 mA	ON: Reset
	10			
	11	Reserved	—	—
	12			
	13	Run/Stop	Contact input 110 VAC, 15 mA	ON: Run
	14			
	15			OFF: Stop
Sequence Output Terminals	30	Inverter fault detection (major fault)	NO contact relay output LY4N 110 VAC (manufactured by OMRON Corporation) 110 VAC/7.5 A, 24 VDC/5 A	Fault detection (major fault): Closed
	31			
	32	Inverter in operation	NO contact relay output LY4N 110 VAC (manufactured by OMRON Corporation) 110 VAC/7.5 A, 24 VDC/5 A	Inverter in operation: Closed
	33			
	34	Inverter ready	NO contact relay output LY4N 110 VAC (manufactured by OMRON Corporation) 110 VAC/7.5 A, 24 VDC/5 A	Ready: Closed
	35			
	36	Inverter alarm detection (minor fault)	NO contact relay output LY4N 110 VAC (manufactured by OMRON Corporation) 110 VAC/7.5 A, 24 VDC/5 A	Alarm detection (minor fault): Closed
	37			
	39	Main circuit power supply OFF command	NO contact relay output MM2XP 110 VAC (manufactured by OMRON Corporation) 220 VAC/7.5 A, 110 VDC/6 A	When power needs to be shut OFF: Closed
	40			

Digital Operator

Digital Operator Functions

Rotating Direction Display
FWD: LED lights at forward run.
REV: LED lights at reverse run.

Remote Mode
Lights when selecting input mode from the control circuit terminal.
SEQ: LED lights when selecting run command from control circuit terminal.
REF: LED lights when selecting frequency reference from control circuit terminals A1, A2, and A3.

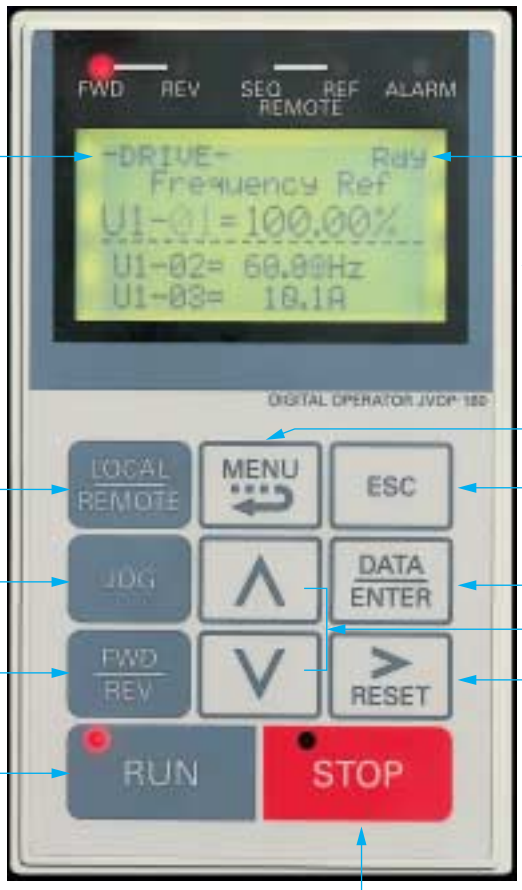
Alarm Display

Mode Display
DRIVE: LED lights at Drive Mode.

QUICK: LED lights at Quick Programming Mode.

ADV: LED lights at Advanced Programming Mode.

A.TUNE: LED lights at Autotuning Mode.



Rdy Display
Can operate when a run command is input.

Data Display
Displays data for monitoring, parameters, and set values.
(1 line×13 characters and 3 lines×16 characters)

Operation Mode Selection Key
The operation mode is alternated with REMOTE (control circuit terminal) and LOCAL (digital operator) (When run command and frequency reference are set at control circuit terminal.)

Menu Key
Changes the display of operation and programming mode.

Escape Key
Returns to the status entered before [DATA/ENTER] key was pressed.

Run Command Keys
Run command keys for use by digital operator. Enabled only in the drive mode.

JOG: Jog run is enabled while depressing this key.

FWD/REV: Selects forward or reverse run. Forward and reverse run is alternated.

RUN*: Red LED lights by depressing RUN.

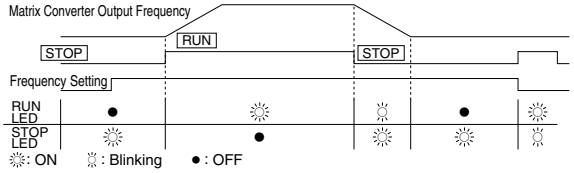
STOP*: Red LED lights by depressing STOP.

DATA/ENTER Key
Selects mode, group, function or parameter name. Displays each parameter set value while displaying a parameter name. By pressing this key again, the set value is written in.

∧: Increment Key
∨: Decrement Key
Selects mode, group, function, parameter name or set value.

Shift/Reset Key
Selects a digit of a set value to be changed. The selected digit blinks.
(Resets operation at faults.)

*: RUN or STOP LED turns ON , OFF, or blinks in accordance with each operation.



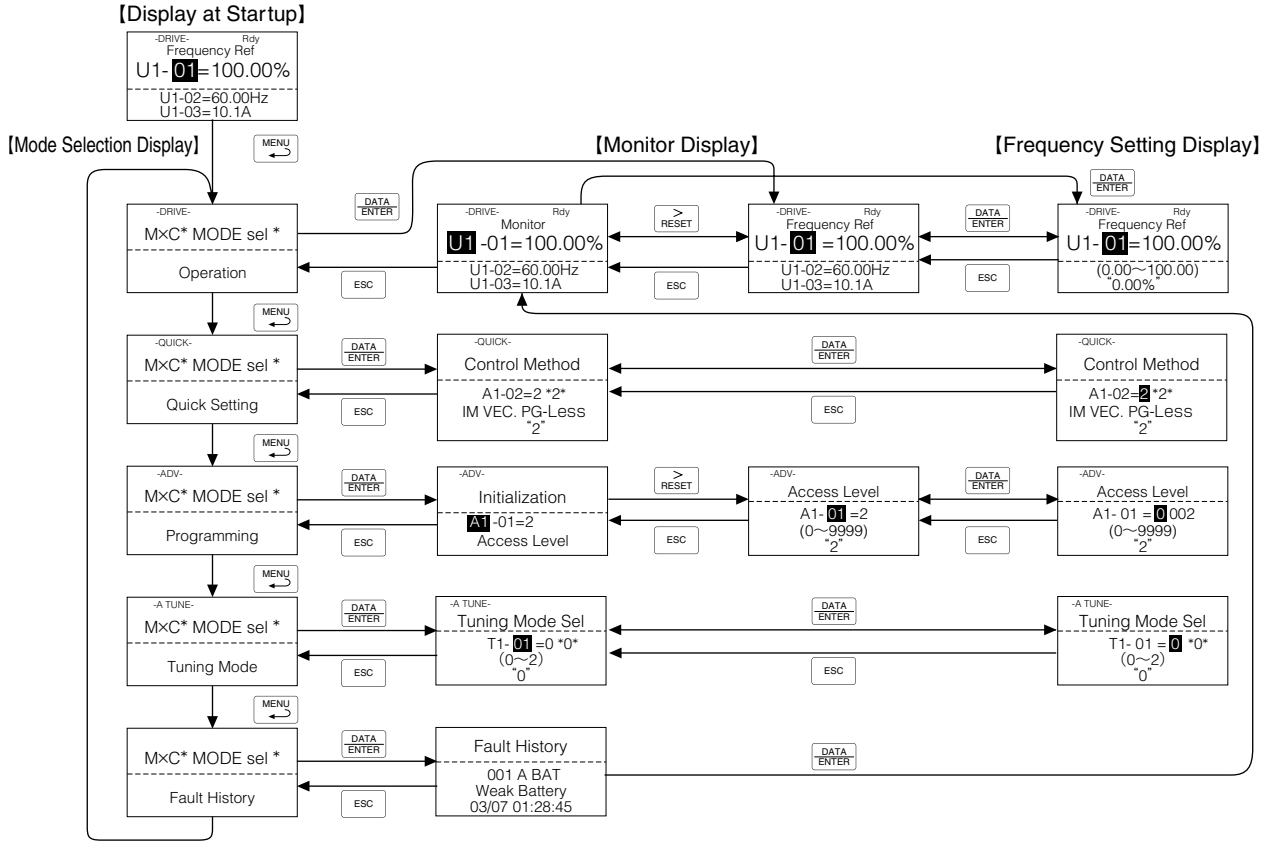
Easy Operation with Digital Operator

Description	Key Operation	Operator Display
①Power ON ・Displays frequency reference value.		-DRIVE- Rdy Frequency Ref U1-01 = 0.00% U1-02= 0.00Hz U1-03= 0.0A
		REMOTE(SEQ.REF)LED ON (d1-01=0.00 %)
②Operation Condition Setting ・Select LOCAL mode.	LOCAL/REMOTE	REMOTE(SEQ.REF)LED OFF FWD LED ON
③Frequency Setting ・Change reference value.	DATA/ENTER	-DRIVE- Rdy Frequency Ref U1-01=000 .00% (0.00 ～100.00) 0.00%
	RESET / ∨ / ∧	-DRIVE- Rdy Frequency Ref U1-01=025.00% (0.00 ～100.00) 0.00%
・Write-in set value.	DATA/ENTER	-DRIVE- Rdy Enter Accepted
(cont'd)		-DRIVE- Rdy Frequency Ref U1-01=025.00% (0.00 ～100.00) 0.00%

Description	Key Operation	Operator Display
・Select output frequency monitor display.	ESC	-DRIVE- Rdy Frequency Ref U1-01 = 25.00% U1-02= 0.00Hz U1-03= 0.0A
	∧	-DRIVE- Rdy Output Freq U1-02 = 0.00Hz U1-03= 0.0A U1-04= 2
④Forward Run ・Forward Run(15Hz)	RUN	-DRIVE- Rdy Output Freq U1-02 =15.00Hz U1-03= 1.5A U1-04= 2
		RUN LED ON
⑤Reverse Run ・Switch to reverse run.	FWD/REV	-DRIVE- Rdy Output Freq U1-02 =15.00Hz U1-03= 1.1A U1-04= 2
		REV LED ON
⑥Stop ・Decelerates to a stop.	STOP	-DRIVE- Rdy Output Freq U1-02 = 0.00Hz U1-03= 0.0A U1-04= 2
		STOP LED ON (RUN LED blinks during deceleration.)

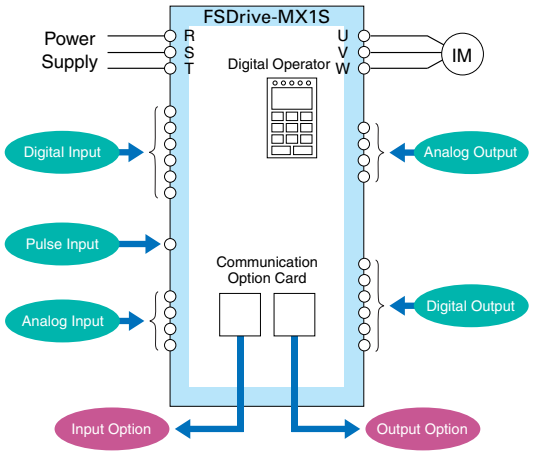
Note: ■expresses blinking of numbers.

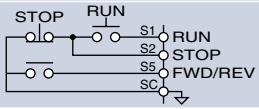
Monitor Display Procedure



Software Functions

The FSDrive-MX1S flexible matrix converter incorporates a variety of application features. Select special functions from a multitude of possibilities to perfectly match your machine requirements.



Function	Application	Description of Function
Energy Saving Control	Most efficient automatic operation	Supplies voltage to motor to always be most effective according to load and rotating speed. (Automatic temperature compensation function provided)
Speed Search Operation	Starting the free running motor	Starts the matrix converter at the specified frequency, automatically detects the synchronization point, and performs at the operation frequency. No speed detector is required.
DC Injection Braking at Start	Starting the free running motor	When the direction of the free running motor is not fixed, the speed search operation function is difficult to use. The motor can be automatically stopped by DC injection braking, and be restarted by the matrix converter.
Commercial Power Source/Matrix Convereter Switchover Operation	Automatic switching between commercial power source and matrix converter	Switching of commercial power source to matrix converter or vice versa is done without stopping the motor.
Multi-step Speed Operation	Schedule operation under fixed speed and positioning	Multi-step operation (up to 8-step) can be set by setting the contact combinations.
Accel/Decel Time Changeover Operation	The accel/decel time changeover with an external signal	The accel/decel times are switched by an external contact signal.
3-wire Sequence	Simple configuration of control circuit	Operation can be accomplished using a spring-loaded push-button switch. 
Operating Site Selection	Easy operation	Operation and settings can be selected while the matrix converter is online. (digital operator/external instruction, signal input/output)
Frequency Hold Operation	Easy operation	Temporarily holds frequencies during acceleration or deceleration.
UP/DOWN Command	Easy operation	Sets speed by ON/OFF from a distance.
Torque Limit (Drooping Characteristics)	Protection of machine, improvement of operation reliability, torque limit	The matrix converter can be switched to coasting or motor speed reducing mode as soon as it reaches a certain preset torque level. For pump or blower, the operation frequency can be automatically reduced to the load balancing point, according to the overload condition, and prevent overload tripping.
Upper/Lower Frequency Limit Operation	Motor speed limit	The upper and lower limits of the motor speed, reference signal bias and gain can be set independently without peripheral operation units.
Prohibit Setting of Specific Frequency (Frequency Jump Control)	Prevent mechanical vibration in the equipment	The motor simply passes through the preset speed, but continuous running cannot be done at this speed. This function is used to avoid the mechanical resonance point of the equipment.
Load Speed Display	Monitor function enhancement	Can indicate motor speed (min^{-1}), machine speed under load (min^{-1}), line speed (m/min), etc.
Run Signal	Zero-speed interlock	"Closed" during operation. "Open" during coasting to a stop. Can be used as interlock contact point during stop.
Zero-speed Signal	Zero-speed interlock	"Closed" when output frequency is under min. frequency.
Frequency (Speed) Agreed Signal	Reference speed reach interlock	The contact closes when matrix converter output frequency reaches the set value. Can be used as an interlock for lathes, etc.
Overtorque Signal	Protection of machine, improvement of operation reliability	"Closed" when overtorque setting operation is accomplished.
Low Voltage Signal	System protection for undervoltage	"Closed" only when tripped by low voltage. Can be used as a countermeasure power loss detection relay.
Free Unintentional Speed Agreement Signal	Reference speed agreed interlock	"Closed" when the speed agrees at arbitrary frequency reference.
Output Frequency Detection 1	Gear change interlock, etc.	"Closed" at or over an arbitrary output frequency.
Output Frequency Detection 2	Gear change interlock, etc.	"Closed" at or below the arbitrary output frequency.
Base Block Signal	Operation interlock, etc.	Always "closed" when the matrix converter output is OFF.
Frequency Reference Sudden Change Detection	Improvement of operation reliability	"Closed" when the frequency reference suddenly drops to 10 % or below of the set value. Can be used to detect an error in the host controller.
Multi-function Analog Input Signal	Easy operation	Functions as supplementary frequency reference. Also used for fine control of input reference, output voltage adjustment, external control of accel/decel time, and fine adjustment of overtorque detection level.
Multi-function Analog Output Signal	Monitor function enhancement	Use two of the following devices: a frequency meter, ammeter, voltmeter, wattmeter, or U1 monitor.

Protective Functions

If a fault occurs, the type of fault is displayed on the digital operator, and details are stored in the internal memory.

Drive Faults

Fault	Display*		Meaning
Main Circuit Overvoltage	IOV	Over Voltage	The voltage of the power supply for the main circuit exceeded 120% of the rated voltage.
Input Power Undervoltage	AUV	Power UV	The input power voltage was below the voltage set in L2-21 for the time set in L2-20. (Consistency with another column.)
Input Power Frequency Deviation Fault	FDEV	Power Freq Fault	The power-supply frequency deviated more than the allowable amount in the deviating range set in L2-13 from the rated frequency of 50/60 Hz for the time set in L2-18. (Consistency with another column.)
Phase-order Fault	SRC	Power Phase Flt	The input-voltage phase order was not kept for the time set in L2-20 after the power was turned on. (Consistency with another column.) The phase order was changed after the power had been turned on.
Control Power Fault	CUV	CTL PS Under Volt	The voltage of the control power dropped.
Matrix Converter Overcurrent	IOC	Over Current	The current from the matrix converter exceeded the overcurrent detection level (approx. 132 % of the rated current).
Output Overvoltage	OOV	Output Ov Fault	The output voltage exceeded the voltage set in L9-06 for the time set in L9-07.
Motor Overload	OL1	Motor Overloaded	The motor overload protection function has operated based on the internal electronic thermal value.
Matrix Converter Overload	OL2	Mxc Overloaded	The matrix converter overload protection function has operated based on the detected current.
Overtorque 1	OL3	Overtorque Det 1	There has been a current greater than the setting in L6-02 for longer than the time set in L6-03.
Overtorque 2	OL4	Overtorque Det 2	There has been a current greater than the setting in L6-05 for longer than the time set in L6-06.
Undertorque 1	UL3	Undertorque Det 1	There has been a current less than the setting in L6-02 for longer than the time set in L6-03.
Undertorque 2	UL4	Undertorque Det 2	There has been a current less than the setting in L6-05 for longer than the time set in L6-06.
PG Disconnected	PGO	PG Open	PG pulses were not input when the matrix converter was outputting a frequency.
Excessive Speed Deviation	DEV	Speed Deviation	The speed deviation has been greater than the setting in H7-10 for longer than the time set in H7-11.
Overspeed	OS	Overspeed Det	The speed has been higher than the setting in H7-08 for longer than the time set in H7-09.
Output Ground Fault	OGF	Ground Fault	・The ground fault current at the matrix converter output exceeded approx. 25% of the rated output current. ・The total value of the output voltage for three phases exceeded the value set in L9-21 for the time set in L9-22.
Output Open-phase	LF	Output Pha Loss	An open-phase occurred at the matrix converter output. (Detected when L8-07 is set to Enabled.)
Control Fault	CF	Out of Control	The torque limit was reached continuously for 3 seconds or longer during a deceleration stop at open-loop vector control.
Digital Operator Disconnected	OPR	Opr Disconnect	The connection to the digital operator was broken during operation for a run command from the digital operator.
Digital Operator Communications Error 1	CPF00	COM-ERR (OP&INV)	Communications with the digital operator were not established within 5 seconds after the power was turned on.
Digital Operator Communications Error 2	CPF01	COM-ERR (OP&INV)	After communications were established, there was a communications error with the digital operator for more than 2 seconds.
EEPROM Error	CPF03	EEPROM Error	The matrix converter control circuit was damaged.
A/D Converter Error	CPF05	External A/D Err	
Hardware Fault	HDE	HARD Fault	
Modulator Watchdog Timeout Fault	DTM	MB Watchdog Flt	
CPU Fault	CER	CTL CPU Fault	
Analog Power Supply Fault	CTF	Analog Pwr Fault	The power-supply voltage (±15V) of the analog detection circuit was lowered.
Lowered Battery Voltage	BAT	Battery Lowered	The battery voltage (3V) was lowered.
Communications Error (Link Error)	LIN	xx:LINK FLT	A cell communications error (link error) occurred in the main board.
Communications Error (Parity Error)	PAR	Parity Fault (MB)	A cell communications error (parity error) occurred in the main board.
External Fault (Input Terminals S3 to S16)	EF3～16	Ext Fault (S3～16)	An “ external fault ” was input from a multi-function input terminal.

Cell Faults

Fault	Display*		Meaning
Communications Error (Link Error)	LIN	xx:LINK FLT	A cell communications error (link error) occurred.
Cell Fault	CFA		One of the following faults occurred in the cell.
		xx:OVR VOLT	・Input power overvoltage : The DC bus voltage of the snubber increased to a value greater than the allowable voltage.
		xx:UDR VOLT	・Input power undervoltage : The DC bus voltage of the snubber dropped to a value less than the allowable voltage.
		xx:CTR PWR OV	・Control power overvoltage : The control power voltage of the cell increased to a value greater than the allowable voltage.
		xx:OC FLT	・Overcurrent: The output current exceeded to a value greater than the allowable level.
		xx:SROH FLT	・Snubber resistor temperature fault: The temperature of the snubber resistor increased to a value greater than the allowable temperature.
		xx:OVER TEMP	・IGBT temperature fault: The temperature of the Insulated Gate Bipolar Transistor (IGBT) increased to a value greater than the allowable temperature.
		xx:CAP FLT	・Snubber capacitor voltage allotment fault : The voltage of the snubber circuit capacitor increased to a value greater than the allowable voltage.
		xx:CEL INIERR	・Initial setting error: The initial setting of the cell is incorrect.
		xx:INVOLT ERR	・Input voltage fault: The input fuse blew or an input open phase occurred.
		xx:HARD FLT	・Hardware fault: Watchdog timeout error (controller fault) occurred.

*:×× represents the cell number.

Specifications

Standard Specifications

3kV Class	Model: CIMR-MX1S□A□□□		**132**	**200**	**315**	**450**	**630**	**900**	**13C**	**18C**	**25C**
	Nominal Capacity	kVA	200	285	400	570	800	1150	1500	2300	3000
	Maximum Applicable Motor Capacity*1	kW	132	200	315	450	630	900	1250	1800	2500
	Output Rating	Rated Output Current A	35	50	70	100	140	200	260	400	520
		Rated Output Voltage	3-phase, 3 / 3.3 kV (sinusoidal wave)								
	Main-circuit Power Supply*2		3-phase, 3 / 3.3 kV±10%, 50 / 60 Hz±5%								
6kV Class	Model: CIMR-MX1S□C□□□		**250**	**400**	**630**	**900**	**13C**	**18C**	**25C**	**36C**	**50C**
	Nominal Capacity	kVA	400	570	800	1150	1600	2300	3000	4600	6000
	Maximum Applicable Motor Capacity*1	kW	250	400	630	900	1250	1800	2500	3600	5000
	Output Rating	Rated Output Current A	35	50	70	100	140	200	260	400	520
		Rated Output Voltage	3-phase, 6 / 6.6 kV(sinusoidal wave)								
	Main-circuit Power Supply*2		3-phase, 6 / 6.6 kV±10%, 50 / 60 Hz±5%								
Matrix Converter Efficiency / Power Factor			Efficiency: Approx. 98%, Power Factor: 0.95 or more								
Cooling Method			Forced air-cooling by fan (with failure detection)								
Control Power Supply			Controller: 3-phase, 200/220, 380, 400/440 V±10%, 50/60 Hz ±5%, 3kVA or more								
Control Specifications	Control Method		Open-loop vector control, flux vector control								
	Main Circuit		Matrix converter with multi-output connected in a series								
	Frequency Control Range		0 to 120 Hz								
	Frequency Control Accuracy		±0.5%								
	Analog Input Resolution		0.03 Hz								
	Accel/Decel Time		0.1 to 6000 s								
	Main Control Functions		Restart after momentary power loss*3, torque limit, accel/decel stall prevention, catching the coast, operation prohibition at specified speeds, S-curve accel/decel, multi-step speed operation								
Protective Functions			Overcurrent, overvoltage, undervoltage, output ground fault, output open-phase, cooling-fan error, overload, motor overheat, etc.								
Communication (optional)			Applicable to various types such as Modbus, CP-215, CP-218 (Ethernet), and CP-261(PROFIBUS-DP)								
Maintainability	Digital Operator		Status display, fault display, run command, parameter setting and monitoring								
	Display Tools on PC		Trend display, data analysis tool								
	Main Circuit		Module configuration								
Input Transformer			Class H dry type, +5% tap, secondary multi-phase winding								
No. of I/O Terminals			Digital input: 10 points; digital output: 8 points; analog input: 2 points; analog output: 2 points								
Temperature Protection			Power cells: protected by thermistor for temperature, transformer : protected by thermostat								

✻1 : The figures shown for maximum applicable motor output were obtained by using Yaskawa's standard four-pole motors.

✻2 : · The capacity (kVA) of the power supply must be larger than the nominal capacity (kVA) of the matrix converter. When connecting multiple matrix converters to the same power supply system, make sure that the capacity is at least the sum of the nominal capacities of matrix converters. The maximum percent impedance of the power supply should be 5%. The capacity of the power supply must include the capacities of all the power supply systems that is connected to the matrix converter. Insufficient capacity of the power supply or distortions of voltage waveforms may cause problems. Contact your Yaskawa representative for more information.

· If you need to connect the matrix converter to a generator or to a thyristor that is connected to the same power supply system as the matrix converter, contact your Yaskawa representative for more information.

✻3 : When the restart function for the momentary power loss is used, an uninterruptive power supply unit for the control power supply is needed optionally.

Environmental Conditions

Conditions		Specifications
Applicable Standards		JIS, JEM, JEC
Environment	Atmosphere	General environmental conditions (free from dust and corrosive gases)
	Ambient Temperature	−5 to +40℃
	Relative Humidity	45 to 85%RH (no condensing)
	Storage Temperature	−10 to +50℃
	Amplitude	1000 m or less
Cabinet Specifications	Form	Made of enclosed steel sheets, vertically-standalone type, protective front panal type
	Painting	5Y7/1 semi-gloss both for inner and outer faces
Enclosure		IP40 (dustproof type)

Communication Option Cards

Card Name	Code No.	Function
CP-215 communications I/F card 215IF	JEBC-61603 7910161-6030X-S010Y	Used for running or stopping the matrix converter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through CP-215 communications with the host controller. Used as real-time network at high speeds with N/N as control method for media access. Cyclic and message communications with a shared memory are available.
CP-218 communications I/F card 218IF	JEBC-61604 7910161-6040X-S010Y	Used for running or stopping the matrix converter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through CP-218 communications with the host controller. Used as Ethernet with MEMOBUS, MELSEC, or no protocol.
CP-261 communications I/F card 261IF	JEBC-61607 7910161-6070X-S010Y	Used for running or stopping the matrix converter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through CP-261(PROFIBUS-DP) communications with the host controller.

Dimensions Units:mm

Fig.1

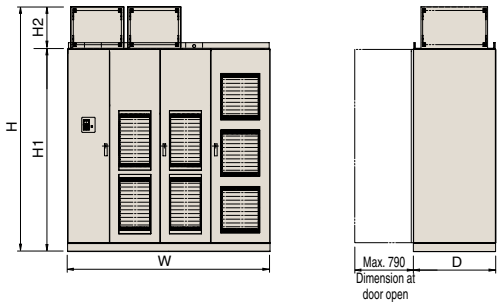


Fig.2

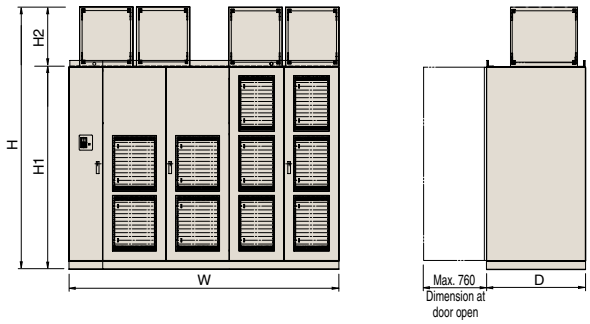


Fig.3

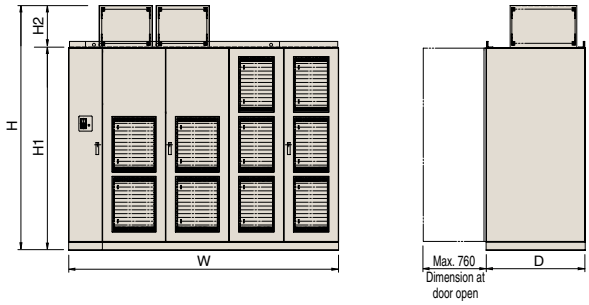


Fig.4

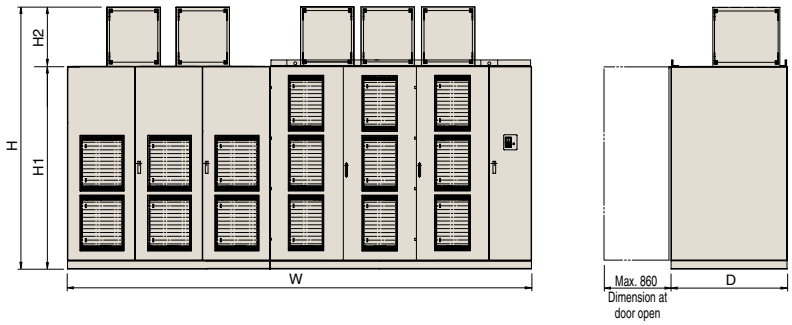
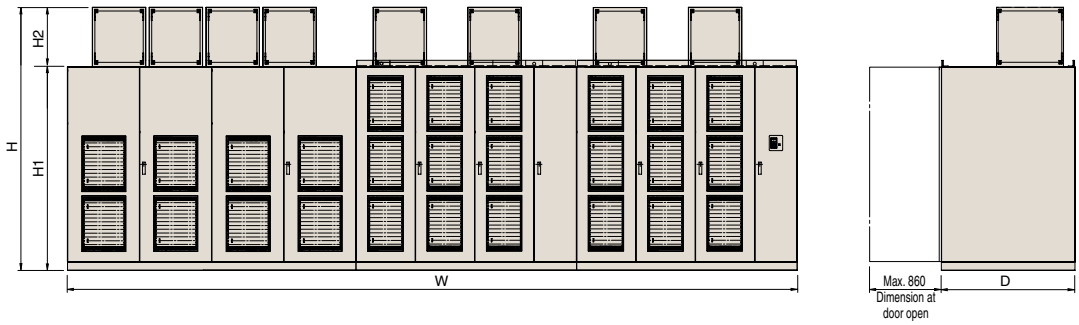


Fig.5



	Model CIMR-MX1S□□□	Figure	Dimensions mm W	H	H1	H2	D	Approx. Mass kg
3kV Class	132	Fig.1	2300	2900	2400	500	1200	2800
	200							3000
	315		2400					3400
	450		2500					3600
	630							4300
	900	Fig.2	3400	3050		650		4800
	13C							5900
	18C		3900*				1400	7700
	25C	Fig.4	5100*					9500
6kV Class	250	Fig.3	3400	2900	2400	500	1200	3500
	400							3800
	630							4400
	900							5600
	13C							6400
	18C	Fig.4	5900*	3050		650	1400	8000
	25C		6200*					8700
	36C		6500*				1600	12000
	50C	Fig.5	8600*					16000

*: Block construction.

Model Numbers

C I M R - M X 1 S □ □ □ □ □

Matrix Converter

FSDrive-MX1S

Input Voltage, Frequency

A : 3300 V 60 Hz
B : 3000 V 50 Hz
C : 6600 V 60 Hz
D : 6000 V 50 Hz
E : 3300 V 50 Hz
F : 6600 V 50 Hz

Output Voltage Class

A : 3 kV class
C : 6 kV class

Maximum Applicable Motor Capacity

132 : 132 kW
200 : 200 kW
250 : 250 kW
315 : 315 kW
400 : 400 kW
450 : 450 kW
630 : 630 kW
900 : 900 kW
13C : 1250 kW
18C : 1800 kW
25C : 2500 kW
36C : 3600 kW
50C : 5000 kW

FSDrive-MX1S

Energy-saving Power Calculation for Fan/Blower

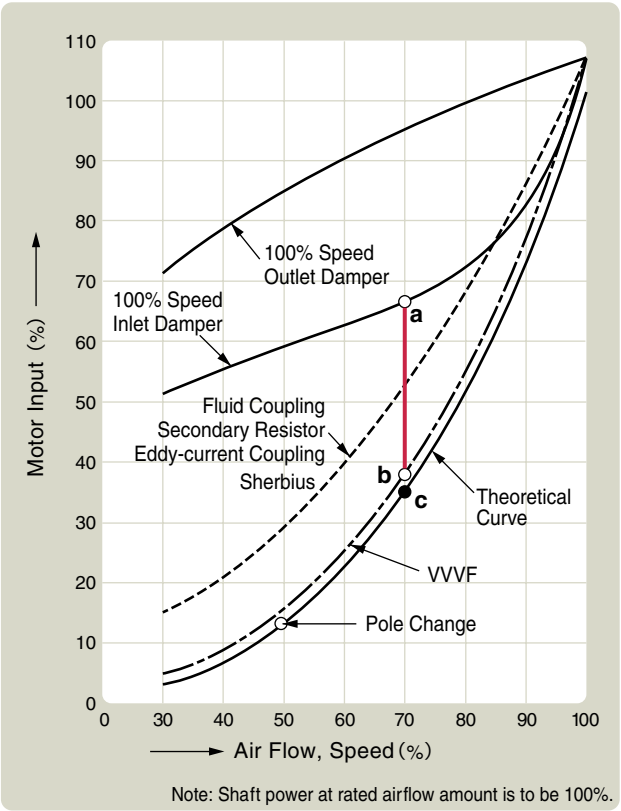
The most significant point of the energy-saving operation for fans or blowers is application of speed control by using matrix converters.
Compared to the airflow control by using dampers, the matrix converter drives can save a great deal of power.

Conditions

(1) Applicable motors: 3300 V, 500 kW, 6P.
(with 95% motor efficiency)

(2) 70% airflow operation.
(with 90% motor efficiency at 100% airflow)

◆Consumed power of blower motor



Note: Shaft power at rated airflow amount is to be 100%.

1

Power at inlet damper control

$$500 \times 0.9 \times 0.68^{*} \times \frac{1}{0.95}\ (\text{Motor efficiency}) \fallingdotseq 322\text{kW} \cdots\cdots ①$$

* Point "a" in the characteristics curve

2

Power at matrix converter energy-saving control

◆Motor output (point c)

$$500 \times 0.9 \times (0.7)^{3} = 154.3\text{kW}$$

◆Motor input power

$$154.3 \times \frac{1}{0.95}\ (\text{Motor efficiency}) = 162.4\text{kW}$$

◆Matrix converter input power (point b)

$$162.4 \times \frac{1}{0.97}\ (\text{Matrix converter efficiency}) \fallingdotseq 167\text{kW} \cdots\cdots ②$$

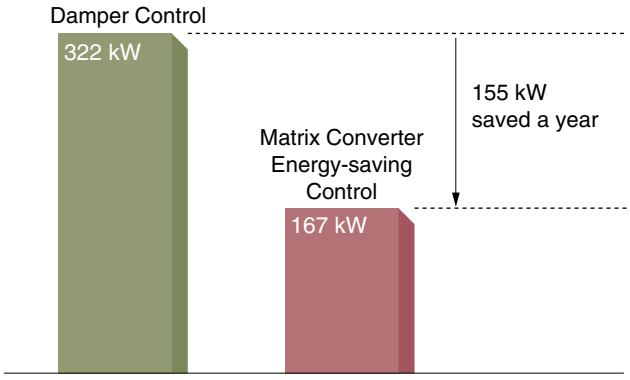
3

Power saved

◆Annual power saving by employing matrix converters

①−②
(322−167) kW×6000h=930,000kWh

Assume that the annual operating time is 6,000 hours
(Equivalent to 8.2 months when operating continuously for 24 hours)



Matrix Converter Capacity Selection FSDrive-MX1S

Examination of capacity 1

Selection of optimum capacity for blower motors (for actual loads)

The applicable matrix converter capacity is determined as follows when the available commercial power supply operation method is changed into the speed control method.

(Example) Motor rating: 500 kW, 4P, 3 kV at 50 Hz

Assuming that:

・Motor rated current value : 120 A

・Maximum value of actual operation load current : 95 A

For the applicable matrix converter capacity, rated output current 100A (nominal capacity 600 kVA) should be selected. (100 A ＞ 95 A)

Examination of capacity 2

Matrix converter application for extruder motors

(Example) Motor rating: 400 kW, 6P, 3.3 kV at 60 Hz

Assuming that:

・Motor rated current value: 88 A

・Required overload capacity: 120% for 60 seconds

The applicable matrix converter capacity will be as shown below considering the allowance of 10%;

88 A × 1.3 ＝ 115 A

Therefore, rated current 140 A (nominal capacity 800 kVA) should be selected.(140 A > 115 A)

Examination of capacity 3

Matrix converter application for cement kiln motors

(Example) Motor rating: 500 kW, 6P, 6.6 kV at 60 Hz

Assuming that:

・Motor rated current value: 53 A

・Required overload capacity: 250% for 60 seconds

The applicable matrix converter capacity will be as shown below considering the allowance of 10%;

53 A × 2.6 ＝ 138 A

Therefore, rated current 140 A (nominal capacity 1600 kVA) should be selected.

(140 A > 138 A)

Fill out the following form for estimation.

1	Name of facility or application	
2	Name of load machine	☐Pump ☐Fan ☐Blower ☐Compressor ☐Extruder ☐Others
3	Load machine characteristics	☐Variable torque ☐Proportional torque ☐Constant torque ☐Constant output　J(GD²／4)＿＿＿＿ kg・m²
4	Operation conditions	Motor current＿＿＿＿A　Operation time Annual＿＿＿＿hours
5	Motor model to be driven	☐Squirrel-cage induction motor ☐Wound-rotor type 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 capacity	＿＿＿＿%／＿＿＿＿Second(s)
11	Commercial power supply by-pass operation circuit	☐Not needed ☐Needed〈Matrix converter ⇒ commercial power supply operation ☐Automatic changing method ☐Manual changing method〉
12	Power supply specifications	Power supply shortcircuit capacity＿＿＿＿MVA Main circuit voltage＿＿＿＿V＿＿＿＿Hz Control circuit voltage 200/220V, 50/60Hz, 3-phase 3-step method 400/440V
13	Ambient conditions	Indoors ☐Ambient temperature＿＿＿＿to＿＿＿＿℃ ☐Humidity＿＿＿＿% or less ☐Air-conditioning facility (Provided/Not provided)

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YASKAWA ELECTRIC CORPORATION

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Specifications are subject to change without notice
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