# Medium Voltage VFD

Perfect Energy Saving Drive

3kV 200kVA ~ 3,700kVA / 4kV 250kVA ~ 4,700kVA
6kV 400kVA ~ 7,500kVA / 10kV 600kVA ~ 11,000kVA

LSIS

- The most efficiency energy management for great energy saving.
- User friendly convenience monitoring system
- Optimum solution for variety industry fields.

Multi-winding Phase-shift Transformer Part

Power Cells Part

Master Controller Part
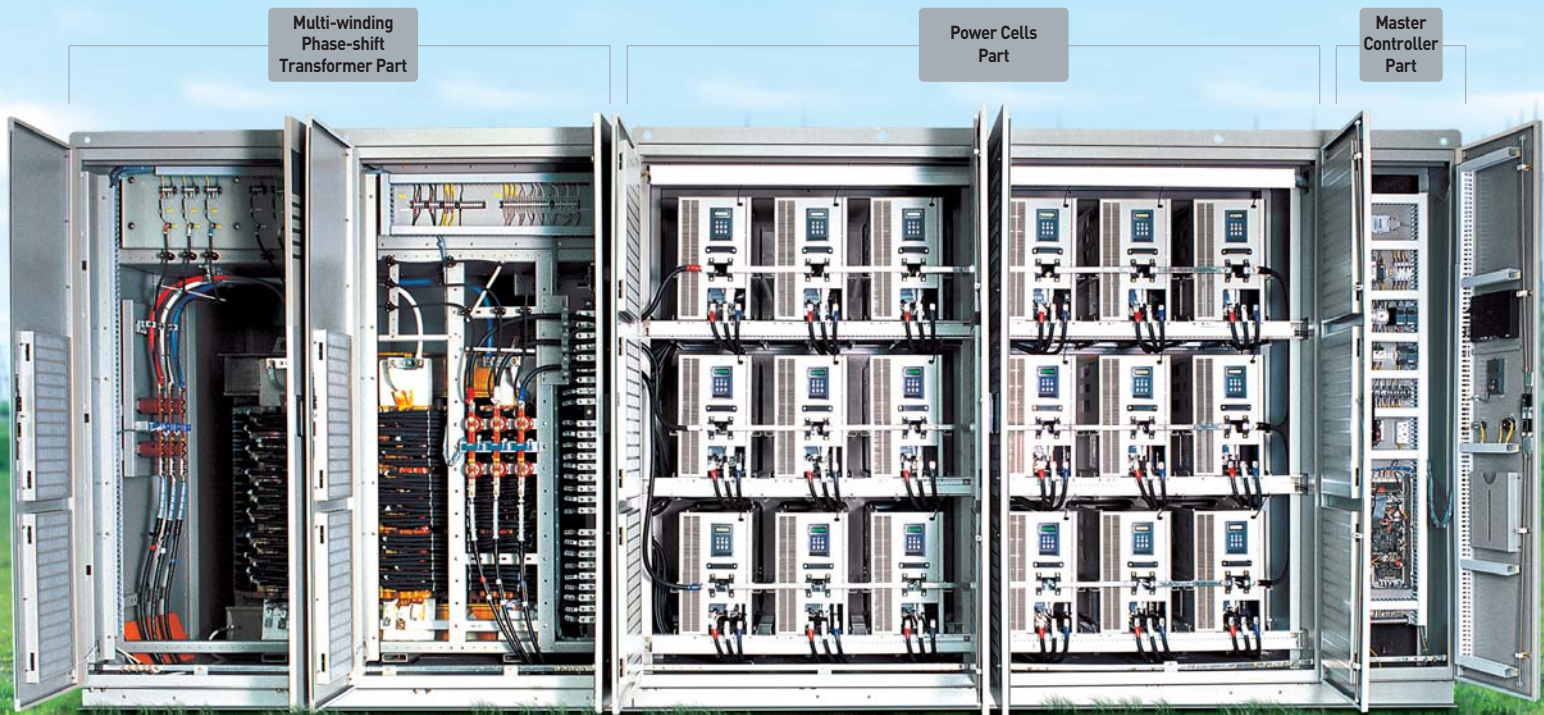
Sensorless Vector Control

- MV VFD adopts powerful Sensorless vector control algorithm on the basis of LV VFD`s technology, and it improves not only the torque control characteristics, but the speed control ability in uncertain condition caused by the load variation as well.

- MV VFD generates strong torque at a low speed range as shown below.

V/F Control

Sensorless Vector Control
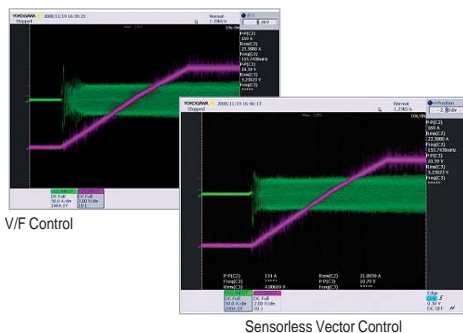
Flying Start

- In case of more than 2 fans operated in one system or heavy fan spinning by inertia, MV VFD detects motor's speed and is able to control motor effectively.

Ch1 : Output Current / Ch2 : Output Frequency
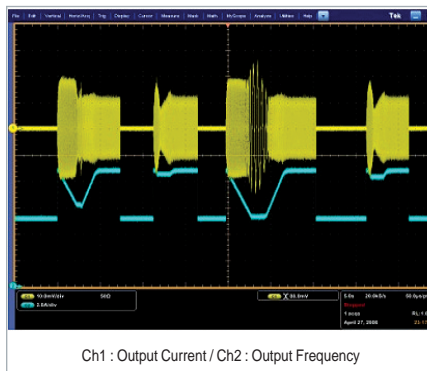
Auto tuning

- In the application which requires a high torque at low speed, the electrical parameters of motor should be properly set for an optimal operation.

- The Auto tuning function automatically measures the motor parameters needed for control selected in control mode such as stator resistance, rotor resistance, leakage inductance and no-load current.

Auto tuning   Ch1: Output Current / Ch2: Output Current
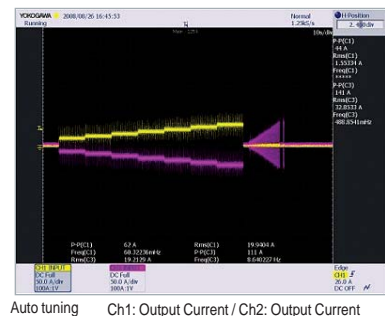
⊡ Multi-winding Transformer

Cell input voltage can be connected each terminal and 36 pulse/18 winding of dry type phase-shift transformer has equipped. Also it has constructed 5% tap for input voltage change.

⊡ Power Cells

6 cell connected in series per VFD output phase. It occurs 25 level, 3 phase output voltage. Each cell uses PWM switching with distributed control process. Cell maintenance is user friendly as self cell protection and built-in bypass function.

⊡ Master Controller

There is a Master Controller for managing PWM output voltage. It uses CAN communication and controls VFD with 18 each unit cell and optical communication. It also has user friendly MV System View for system maintaining and monitoring

Circuit Configuration

6 Cells per Phase

Single-phase Cell VFD
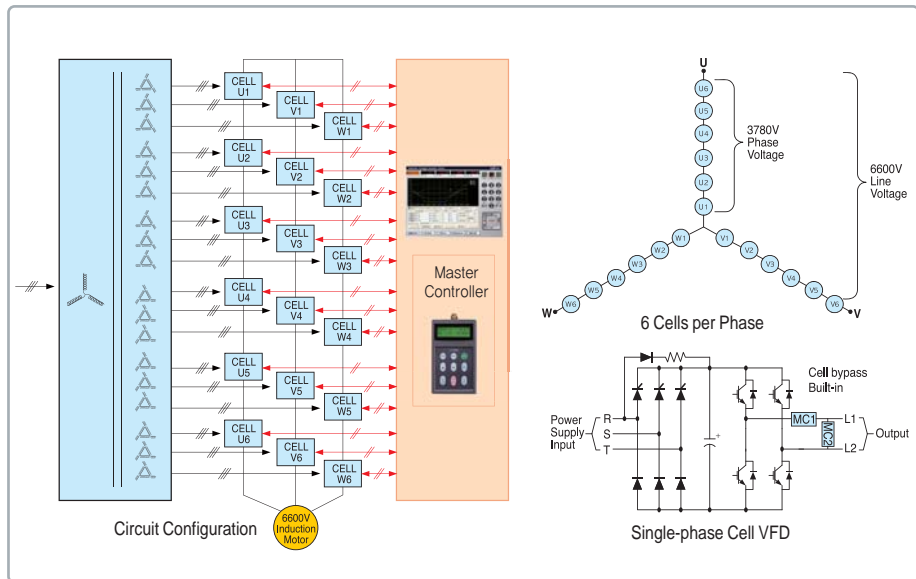
>>> **Energy Saving**

Compared to the airflow control by using dampers, the VFD saves more energy.
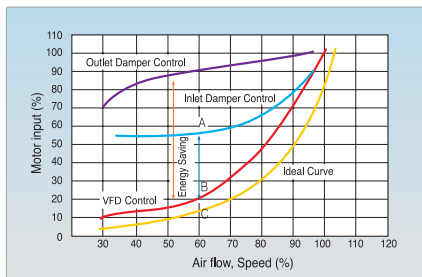
■ **Conditions**

(1) Applicable Motor: 3300V, 600kW, 6P (with 95% motor Efficiency)
(2) 60% airflow operation (with 90% motor efficiency at 100% airflow)

1. Power at inlet damper control

$$600 \times 0.9 \times 0.55 \times \frac{1}{0.95}_{\text{Motor efficiency}} = 312.6 kW \cdots (1)$$

2. Power at VFD energy saving control

■ Motor output (point C)

$$600 \times 0.9 \times (0.6)^3 = 116.6 kW \cdots (1)$$

■ Motor input power

$$116.6 \times \frac{1}{0.95}_{\text{Motor efficiency}} = 122.7 kW$$
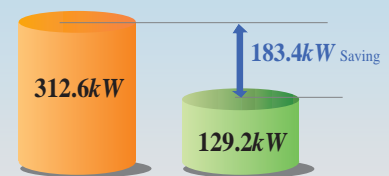
■ VFD input power (point b)

$$122.7 \times \frac{1}{0.95}_{\text{VFD efficiency}} = 129.2 kW \cdots (2)$$

3. Energy Saving

■ Annual energy saving by VFD (1) -(2)

$$(312.6\text{-}129.2)kW \times 8,000 h = 1,467,200 kWh$$
* Assume that annual motor operating time is 8,000 hours
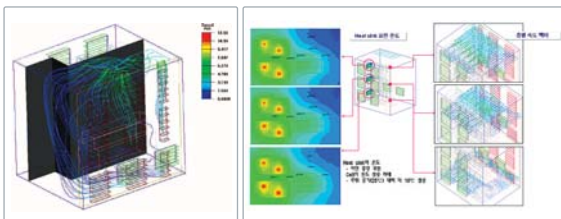
312.6kW

183.4kW Saving

129.2kW

■ Annual electric charge can be saved

$$1,467,200 \times 9 = 13,204,800 \text{ cent} = 13,204.8 \text{ dollar}$$
* Assume 9 cent per kWh

>>> **Compact Size**

- MV VFD has designed an optimum inner panel through heat analysis; it promotes to get the most out of space.
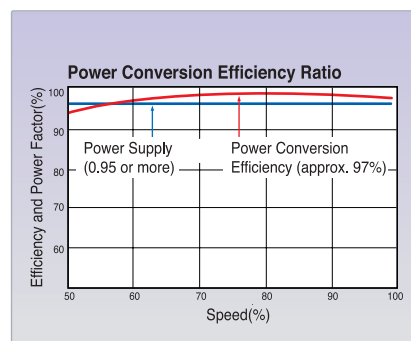
>>> **Energy Saving & High Efficiency**

- MV VFD realizes high efficiency and high power factor more than 95% without any compensation tools.
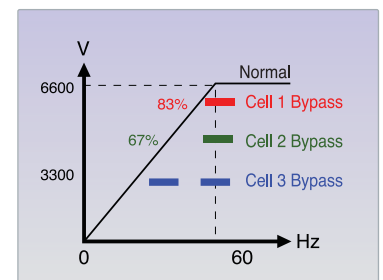- MV VFD realizes perfect energy saving VFD system without input/output filter.

>>> **Redundant Cell Power Factor Control**

- MV VFD has no extra charge for low power factor.
- MV VFD's voltage regulation is advanced.
- MV VFD keeps High power factor with standard induction motor in all of the speed range. (More than 95%)

Power Conversion Efficiency Ratio

Power Supply (0.95 or more)

Power Conversion Efficiency (approx. 97%)
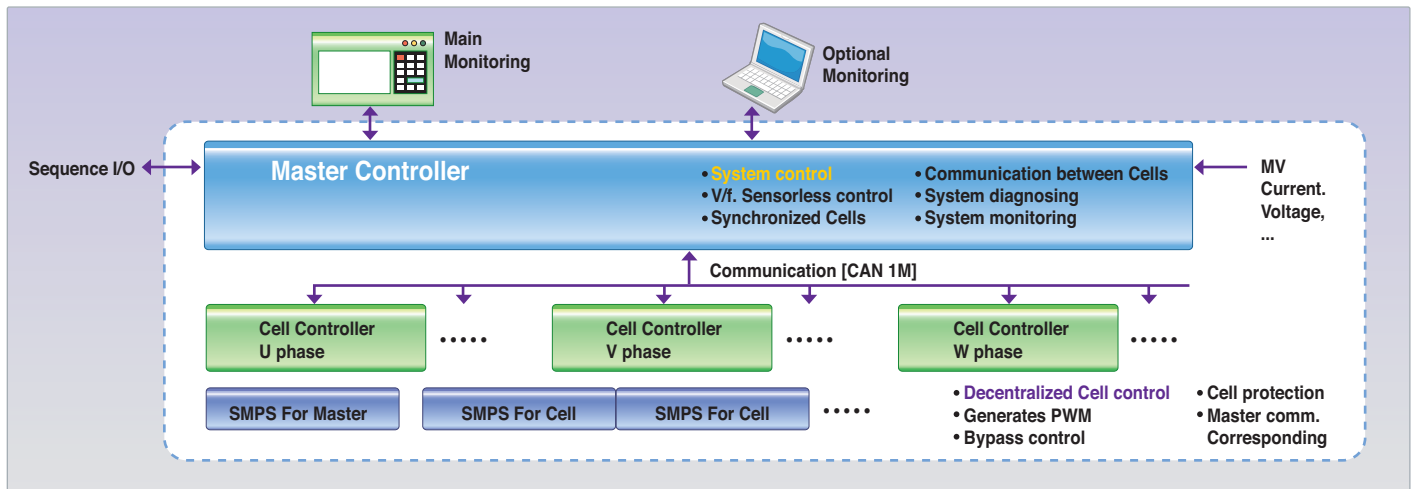
Speed(%)

>>> **Built-in Cell Bypass**

- In case of cell failure during operation, the fault cell is bypassed and 83% of the rated voltage can be output after the failure of one cell.
- This function can be operated by automation and manual setting.
- MV VFD's drag torque is constantly maintained when cell is bypassed.

Normal
83% Cell 1 Bypass
67% Cell 2 Bypass
Cell 3 Bypass

》》》 System Configuration

Main Monitoring

Optional Monitoring

Sequence I/O

Master Controller
- System control
- V/f. Sensorless control
- Synchronized Cells
- Communication between Cells
- System diagnosing
- System monitoring

MV Current. Voltage, ...

Communication [CAN 1M]

Cell Controller U phase

Cell Controller V phase

Cell Controller W phase

SMPS For Master

SMPS For Cell

SMPS For Cell

- Decentralized Cell control
- Generates PWM
- Bypass control
- Cell protection
- Master comm. Corresponding

》》》 MV System View (Option)

- Displays the status of drive operation
- Displays max. of 4 common field data in each segment

- Buttons for Forward/Backward, Stop/Reset Commands
- These LEDs Display running direction of the connected drive

- This is a touch screen based operation system
- User can set the data by using either a Keypad or a Direction pad
- Displays max. of 4 common field data in graph form

- Has a monitoring stop trigger function in case of certain situation
- Can continuously save the monitoring data at specified intervals

- Touching one of these buttons will display the window for each of selected category.

》》》 FAN speed control by inverter internal heat value

Automatic control for cooling FAN compatible with inverter internal temperature
- Reduced FAN noise with optimized control
- Reduced power consumption of FAN
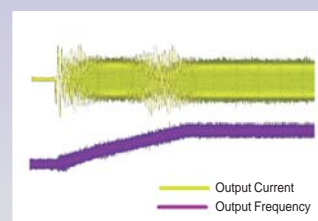- Extended durability of FAN

Speed control compatible with the temperature variation

Speed control of FAN

Internal temperature
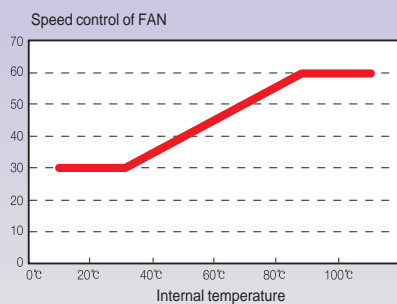
》》》 New algorithm for an anti-current hunt

- When the motor operates, mechanic resonant or resonant point of each component's organic union makes current hunt. It occurs over current trip or damaged motor shaft.
- New algorithm, the advanced technology compared with the currently jump function, resolves the current hunt generated by the resonance of the frequency in the specific site and it drives with stable in all frequencies of the operating sector

Without New Algorithm

With New Algorithm

Output Current
Output Frequency

Output Current
Output Frequency
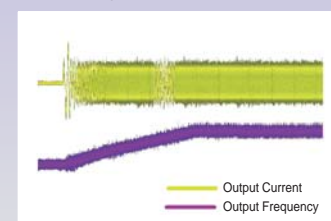
Standard Specifications

		1	2	3	4	5	6	7	8	9	10	11	12	13
3kV Class	Model Number [60Hz]	LSMV-033S200	LSMV-033S300	LSMV-033S400	LSMV-033S500	LSMV-033S600	LSMV-033S750	LSMV-033S10H	LSMV-033S12H	LSMV-033S15H	LSMV-033S20H	LSMV-033S25H	LSMV-033S30H	LSMV-033S37H
	Model Number [50Hz]	LSMV-030F200	LSMV-030F300	LSMV-030F400	LSMV-030F500	LSMV-030F600	LSMV-030F750	LSMV-030F10H	LSMV-030F12H	LSMV-030F15H	LSMV-030F20H	LSMV-030F25H	LSMV-030F30H	LSMV-030F37H
	Output Capacity [kVA]	200	300	400	500	600	750	1000	1200	1500	2000	2500	3000	3700
	Cell Rated Current [A]	35	53	70	88	105	131	175	218	260	350	438	525	657
	Max. Applicable Motor Capacity [kW]	160	250	330	410	500	620	850	1000	1250	1700	2080	2500	3150
4kV Class	Model Number	LSMV-041F250	LSMV-041F380	LSMV-041F500	LSMV-041F630	LSMV-041F750	LSMV-041F950	LSMV-041F12H	LSMV-041F15H	LSMV-041F19H	LSMV-041F25H	LSMV-041F31H	LSMV-041F37H	LSMV-041F47H
	Output Capacity [kVA]	250	380	500	630	750	950	1200	1500	1900	2500	3100	3700	4700
	Cell Rated Current [A]	35	53	70	88	105	131	175	218	260	350	438	525	657
	Max. Applicable Motor Capacity [kW]	200	310	410	530	620	790	1000	1250	1580	2080	2650	3150	4000
6kV Class	Model Number [60Hz]	LSMV-066S400	LSMV-066S600	LSMV-066S800	LSMV-066S10H	LSMV-066S12H	LSMV-066S15H	LSMV-066S20H	LSMV-066S25H	LSMV-066S30H	LSMV-066S40H	LSMV-066S50H	LSMV-066S60H	LSMV-066S75H
	Model Number [50Hz]	LSMV-060F400	LSMV-060F600	LSMV-060F800	LSMV-060F10H	LSMV-060F12H	LSMV-060F15H	LSMV-060F20H	LSMV-060F25H	LSMV-060F30H	LSMV-060F40H	LSMV-060F50H	LSMV-060F60H	LSMV-060F75H
	Output Capacity [kVA]	400	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	7500
	Cell Rated Current [A]	35	53	70	88	105	131	175	218	260	350	438	525	657
	Max. Applicable Motor Capacity [kW]	330	500	660	850	1000	1250	1700	2080	2500	3400	4100	5000	6200
10kV Class	Model Number	LSMV-100F600	LSMV-100F900	LSMV-100F12H	LSMV-100F15H	LSMV-100F18H	LSMV-100F22H	LSMV-100F30H	LSMV-100F37H	LSMV-100F45H	LSMV-100F60H	LSMV-100F75H	LSMV-100F90H	LSMV-100F11M
	Output Capacity [kVA]	600	900	1200	1500	1800	2200	3000	3700	4500	6000	7500	9000	11000
	Cell Rated Current [A]	35	53	70	88	105	132	175	218	260	350	438	525	657
	Max. Applicable Motor Capacity [kW]	500	700	1000	1250	1500	1800	2500	3150	3800	5000	6200	7200	9300

Power Factor		Approx. 95% (rated speed and load condition)
Efficiency		Approx. 98.5%[*1] (rated speed and load condition)
Input current THD		Satisfies IEEE Standard
Input	Main circuit	3-phase 3 kV/3.3 kV/4.16 kV/6 kV/6.6 kV/10 kV $\pm$10%, 50/60 Hz
	Control circuit	3-phase 220 V/380 V/440 V $\pm$10%, 50/60 Hz $\pm$5%
Output	Rated voltage	3-phase 3 kV/3.3 kV/4.16 kV/6 kV/6.6 kV/10 kV Max. 25 level
	Output frequency	0 - 120 Hz
Control	Control method	V/F, sensorless vector control
	Frequency control precision	$\pm$0.1%
	Frequency resolution	0.01 Hz
	Accel/Decel time	6000 s
	Overload tolerance	120% 60 s
	Method of modulation	Multi-level pulse width modulation (multi-level PWM)
	Extra features	Flying start / Cell bypass
Operation	Keypad loader	RS-232, Modbus-RTU, key input mode
	System monitoring	HMI (XP-50) basic installation
	MV System View (Option)	Built-in touch screen input-type wide-view angle 12.1-inch 144-color TFT-KEYPAD, 1024 $\times$768 resolution and 40 ms response speed.
Signal Input/Output	Digital PLC	Input: 15 channels, output: 9 channels XBC-DR64H input: 32 channels, output: 32 channels
	Analog	Input: 3-channel (DC 0 - 10 V or 4 - 20 mA) output: 4-channel (DC 0 - 10 V or 4 - 20 mA)
Protective function		Overcurrent, overvoltage, insufficient voltage, ground fault, drive overheat, motor overheat fan trip, overload, communications error, cell trip... .
Communication		RS-485 built-in, option: DeviceNet, Profibus, Modbus-RTU, Modbus/TCP, Ethernet/IP
Structure	Protection level	IP20
	Cell bypass	Default built-in (manual/auto bypass)
	Cooling method	Air-cooled
Installation environment	Ambient temperature	0~40℃
	Humidity	Max. 85% (should not have condensation)
	Altitude	Below 1,000 m
	Installation	Indoor
Input transformer		Class H, air-cooling, N/+5%/10% or -5%/N/+5%

*1) without transformer

Model Number

LSMV

LS Industrial Systems Medium Voltage VFD

Input Voltage
030 : 3000[V]
033 : 3300[V]
041 : 4160[V]
060 : 6000[V]
066 : 6600[V]
100 : 10000[V]

Input Frequency
F : 50[Hz]
S : 60[Hz]

Total Capacity
200 : 200 kVA	15H : 1500 kVA	55H : 5500kVA
250 : 250 kVA	18H : 1750 kVA	60H : 6000kVA
300 : 300 kVA	20H : 2000 kVA	70H : 7000kVA
400 : 400 kVA	25H : 2500 kVA	75H : 7500kVA
500 : 500 kVA	30H : 3000 kVA	80H : 8000kVA
600 : 600 kVA	35H : 3500 kVA	90H : 9000kVA
700 : 700 kVA	40H : 4000kVA	95H : 9500kVA
800 : 800 kVA	45H : 4500kVA	10M : 10000kVA
10H : 1000 kVA	50H : 5000kVA	11M : 11000kVA
13H : 1250 kVA		

Product Type
G1 : 1st Generation
※ G : General Type
R : Regeneration Type

Class	MV VFD Capacity (kVA)												
3kV	200	300	400	500	600	750	1000	1200	1500	2000	2500	3000	3700
4kV	250	380	500	630	750	950	1200	1500	1900	2500	3100	3700	4700
6kV	400	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	7500
10kV	600	900	1200	1500	1800	2200	3000	3700	4500	6000	7500	9000	11000

* As for the specific information, please contact LS Industrial Systems Co,. Ltd.

◪ Display of Master Controller Faults

Protective function	Keypad loader	Contents
Overcurrent	Output OCT	Blocks drive output if the output is more than 140% of the rated current for the drive.
Cell overvoltage protection	DC-Link OVT	Blocks drive output if the DC_Link voltage of each cell becomes higher than the standard.
Input overvoltage protection	Input OVT	Blocks drive output when voltage of transformer input terminal become higher than 120% of the specified standard voltage (rated voltage of the transformer).
Input low-voltage protection	Input LVT	Blocks drive output when voltage of transformer input terminal becomes lower than 70% of the specified standard voltage (rated voltage of the transformer).
Overload trip Overload protection	Over Load	Blocks drive output and processes it as a fault if the drive output exceeds OLT (overload) time and OLT (overload) levels set in [FU1-60] and [FU1-61] by the user for the rated current of the motor.
Transformer overheat	Trans Over Heat	Blocks drive output and processes it as a fault if the cooling fan experiences problems or the transformer overheats because of foreign substances in the cooling fan, and therefore the detected temperature (transformer PTC) value is over 120 degrees.
Cell overheat	CELL OverHeat	Blocks drive output when the master receives the heat sink temperature of each cell and the cell temperature is higher than 75 degrees (configurable).
Cell fault	Cell Fault	When any fault (e.g., overvoltage, low-voltage, NTC Open, Fuse Open, over current, Arm Short, overheat) occurs on each cell composing the drive, the master recognizes the fault by communications, blocks drive output and processes it as a fault.
Electronic thermal	E-Thermal	Computes motor overheat when the motor is running with overload by ETH 1 minute rating set in FU1-54 and ETH continuation value set in FU1-55 considering correlations between current amount and heat. If the drive overheat exceeds the specified condition, it blocks drive output and processes it as a fault.
External trip 1	Ext.Trip 1	Use when you want to block drive output by an external trip signal. It detects a trip with the external trip terminal within the drive and then blocks drive output if a trip is detected to protect motor overload.
External trip 2	Ext.Trip 2	Use when you want to block drive output by an external trip signal. It detects a trip with the external trip terminal within the drive and then blocks drive output if a trip is detected to protect motor overload.
Input open-phase	InPhaseOpen	Blocks drive output if input (R, S and T) open-phase occurs in the transformer. It detects the input current of the transformer to check an open-phase.
Output open-phase	OutPhase Open	Blocks drive output if output (U, V and W) open-phase occurs to the driver. It detects the output current of the drive to check an open-phase.
BX protection (Momentary cutoff)	BX	Use this for an emergency stop of the drive. It momentarily blocks drive output when drive BX terminal is input. The drive returns to its normal condition if BX terminal is off. **Caution: Use this with caution.**
Communications error 1	COM Error CPU Error	Displayed when communications between the main board of drive and keypad is inadequate.
Communications error 2	CAN Error	Blocks drive output if communications between master and each cell experience problems more than three times consecutively.
Operation method when a frequency command was lost	LOP/LOV/LOI/ LOX	Select one of Continue operation, Deceleration stop and Free Run stop according to [I/O-12] operation method when a frequency command is lost.
Drive overload	Inv. OLT	Blocks drive output when the drive output stays longer than a minute with 120% of rated current of the drive. (Character of inverse time operation)
Ground fault protection	Ground Fault	Blocks drive output if a drive's output wire has a ground fault or insulation of the motor becomes deteriorated for longer than the specified GFT level and the GFT trip time that is set on the drive.
Fan error	FAN Error	Blocks drive output when there is a trouble with a fan. A fault on the system fan may cause transformer and cell overheat. Returns to its original condition when the fault is handled with terminal input.
Insufficient UPS control power	Control LVT	Supplies master control power via UPS if there is a control power outage. Blocks drive output and processes it as a fault if the drive cannot be operated normally because of lack in UPS capacity after it suppies power. (holding time by UPS capacity [IO-98 UPS_OFF_Dly] is configurable.)

◪ Cell Fault Display

Protective function	Keypad loader	Contents
Overcurrent	Over Current 1	If the cell output current becomes larger than the cell IGBT rating (which varies according to the capacity of each cell), the system processes it as a cell fault, sends a fault signal to the master, and then blocks drive output.
Cell overvoltage protection	Over Voltage	If the DC_Link voltage of a cell becomes higher than the specified standard voltage (820 V for 400 V cell, 1100 V for 600 V cell), the system processes it as a fault, sends a fault signal to the master, and blocks drive output.
Arm short	Over Current 2	If an arm short occurs on a cell's IGBT, the system processes it as a cell fault, sends a fault signal to the master, and blocks drive output.
Communications error	Can Rx Error	If the master does not receive communications signal three times consecutively, the system processes it as a cell fault, sends fault signal to the master, and blocks drive output.
Fuse damage	Fuse Open	If the fuse inside a cell is damaged due to overcurrent in the cell, the system processes it as a cell fault, sends a fault signal to the master, and blocks drive output.
Cell overheat	Over Heat	If the heat sink in a cell overheats because of cooling fan failure or by cooling fan disorder, and the temperature became higher than 80 degrees, the system processes it as a cell fault, sends a fault signal to the master, and blocks drive output.
NTC open	NTC open	If there is a problem with the device (NTC) for detecting cell heat sink temperature, the system processes it as a cell fault, sends a fault signal to the master, and blocks drive output.
Low voltage protection	Low Voltage	When power voltage of the cell is lowered, it causes torque shortage or motor overheat. Therefore, if power voltage of the cell drops below the voltage detection level (less than 70% of standard input voltage), the sytem processes it as a cell fault, sends fault signal to the master, and blocks drive output.

Form for quotation

1	Name of Application	

2	Type of Load	☐ Pump ☐ Fan ☐ Blower ☐ Compressor ☐ Others

3	Torque Characteristics	☐ Variable Torque ☐ Proportional Torque ☐ Constant Torque ☐ Constant Output J(GD^2/4) kg·㎡

4	Operation Conditions	Motor Current_____A , Annual Operation Time_____hours

5	Motor Specifications	☐ Squirrel-Cage Induction motor ☐ Wound-Rotor Type Motor ☐ Existing ☐ New Output _____kW , Voltage_____V , Frequency _____Hz , Pole Number _____P Speed _____min , Rated Current _____A , Efficiency _____% , Power, Factor_____%

6	Speed Control Range	Minimum_____/min to Maximum_____/min or Minimum_____/Hz to Maximum_____/Hz

7	Acceleration/Deceleration Time Setting	Acceleration Time_____Second(s)/_____min Deceleration Time_____Second(s)/_____min

8	Overload Capacity	_____% /_____Second(s)

9	By-Pass Operation Circuit	☐ Required < ☐ Automatic ☐ Manual >

10	Power Supply Specifications	Main Circuit Voltage _____V , _____Hz Control Circuit Voltage ☐ 220V 3P ☐ 380V 3P ☐ 440V 3P ☐ Others _____V 3P

11	Ambient Conditions	Indoors ☐ Ambient Temperature _____℃ , ☐ Humidity_____% or less ☐ Air-Conditioning Facility (☐ Provided ☐ Not Provided) ☐ Install Space (Width _____mm ☐ Height _____mm ☐ Depth _____mm) ☐ Cable Entry (☐ Bottom ☐ Top)
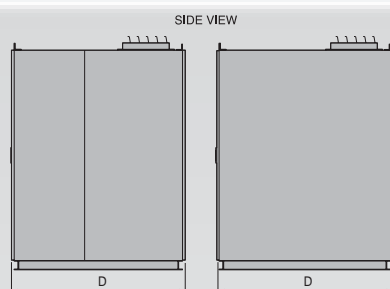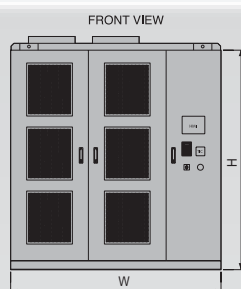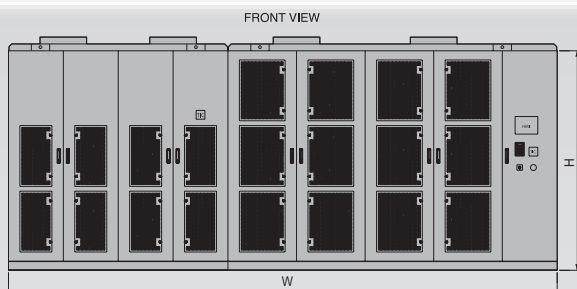
Dimensions

Unit : mm

Voltage Class (V)	Capacity (KVA)	Dimensions		
		W	D	H
3,000 / 3,300	200	1,600	1,800	2,350
	300	1,600	1,800	2,350
	400	1,600	1,800	2,350
	500	1,600	1,800	2,350
	600	3,600	1,800	2,350
	750	3,600	1,800	2,350
	1000	3,600	1,800	2,350
	1200	3,600	1,800	2,350
	1500	3,600	1,800	2,350
	2000	4,000	1,800	2,350
	2500	4,000	1,800	2,350
	3000	5,000	1,800	2,350
	3700	5,000	1,800	2,350
4,160	250	2,000	1,800	2,350
	380	2,000	1,800	2,350
	500	2,000	1,800	2,350
	630	2,000	1,800	2,350
	750	4,200	1,800	2,350
	950	4,200	1,800	2,350
	1200	4,200	1,800	2,350
	1500	4,200	1,800	2,350
	1900	4,200	1,800	2,350
	2500	5,000	1,800	2,350
	3100	5,000	1,800	2,350
	3700	6,000	1,800	2,350
	4700	6,000	1,800	2,350

Unit : mm

Voltage Class (V)	Capacity (KVA)	Dimensions		
		W	D	H
6,000 / 6,600	400	2,400	1,800	2,350
	600	2,400	1,800	2,350
	800	2,400	1,800	2,350
	1000	2,400	1,800	2,350
	1200	4,800	1,800	2,350
	1500	4,800	1,800	2,350
	2000	4,800	1,800	2,350
	2500	4,800	1,800	2,350
	3000	4,800	1,800	2,350
	4000	6,000	1,800	2,350
	5000	6,000	1,800	2,350
	6000	8,000	1,800	2,350
	7500	8,000	1,800	2,350
10,000	600	2,400	1,800	2,350
	900	2,400	1,800	2,350
	1200	2,400	1,800	2,350
	1500	2,400	1,800	2,350
	1800	6,000	1,800	2,350
	2200	6,000	1,800	2,350
	3000	6,000	1,800	2,350
	3700	6,000	1,800	2,350
	4500	6,000	1,800	2,350
	6000	7,500	1,800	2,350
	7500	7,500	1,800	2,350
	9000	10,000	1,800	2,350
	11000	10,000	1,800	2,350

LSIS

Specifications in this catalog are subject to change without notice due to continuous product development and improvement.