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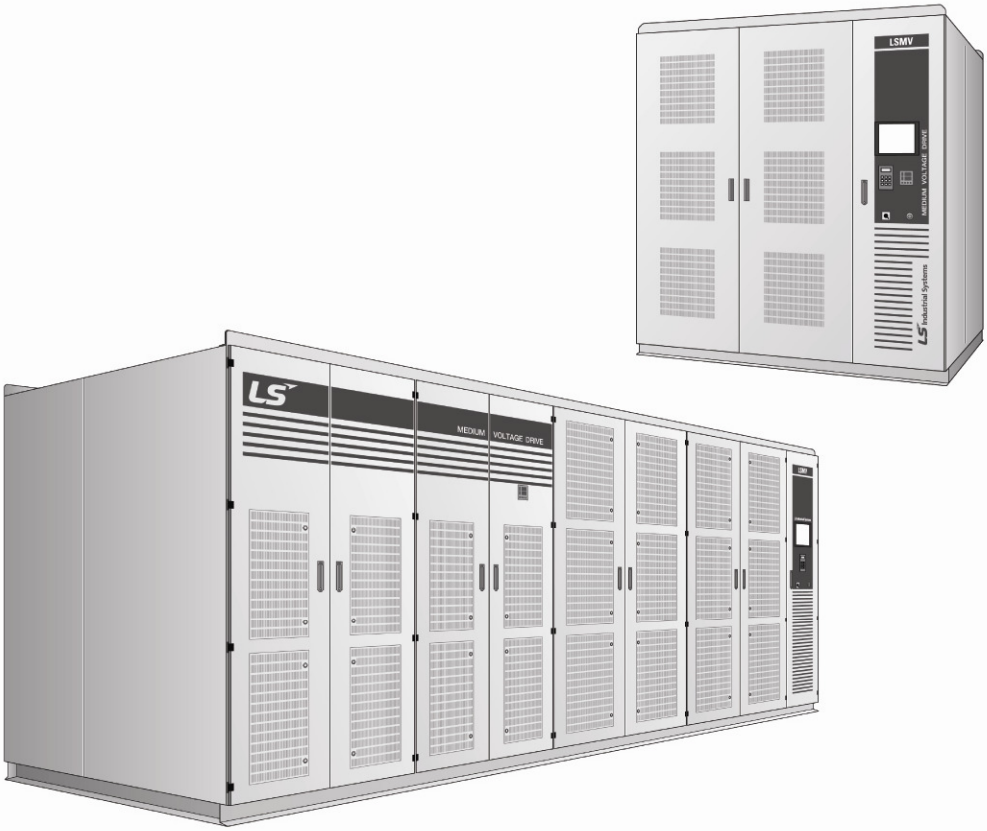
MV Drive User Manual

LSMV Series



⚠ Safety Instructions

- Read this manual carefully before installing wiring, operating, servicing or inspection this equipment.
- Keep this manual within easy reach for quick refernce.

LS Industrial Systems

Preface

This user's manual helps you safely and correctly use the LSMV series products (medium voltage drives) of LS Industrial Systems. Read this manual before you install, operate, maintain or check any LSMV series products. You are required to know the procedures and safety rules necessary to install, operate, maintain and check LSMV series products before you use them.

You need this manual when you perform maintenance, daily checkup and repair of LSMV series products. Keep the manual in a designated place so that you and other users can immediately find required information.

General Guidelines

To show the interior of LSMV series products in detail, figures in this manual do not usually show covers or protective films. Therefore, put covers or protective films back on the product according to instructions in this manual before operation.

Figures, photos and examples in this manual are only to help you understand the product. Therefore, the figures, photos and examples may not apply to all products.

This manual contains information about the product and general standards. The content and descriptions in this manual are subjects to change without notice when improvements to LSMV series products are made.

In the event the manual is lost or damaged, contact LS Industrial Systems or a local LSIS distributor for a replacement. When you order a new manual, provide the exact manual title by checking the plate that is attached to the front of the product.

If the plate is damaged, contact LS Industrial Systems or a local LSIS distributor and order a new plate.

Safety Precautions

Safety precautions prevent accidents and eliminate danger that may occur during installation, operation, maintenance or checking of the product. Follow all these precautions for safe and proper use of the product.

Safety precautions are divided into two categories: "Warning" and "Caution". The meanings of "Warning" and "Caution" are as follows:

Precaution		Meaning
	Warning	**May cause serious injury or death if the instruction is not followed.**
	Caution	**May cause minor injury or damage to the product if the instruction is not followed.**

Note

- Depending on the circumstances, a precaution categorized as "Caution" may also cause a serious outcome.

The meanings of icons shown on the product and in the manual are as follows:

Icon	Meaning
	Be cautious that there is a potential risk factor.
	Be cautious that there is a risk of electric shock.

Read the manual thoroughly in order to use LSMV drives safely and to use all functions that LSMV drives have to offer. After you have read the manual, keep it in a place where you can access it easily whenever you need it.

Warning

- Do not open the door when the power is on or while driving.
  It may cause electric shock.
- Do not drive with the door open.
  Medium voltage terminal or charging area may be exposed to the outside and it may cause electric shock.
- Do not open the door other than to perform wiring or regular inspection, even if the power is off.
  After the power supply is turned off the inverter may remain charged for a long time. It may cause electric shock.
- When you do wiring or perform regular inspection, wait more than 10 minutes after the power is turned off and make sure the DC voltage in the cell is completely discharged. Use a device such as a tester.
  It may cause electric shock. (Lower than DC 30 V)
- Do not operate switches with wet hands.
  It may cause electric shock.
- Change the cable immediately if its coating is damaged.
  It may cause electric shock.
- Do not put things that excessively stress the cable.
  It may cause damage to the cable coating and electric shock.

⚠Caution

- Do not install the product near any flammable materials.
  It may cause fire if it is installed on a surface that is made of flammable material or if it is in contact with flammable material.
- In the event of inverter failure, immediately turn off input power.
  If you do not turn off input power of the inverter, it may cause fire in a following accident.
- Do not touch the inverter while power is on or until 10 minutes after power is off.
  Contact with the high-temperature inverter may cause burns.
- Do not supply power to an inverter with damaged exterior or parts.
  It may cause electric shock.
- Do not allow foreign bodies such as screws, metals, water or oil to enter the inverter.
  It may cause a fire.

Directions for Use

■ Transport and Installation

- Transport the product with both the proper tools and method required for its weight.
- Install the product according to the guidelines described in this manual.
- Do not open the door of the product during transportation.
- Do not put heavy items on the product.
- Follow the standards described in this manual for installation directions.
- The inverter is a fragile instrument. Do not drop it or expose it to heavy impact.
- The inverter requires Class 1 grounding.
- If you detach the PCB for installation or repair, put it on a conductor immediately after you detach it. The PCB can be damaged by static electricity.
- Do not expose the inverter to snow, rain, fog or dust.
- Do not cover or block air vents where the cooling fan is located. The inverter may overheat.
- When you install the inverter, make sure the power supply is turned off.
- In order to prevent risk of fire or electric shock, use only a cable in good condition. Do not use a cable that is below standard. Do not extend the length of the cable.

Use the product in the environmental conditions specified on the following table.

Item		Description
Environment	Ambient temperature	0-40℃ (There should be no ice or frost)
	Ambient humidity	Below 85% RH (should not form dew)
	Storage temperature	0 ~ 65℃
	Ambient environment	There should not be corrosive gas, inflammable gas, oil residue, dirt, etc.
	Altitude/vibration	Below 1000 m above sea level / less than 5.9 m/sec² (= 0.6 g)
	Ambient pressure	70 - 106 kPa

■ Wiring

- Do not install phase advanced capacitor, surge filter, or radio noise filter on the output of the inverter.
- Connect output side (terminals U, V and W) in the correct order.
- Be careful. An incorrect terminal connection may damage the inverter.
- Be careful. Connecting input side (terminals R, S, T) into output side (terminals U, V, W), and vice versa may damage the inverter.

⚠Caution
A professional technician is required for wiring work and wiring checkup.

- Install the main body of the inverter first and then perform wiring work.

Test Operation

- Check all parameters before test operation. Parameter change may be necessary depending on the load condition.
- Do not supply power that exceeds the specified voltage range of each terminal. It may damage the invertor.

Normal Operation

- If you selected the auto-restart function, operation automatically restarts after a stop caused by failure.
- The inverter restarts when you reset the failure while the operating signal is entered. Use the RESET switch when the operating signal is confirmed.
- Do not alter inner parts of the product.
- The electronic thermal function may not protect the motor.
- Do not start or stop the inverter with the magnetic contactor that is installed on the input power supply.
- If you initialize parameters, the parameter values are restored to factory defaults. Initialize parameters and then return them to your operation preferences.

  You can set high-speed operation of the inverter with parameters. Check the performance of the motor or machine thoroughly before you change parameter settings for the inverter.

Abnormal Situations

- When the inverter is damaged and becomes uncontrollable, the machine may cause a dangerous situation. Install an additional safety device such as an emergency brake to prevent dangerous situations.

Repair, Inspection and Parts Replacement

- Do not conduct a Megger test (measuring insulation resistance) against the control circuit of the inverter.
- For more details about regular inspection and part replacement intervals, see chapter 8.
- If you discard an inverter, treat it as industrial waste.
- An inverter contains raw materials. Recycle it to preserve energy and resources. Packing and metal materials are recyclable. Plastic materials are recyclable. However, they can be incinerated in a manageable environment according to regional regulations. Recyclable parts usually have the recycle mark.

General

- Figures in this manual are shown with covers or circuit breakers omitted for more detailed explanation of the interior. Install covers and circuit breakers according to the installation guidelines before operation. Operate the product according to the instructions in this manual.

Cleaning

- Be sure to turn off the inverter power supply and remove all plugs that are connected to the inverter socket before cleaning. Do not use a wet cloth or water to clean the inverter. Always clean with a dry cloth.

■ Long-term Storage

If you do not use the inverter for a long time, keep it under the following conditions:

- Comply with the recommended storage environment.
- For more than a three month period of storage, keep the invertor at an ambient temperature of -10-+30˚C to prevent temperature negatively affecting the electrolytic capacitor.
- Tightly seal and pack the inverter so that moisture, etc., cannot enter the inverter. Keep relative humidity lower than 70% with a desiccant (silica gel) in the package.

⚠Caution

If electricity is not supplied to the inverter for a long period, the characteristics of the electrolytic capacitor deteriorate. Turn the electricity on at least once a year and supply electric current for 30-60 minutes. Do not wire the output side (secondary) or operate the machine at this time.

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1. Handling Medium Voltage Drive

1.1 LSMV Series Overview

■ LSMV Models

LSMV series drives are categorized as four voltage classes (3 kV / 4 kV / 6 kV / 10 kV) and two power frequencies (50 Hz / 60 Hz). Contact LSIS for products that are not listed on the following table:

Table 1-1 LSMV Models

Voltage [V]	Power Frequency [Hz]	Output Capacity[1)] [kVA]	Rated Current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW]
3000	50	200	35	LSMV-030F200-G1	160
		300	53	LSMV-030F300-G1	250
		400	70	LSMV-030F400-G1	330
		500	88	LSMV-030F500-G1	410
		600	105	LSMV-030F600-G1	500
		750	131	LSMV-030F750-G1	620
		1000	175	LSMV-030F10H-G1	850
		1200	218	LSMV-030F12H-G1	1000
		1500	260	LSMV-030F15H-G1	1250
		2000	350	LSMV-030F20H-G1	1700
		2500	438	LSMV-030F25H-G1	2080
3300	60	200	35	LSMV-033S200-G1	160
		300	53	LSMV-033S300-G1	250
		400	70	LSMV-033S400-G1	330
		500	88	LSMV-033S500-G1	410
		600	105	LSMV-033S600-G1	500
		750	131	LSMV-033S750-G1	620
		1000	175	LSMV-033S10H-G1	850
		1200	218	LSMV-033S12H-G1	1000
		1500	260	LSMV-033S15H-G1	1250
		2000	350	LSMV-033S20H-G1	1700
		2500	438	LSMV-033S25H-G1	2080
4160	50	250	35	LSMV-041F250-G1	200
		380	53	LSMV-041F380-G1	310
		500	70	LSMV-041F500-G1	410
		630	88	LSMV-041F630-G1	530
		750	105	LSMV-041F750-G1	620
		950	131	LSMV-041F950-G1	790
		1200	175	LSMV-041F12H-G1	1000
		1500	218	LSMV-041F15H-G1	1250

Voltage [V]	Power Frequency [Hz]	Output Capacity[1)] [kVA]	Rated Current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW]
		1900	260	LSMV-041F19H-G1	1580
		2500	350	LSMV-041F25H-G1	2080
		3100	438	LSMV-041F31H-G1	2650
4160	60	250	35	LSMV-041S250-G1	200
		380	53	LSMV-041S380-G1	310
		500	70	LSMV-041S500-G1	410
		630	88	LSMV-041S630-G1	530
		750	105	LSMV-041S750-G1	620
		950	131	LSMV-041S950-G1	790
		1200	175	LSMV-041S12H-G1	1000
		1500	218	LSMV-041S15H-G1	1250
		1900	260	LSMV-041S19H-G1	1580
		2500	350	LSMV-041S25H-G1	2080
		3100	438	LSMV-041S31H-G1	2650
6000	50	400	35	LSMV-060F400-G1	330
		600	53	LSMV-060F600-G1	500
		800	70	LSMV-060F800-G1	660
		1000	88	LSMV-060F10H-G1	850
		1200	105	LSMV-060F12H-G1	1000
		1500	131	LSMV-060F15H-G1	1250
		2000	175	LSMV-060F20H-G1	1700
		2500	218	LSMV-060F25H-G1	2080
		3000	260	LSMV-060F30H-G1	2500
		4000	350	LSMV-060F40H-G1	3400
		5000	438	LSMV-060F50H-G1	4100
6600	60	400	35	LSMV-066S400-G1	330
		600	53	LSMV-066S600-G1	500
		800	70	LSMV-066S800-G1	660
		1000	88	LSMV-066S10H-G1	850
		1200	105	LSMV-066S12H-G1	1000
		1500	131	LSMV-066S15H-G1	1250
		2000	175	LSMV-066S20H-G1	1700
		2500	218	LSMV-066S25H-G1	2080
		3000	260	LSMV-066S30H-G1	2500
		4000	350	LSMV-066S40H-G1	3400
		5000	438	LSMV-066S50H-G1	4100
10000	50	600	35	LSMV-100F600-G1	500
		900	53	LSMV-100F900-G1	750
		1200	70	LSMV-100F12H-G1	1000
		1500	88	LSMV-100F15H-G1	1250

Voltage [V]	Power Frequency [Hz]	Output Capacity[1] [kVA]	Rated Current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW]
		1800	105	LSMV-100F18H-G1	1500
		2200	131	LSMV-100F22H-G1	1800
		3000	175	LSMV-100F30H-G1	2500
		3700	218	LSMV-100F37H-G1	3150
		4500	260	LSMV-100F45H-G1	3800
		6000	350	LSMV-100F60H-G1	5000
		7500	438	LSMV-100F75H-G1	6200
10000	60	600	35	LSMV-100F600-G1	500
		900	53	LSMV-100F900-G1	750
		1200	70	LSMV-100F12H-G1	1000
		1500	88	LSMV-100F15H-G1	1250
		1800	105	LSMV-100F18H-G1	1500
		2200	131	LSMV-100F22H-G1	1800
		3000	175	LSMV-100F30H-G1	2500
		3700	218	LSMV-100F37H-G1	3150
		4500	260	LSMV-100F45H-G1	3800
		6000	350	LSMV-100F60H-G1	5000
		7500	438	LSMV-100F75H-G1	6200

1) The capacity of the LSMV drive is calculated according to a standard type 4-pole induction motor.

1.2 Product Checklist

■ Product Condition

When the product arrives, check the items on the following table.

Table 1-2 Items to Check

Item	Action
Does the model name match the product you ordered?	Check the model name on the plate that is attached to the front of the control panel door.
Is there any trace of product damage from external shock?	**1.** Inspect the exterior for scratch marks or other damage to the product from transportation. **2.** Open the panel door and inspect the interior for damaged, deformed or missing parts.
Are the bolts and assembled parts in good condition?	**1.** Check the marking of bolts. **2.** Confirm bolts are tight with a professional tool such as screwdriver or hex nut driver.

■ Plate Information

A plate is attached to the front of the control panel door. The plate shows product information including model name, serial number, standards and date of manufacturing.

■ Standard Plate Format

A standard plate is shown as follows.

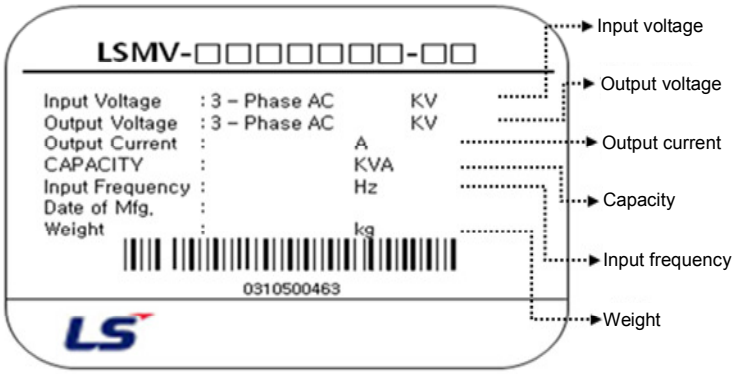
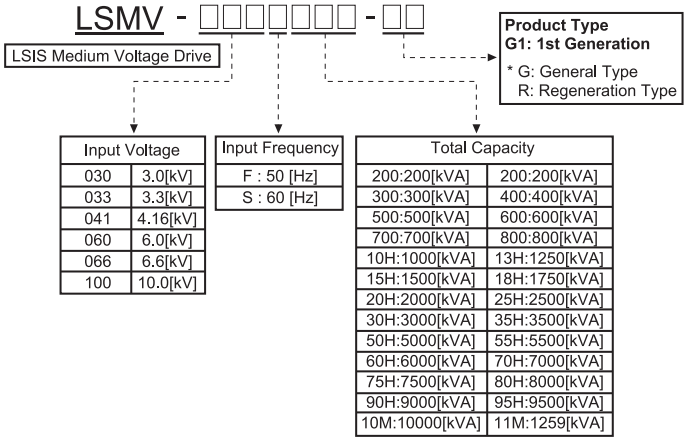


Figure 1-1 Standard Plate Format

■ LSMV Series Product Model Names

The model name contains voltage and maximum capacity information of a LSMV series product.



Input Voltage	
030	3.0[kV]
033	3.3[kV]
041	4.16[kV]
060	6.0[kV]
066	6.6[kV]
100	10.0[kV]

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

Total Capacity	
200:200[kVA]	200:200[kVA]
300:300[kVA]	400:400[kVA]
500:500[kVA]	600:600[kVA]
700:700[kVA]	800:800[kVA]
10H:1000[kVA]	13H:1250[kVA]
15H:1500[kVA]	18H:1750[kVA]
20H:2000[kVA]	25H:2500[kVA]
30H:3000[kVA]	35H:3500[kVA]
50H:5000[kVA]	55H:5500[kVA]
60H:6000[kVA]	70H:7000[kVA]
75H:7500[kVA]	80H:8000[kVA]
90H:9000[kVA]	95H:9500[kVA]
10M:10000[kVA]	11M:1259[kVA]

Figure 1-2 LSMV Series Product Model Name

Class	MV Drive Capacity [kVA]												
3kV Class	200	300	400	500	600	750	1000	1200	1500	2000	2500	3000	3700
4kV Class	250	380	500	630	750	950	1200	1500	1900	2500	3100	3700	4700
6kV Class	400	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	7500
10kV Class	600	900	1200	1500	1800	2200	3000	3700	4500	6000	7500	9000	1100

1.3 Product Overview

1.3.1 LSMV Series Features

An LSMV series product is a multilevel-voltage-type motor inverter. The main specifications of the product are as follows:

■ Input Terminal Multipulse

- Significantly lowered total harmonic distortion (THD) of input current and satisfied IEEE-519_1992 standards are achieved by applying an extended delta-type transformer and separated-type multipulse rectifier.
- MV uses input current which is close to a sine wave. Therefore, a harmonic wave filter or active filter is not necessary.

■ Cascaded Multilevel

- You do not need to change the existing motor and cable as they can be used as they are.
- Minimize the mechanical stress on the motor that is generated from the use of an inverter. You do not need to use a sine wave filter separately.

■ Maximize Efficiency and Power Factor

- Efficiency: More than 97% (with rated speed and loaded)
- Power factor: More than 0.95% (with rated speed and loaded)

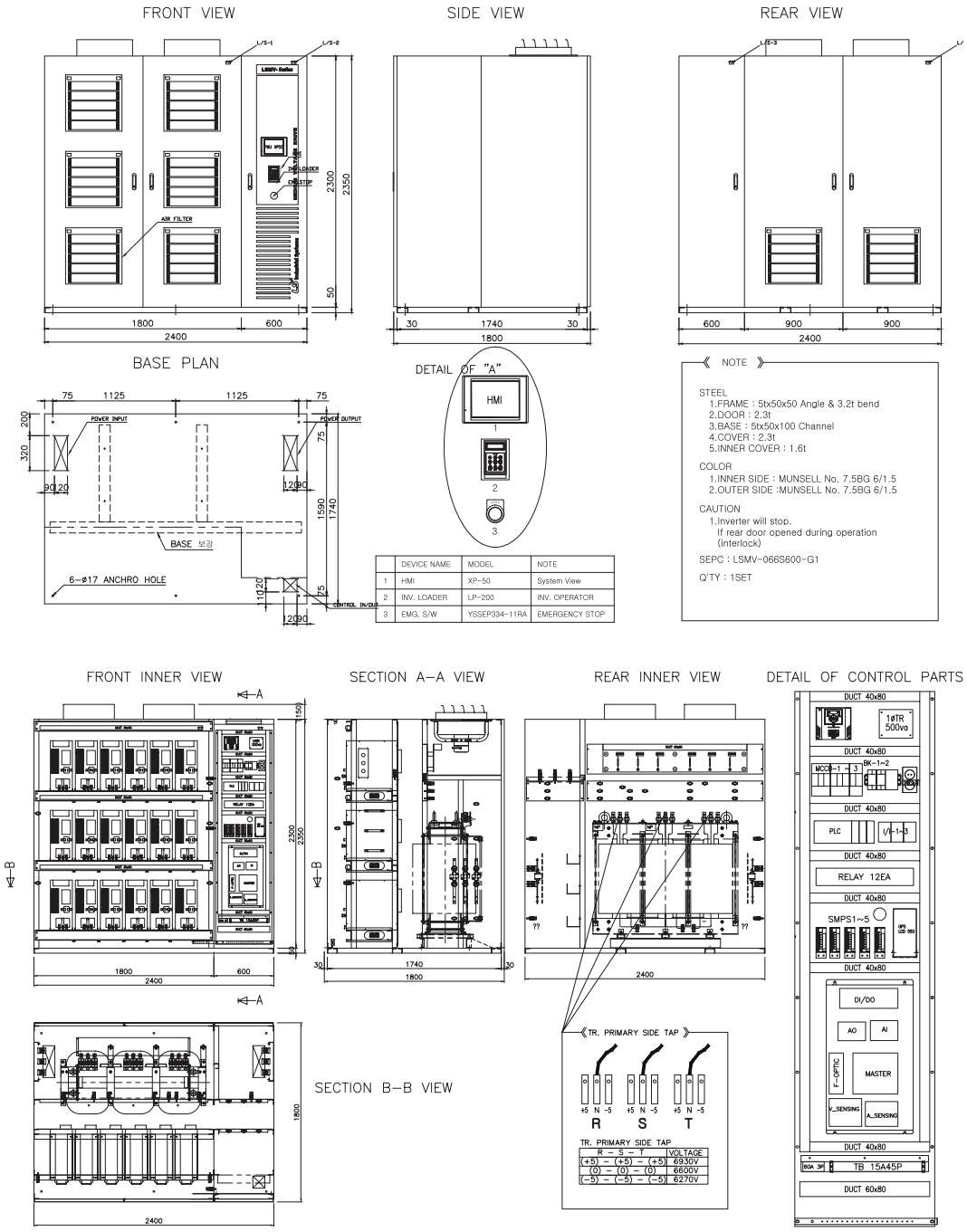
■ Minimize Cost of Installation

- You do not need to install all filters that were required for the use of the existing inverter. Therefore, installation cost is reduced.
- It directly controls high voltage power supply. Therefore, you do not need to add a separate transformer and the cost of wiring is reduced.

1.3.2 Product Lineup

■ Type A

6 kV Class 600 kVA: LSMV - 066S600 - G1



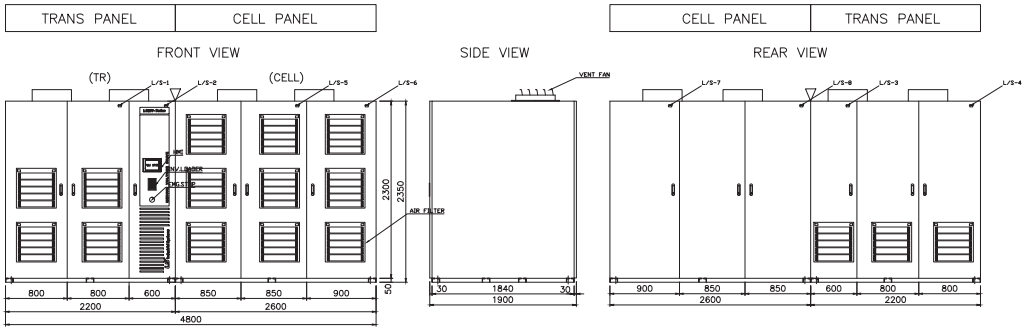
	DEVICE NAME	MODEL	NOTE
1	HMI	XP-50	System View
2	INV. LOADER	LP-200	INV. OPERATOR
3	EMG. S/W	YSSEP334-11RA	EMERGENCY STOP

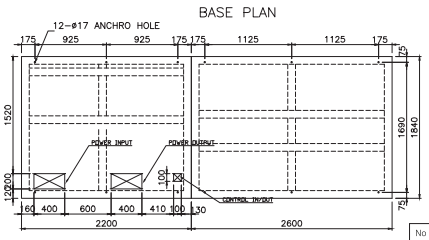
R - S - T	VOLTAGE
(+5) - (+5) - (+5)	6930V
(0) - (0) - (0)	6600V
(-5) - (-5) - (-5)	6270V

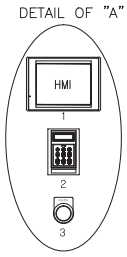
Figure 1-3 LSMV-066F600-G1 Exterior and Interior Block Diagram

■ Type B

6 kV Class 3000 kVA: LSMV-066S30H-G1







No	DEVICE NAME	MODEL	NOTE
1	HMI	XP-50	System View
2	INV. LOADER	LP-200	INV. OPERATOR
3	EMG. S/W	YSSEP334-11RA	EMERGENCY STOP

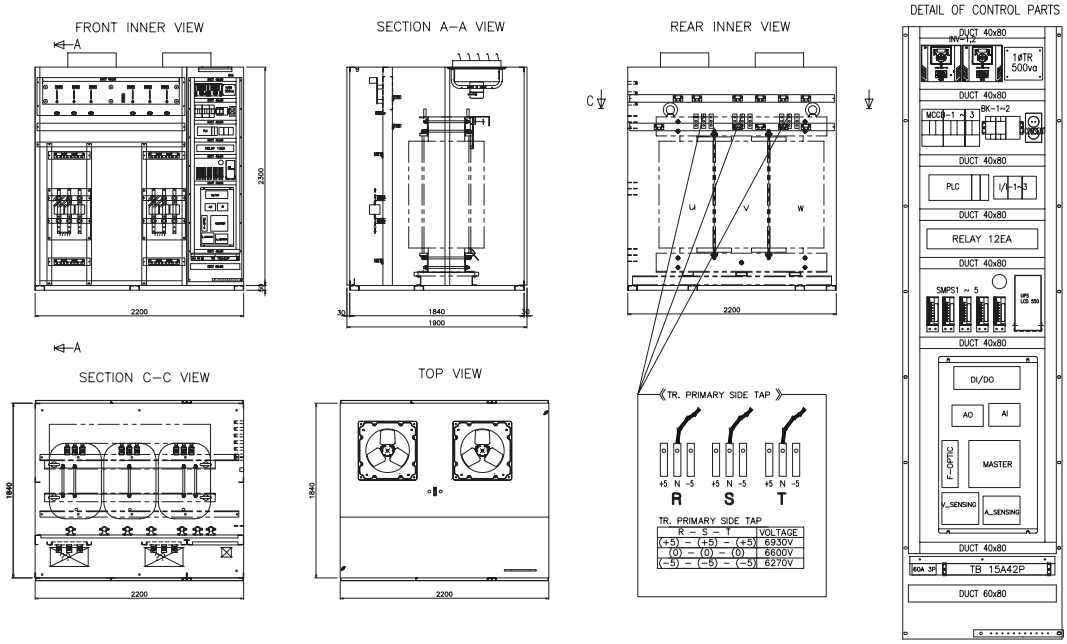
《 NOTE 》

STEEL
1.FRAME : 5tx50x50 Angle & 3.2t bend
2.DOOR : 2.3t
3.BASE : 5tx50x100 Channel
4.COVER : 2.3t
5.INNER COVER : 1.6t

COLOR
1.INNER SIDE : 5Y 7/1 (TEXTURE)
2.OUTER SIDE : 5Y 7/1 (TEXTURE)

CAUTION
1.Inverter will stop.
If rear door opened during operation
(interlock)

Q'TY : 1SET



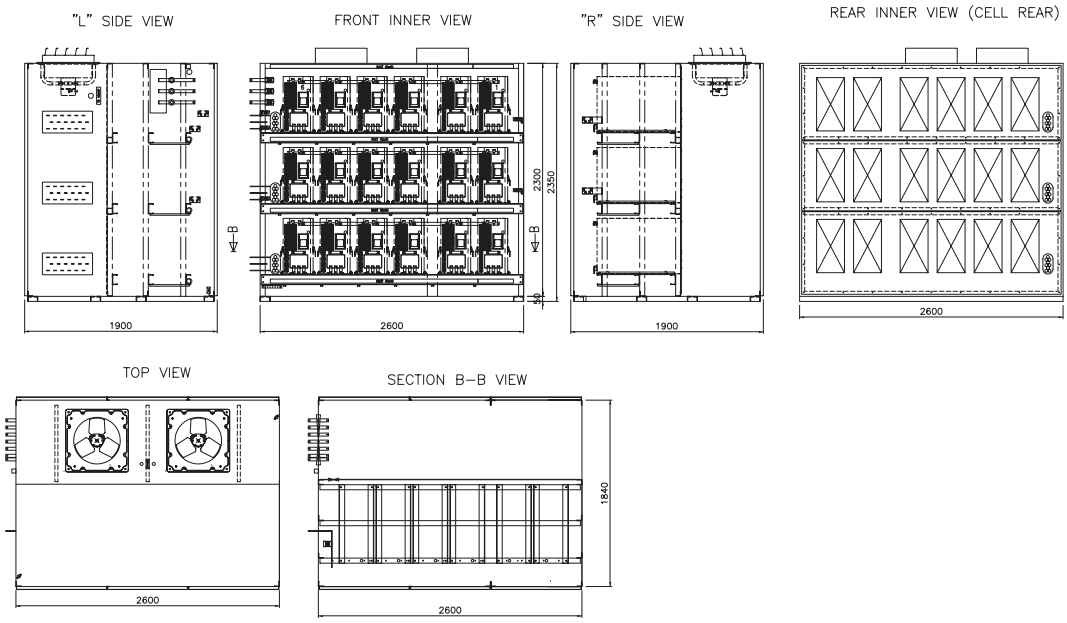


Figure 1-4 LSMV-066F30H Exterior and Interior Block Diagram

1.3.3 Dimension and Weight

Refer to the following table for the dimension and weight of a product.

Table 1-3 Dimensions and Weights of LSMV Series Products

Voltage Class [V]	Power Frequency [Hz]	Output Capacity [kVA]	Rated Current	Product Model No.	Panel Dimension[1)]			Approximate Weight [kg]
					Width W	Depth D	Height H	
3000	50	200	35	LSMV-030F200-G1	1600	1800	2350	2236
		300	53	LSMV-030F300-G1	1600	1800	2350	2524
		400	70	LSMV-030F400-G1	1600	1800	2350	2788
		500	88	LSMV-030F500-G1	1600	1800	2350	2992
		600	105	LSMV-030F600-G1	3600	1800	2350	4190
		750	131	LSMV-030F750-G1	3600	1800	2350	4526
		1000	175	LSMV-030F10H-G1	3600	1800	2350	4970
		1200	218	LSMV-030F12H-G1	3600	1800	2350	5528
		1500	260	LSMV-030F15H-G1	3600	1800	2350	5972
		2000	350	LSMV-030F20H-G1	4000	1800	2350	7866
		2500	438	LSMV-030F25H-G1	4000	1800	2350	8990
		3000	525	LSMV-030F30H-G1	5000	1800	2350	11544
		3700	657	LSMV-030F37H-G1	5000	1800	2350	13118

Voltage Class [V]	Power Frequency [Hz]	Output Capacity [kVA]	Rated Current	Product Model No.	Panel Dimension[1)]			Approximate Weight [kg]
					Width W	Depth D	Height H	
3300	60	200	35	LSMV-033S200-G1	1600	1800	2350	2072
		300	53	LSMV-033S300-G1	1600	1800	2350	2312
		400	70	LSMV-033S400-G1	1600	1800	2350	2538
		500	88	LSMV-033S500-G1	1600	1800	2350	2708
		600	105	LSMV-033S600-G1	3600	1800	2350	3880
		750	131	LSMV-033S750-G1	3600	1800	2350	4160
		1000	175	LSMV-033S10H-G1	3600	1800	2350	4530
		1200	218	LSMV-033S12H-G1	3600	1800	2350	5040
		1500	260	LSMV-033S15H-G1	3600	1800	2350	5410
		2000	350	LSMV-033S20H-G1	4000	1800	2350	7117
		2500	438	LSMV-033S25H-G1	4000	1800	2350	8053
		3000	525	LSMV-033S30H-G1	5000	1800	2350	10420
		3700	657	LSMV-033S37H-G1	5000	1800	2350	11731
4160	50	250	35	LSMV-041F250-G1	2000	1800	2350	2598
		380	53	LSMV-041F380-G1	2000	1800	2350	2946
		500	70	LSMV-041F500-G1	2000	1800	2350	3234
		630	88	LSMV-041F630-G1	2000	1800	2350	3510
		750	105	LSMV-041F750-G1	4200	1800	2350	4868
		950	131	LSMV-041F950-G1	4200	1800	2350	5276
		1200	175	LSMV-041F12H-G1	4200	1800	2350	5804
		1500	218	LSMV-041F15H-G1	4200	1800	2350	6620
		1900	260	LSMV-041F19H-G1	4200	1800	2350	7316
		2500	350	LSMV-041F25H-G1	5000	1800	2350	9755
		3100	438	LSMV-041F31H-G1	5000	1800	2350	11073
		3700	525	LSMV-041F37H-G1	6000	1800	2350	14192
		4700	657	LSMV-041F47H-G1	6000	1800	2350	16390
4160	60	250	35	LSMV-041S250-G1	2000	1800	2350	2416
		380	53	LSMV-041S380-G1	2000	1800	2350	2706
		500	70	LSMV-041S500-G1	2000	1800	2350	2954
		630	88	LSMV-041S630-G1	2000	1800	2350	3184
		750	105	LSMV-041S750-G1	4200	1800	2350	4520
		950	131	LSMV-041S950-G1	4200	1800	2350	4860
		1200	175	LSMV-041S12H-G1	4200	1800	2350	5300

Voltage Class [V]	Power Frequency [Hz]	Output Capacity [kVA]	Rated Current	Product Model No.	Panel Dimension[1)]			Approximate Weight [kg]
					Width W	Depth D	Height H	
		1500	218	LSMV-041S15H-G1	4200	1800	2350	6040
		1900	260	LSMV-041S19H-G1	4200	1800	2350	6620
		2500	350	LSMV-041S25H-G1	5000	1800	2350	8839
		3100	438	LSMV-041S31H-G1	5000	1800	2350	9938
		3700	525	LSMV-041S37H-G1	6000	1800	2350	12837
		4700	657	LSMV-041S47H-G1	6000	1800	2350	14668
6000	50	400	35	LSMV-060F400-G1	2400	1800	2350	3424
		600	53	LSMV-060F600-G1	2400	1800	2350	3698
		800	70	LSMV-060F800-G1	2400	1800	2350	4298
		1000	88	LSMV-060F10H-G1	2400	1800	2350	4766
		1200	105	LSMV-060F12H-G1	4800	1800	2350	6530
		1500	131	LSMV-060F15H-G1	4800	1800	2350	7010
		2000	175	LSMV-060F20H-G1	4800	1800	2350	7694
		2500	218	LSMV-060F25H-G1	4800	1800	2350	9522
		3000	260	LSMV-060F30H-G1	4800	1800	2350	9638
		4000	350	LSMV-060F40H-G1	6000	1800	2350	13204
		5000	438	LSMV-060F50H-G1	6000	1800	2350	15080
		6000	525	LSMV-060F60H-G1	8000	1800	2350	19816
		7500	657	LSMV-060F75H-G1	8000	1800	2350	22630
6600	60	400	35	LSMV-066S400-G1	2400	1800	2350	3174
		600	53	LSMV-066S600-G1	2400	1800	2350	3394
		800	70	LSMV-066S800-G1	2400	1800	2350	3906
		1000	88	LSMV-066S10H-G1	2400	1800	2350	4296
		1200	105	LSMV-066S12H-G1	4800	1800	2350	6020
		1500	131	LSMV-066S15H-G1	4800	1800	2350	6420
		2000	175	LSMV-066S20H-G1	4800	1800	2350	6990
		2500	218	LSMV-066S25H-G1	4800	1800	2350	8690
		3000	260	LSMV-066S30H-G1	4800	1800	2350	8700
		4000	350	LSMV-066S40H-G1	6000	1800	2350	11953
		5000	438	LSMV-066S50H-G1	6000	1800	2350	13517
		6000	525	LSMV-066S60H-G1	8000	1800	2350	17940
		7500	657	LSMV-066S75H-G1	8000	1800	2350	20285
10000	50	600	35	LSMV-100F600-G1	3600	1800	2350	4126

Voltage Class [V]	Power Frequency [Hz]	Output Capacity [kVA]	Rated Current	Product Model No.	Panel Dimension[1)]			Approximate Weight [kg]
					Width W	Depth D	Height H	
		900	53	LSMV-100F900-G1	3600	1800	2350	4966
		1200	70	LSMV-100F12H-G1	3600	1800	2350	5794
		1500	88	LSMV-100F15H-G1	3600	1800	2350	6184
		1800	105	LSMV-100F18H-G1	6000	1800	2350	8330
		2200	131	LSMV-100F22H-G1	6000	1800	2350	8990
		3000	175	LSMV-100F30H-G1	6000	1800	2350	9900
		3700	218	LSMV-100F37H-G1	6000	1800	2350	11760
		4500	260	LSMV-100F45H-G1	6000	1800	2350	12290
		6000	350	LSMV-100F60H-G1	7500	1800	2350	16460
		7500	438	LSMV-100F75H-G1	7500	1800	2350	17940
		9000	525	LSMV-100F90H-G1	10000	1800	2350	24080
		11000	657	LSMV-100F11M-G1	10000	1800	2350	26773
10000	60	600	35	LSMV-100F600-G1	3600	1800	2350	3754
		900	53	LSMV-100F900-G1	3600	1800	2350	4500
		1200	70	LSMV-100F12H-G1	3600	1800	2350	5184
		1500	88	LSMV-100F15H-G1	3600	1800	2350	5496
		1800	105	LSMV-100F18H-G1	6000	1800	2350	7588
		2200	131	LSMV-100F22H-G1	6000	1800	2350	8116
		3000	175	LSMV-100F30H-G1	6000	1800	2350	8844
		3700	218	LSMV-100F37H-G1	6000	1800	2350	10512
		4500	260	LSMV-100F45H-G1	6000	1800	2350	10918
		6000	350	LSMV-100F60H-G1	7500	1800	2350	14736
		7500	438	LSMV-100F75H-G1	7500	1800	2350	15920
		9000	525	LSMV-100F90H-G1	10000	1800	2350	21656
		11000	657	LSMV-100F11M-G1	10000	1800	2350	23811

1) The actual size of a product may change. Confirm before purchase.

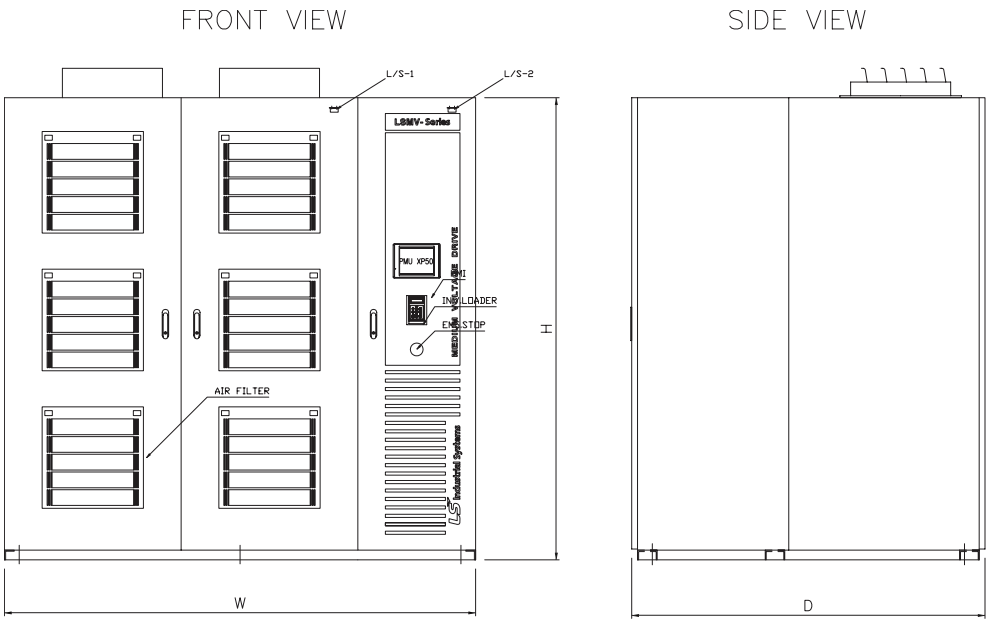


Figure 1-5 LSMV Type A

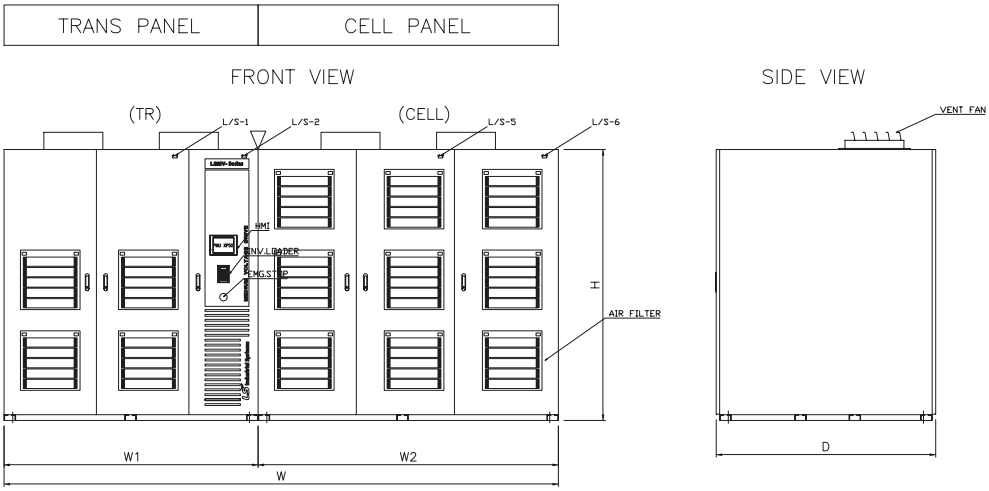


Figure 1-6 LSMV Type B

1.4 Checking the Installation Environment

1.4.1 Installation Environment

LSMV series products require installation in an environment that satisfies the following conditions:

- Ambient Temperature: 0 ~ 40℃
- Ambient Humidity: Below 85% (should not form dew)
- A place water is not dripping
- A place not directly exposed to dust
- A place corrosive liquid or gas does not exist
- A place that does not generate excessive vibration

When you install the product, refer to the provided plans and secure a space that is appropriate for the product size.

1.4.2 Installation Space

The following space is required for maintenance of the product and for cooling to remove heat generated during operation:

■ Above the Panel

- At least 1 m of space is required between the top of the panel and the ceiling.
- Warm air streams up toward the top of the panel by the cooling fan. If the ceiling is too low, it increases pressure loss and cannot maintain the necessary cooling stream.
- Additionally, enough work space is required in order to replace the cooling fan.

■ Front of the Panel

- At least 2 m of work space is required for servicing.
- Space is required in order to place a dedicated lifter when separating cells for cell maintenance.

■ Behind the Panel

- At least 2 m of work space is required behind the panel for maintenance.

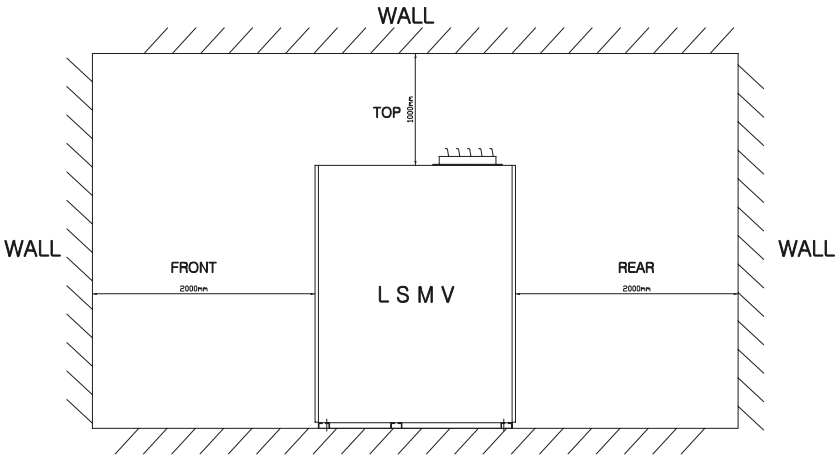


Figure 1-7 Securing Spaces

1.4.3 Ambient Temperature

Install the product in a place without serious environmental changes to ensure reliability. The temperature around the product and the temperature of the air that gets into the drive must always be below 40℃. When you install the product in a small place, use a separate cooling fan or air conditioner to keep room temperature below 40℃.

1.4.4 Blocking Foreign Bodies

Prevent foreign bodies such as dust or metal waste from entering the product during installation. Be especially careful that foreign bodies do not get into the transformer. After installation, do not leave unused parts or installation tools inside the panel.

1.5 Transport and Installation

■ Product Transportation

Comply with the following cautions. Otherwise, the product may drop during transportation and cause injury and/or damage to the product.

⚠Caution

- Designated tools are required in order to transport LSMV series products.
- Do not climb on top of the panel.
- Do not expose the cooling fan on the panel top to external force. It is sensitive to external shock.
- Transport of LSMV products requires a qualified professional crane engineer.

■ Product Installation

The panels are designed to be placed step-by-step in rows for products with capacity greater than that of Type B. (Cell panels and transformer panels are separated.)

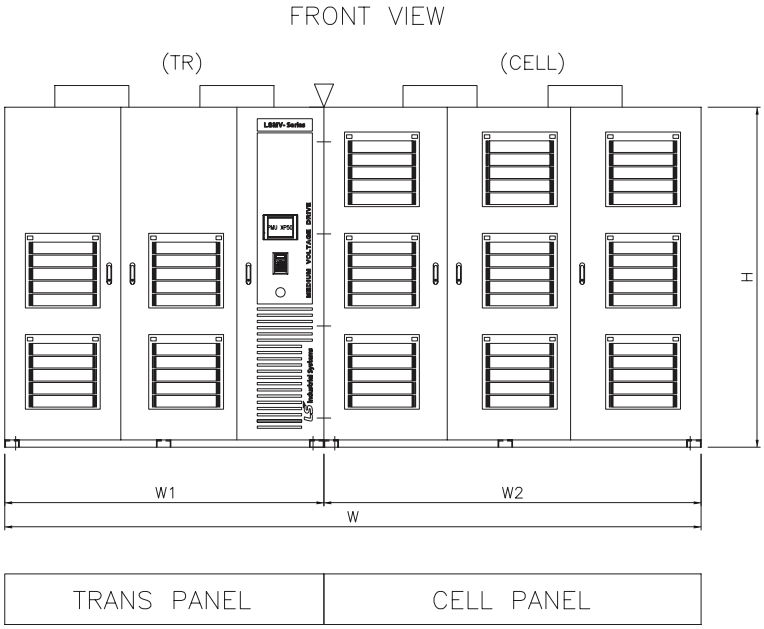


Figure 1-8 LSMV Configuration

■ Base for Product Installation

The following figure shows a base plan and the hole positions for drive installation. Install the product according to the LSMV base to prevent vibration in the product. For the exact size, refer to the plan of the product.

- Base Plan (Sample)

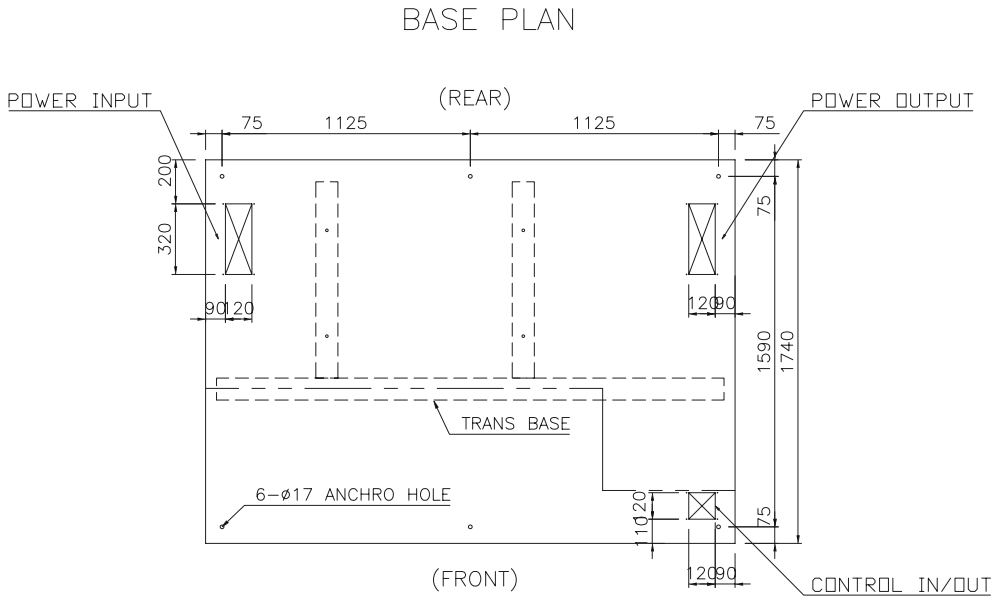


Figure 1-9 LSMV-066S600-G1

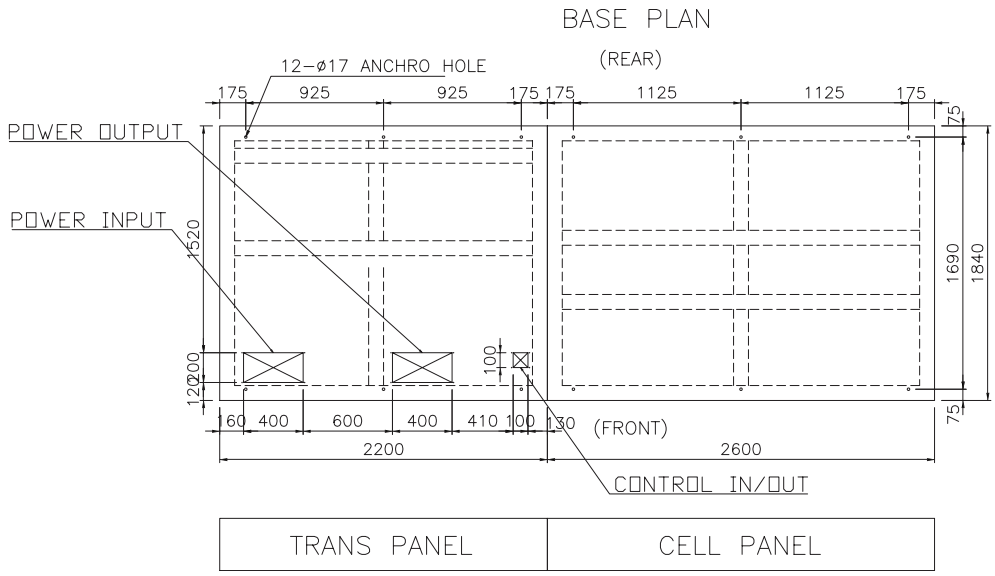


Figure 1-10 LSMV-066S30H-G1 Base Plan

2. Wiring

2.1 Standard Wiring

Figure 2.1 is the standard wiring diagram of LSMV series drive.

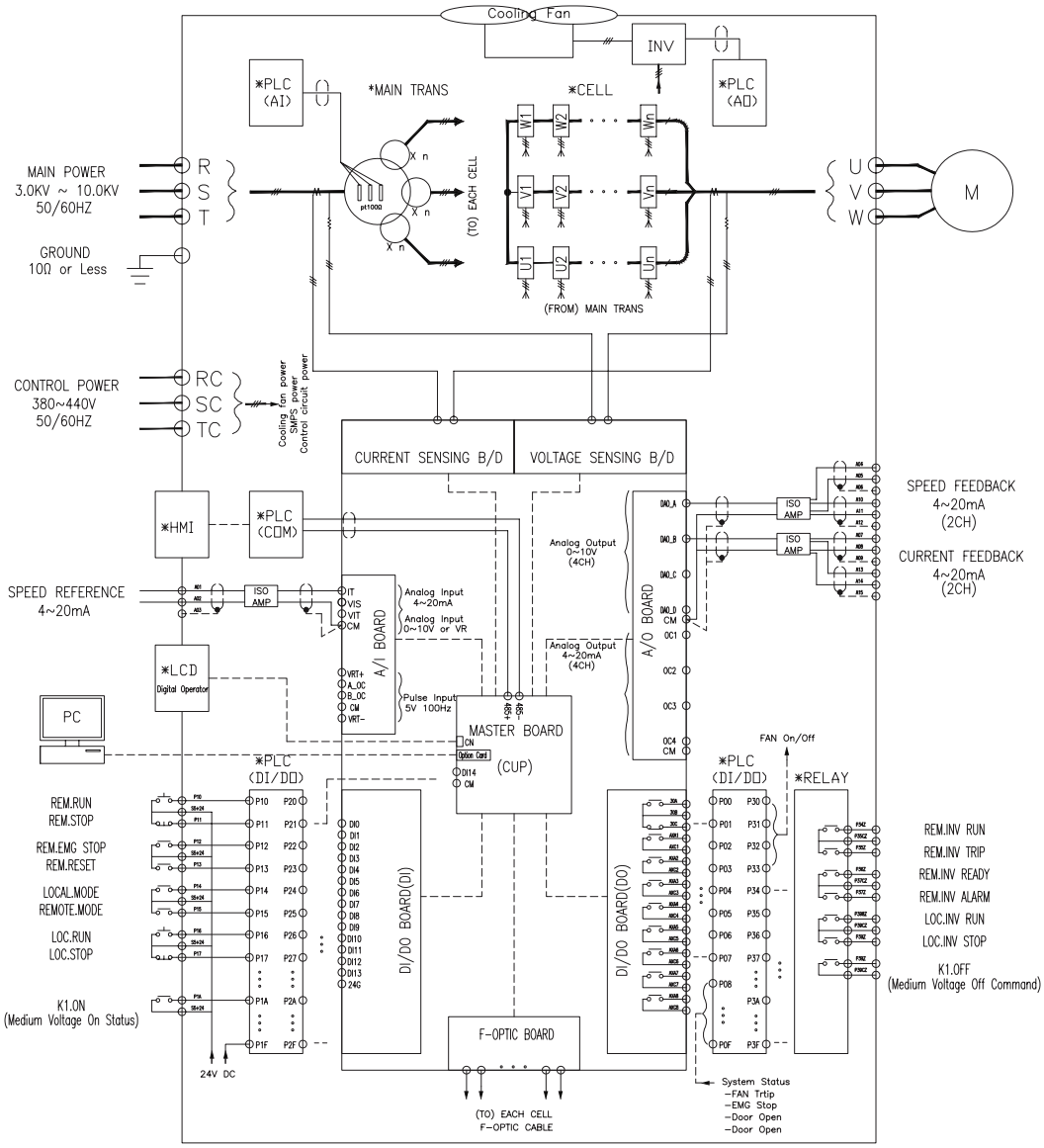


Figure 2-1 Standard Wiring Diagram

Note

- **Main Power Input (R, S, T), Output (U, V, W)**
  - **Before you connect any wires, make sure the power supply matches the rated voltage.**
  - **Do not confuse the input side with the output side.**
- **Control power: Input (RC, SC, TC)**
  - **For the required power capacity, refer to the plan of each product.**
- **Analog signal: Input (A01 - A03) / output (A04 - A15)**
  - **Use DC 4 - 20 mA signal.**
    Do not short the output of the signal wire.
- **DI (digital input) / DO (digital output): Input (P10 - S5+24) / output (P34Z - P29CZ)**
  - **DC 24 V power is supplied to DI signal. Make sure no circuit with power supplied is connected.**
  - **The maximum capacity of the DO signal contact is 250 V, 3 A. Do not exceed the capacity.**
- **Keep the ground resistance of the ground terminal 10 Ω or less.**

2.2 Terminal Configuration

Figures 2-2 and 2-3 indicate the location of LSMV series drive terminals (type A, type B).

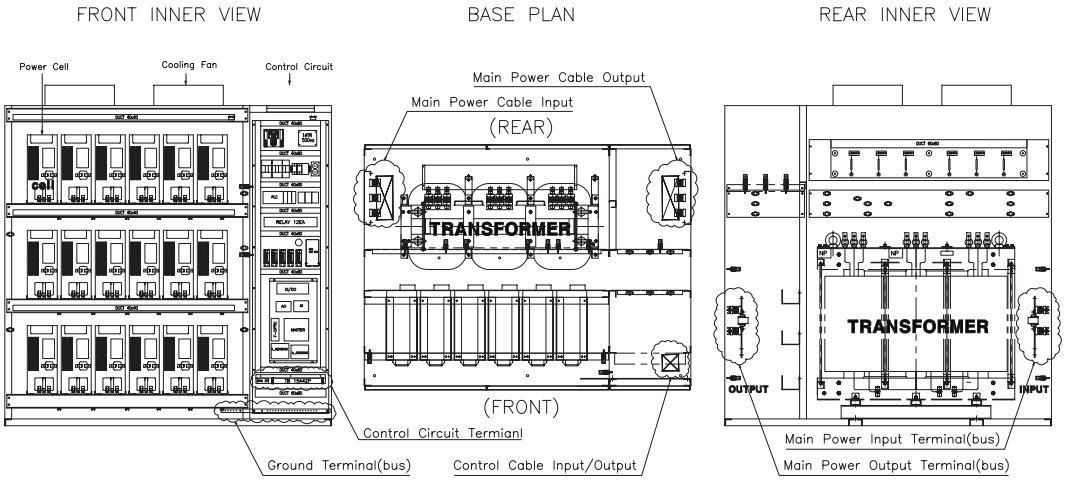
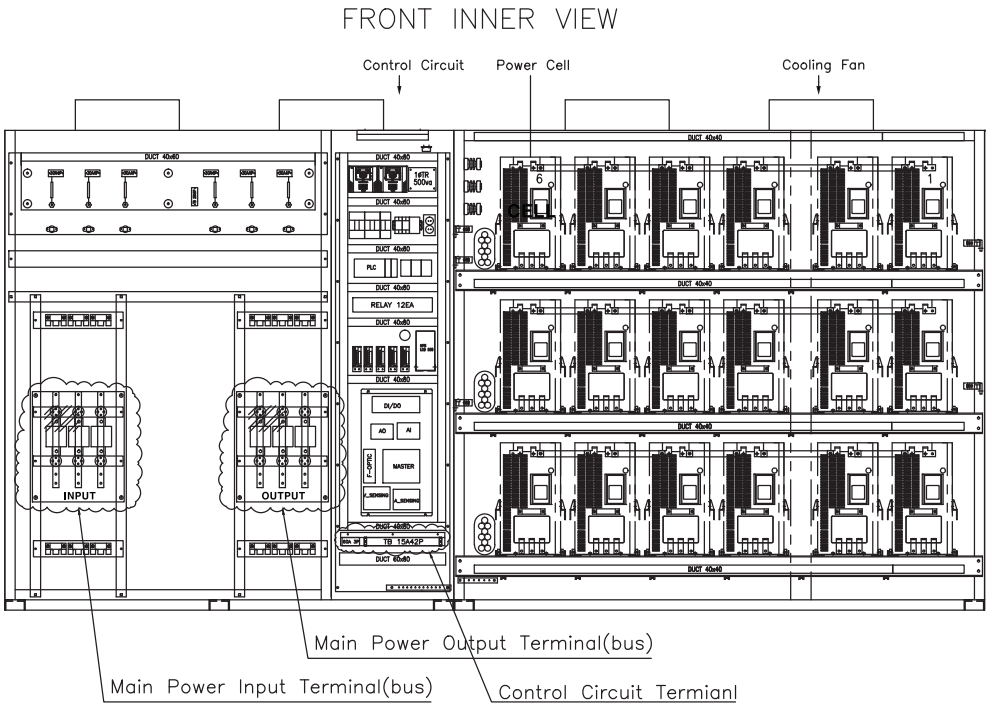


Figure 2-2 Terminal Locations (Type A)



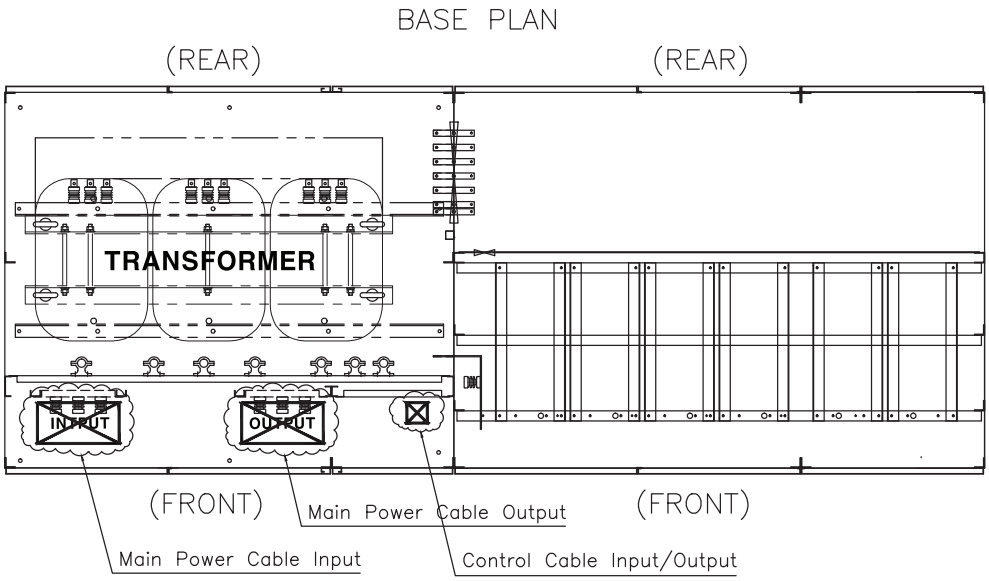


Figure 2-3 Terminal Locations (Type B)

Note

- You can distinguish type A from type B by location.
  - Type A: Cells are at the front, and the transformer is at the rear.
  - Type B: Cells are on the right, and the transformer is on the left.
- For the exact location and size, refer to the plan of each product.

2.3 Main Circuit Wiring

Identify the rated current of the product and use appropriate materials for each product.

Table 2-1 Control Circuit Configuration of LSMV Model

Tag	Description	Standard
R	Main input power R-phase	Main power 3-phase input 3-10 kV AC, 50 Hz / 60 Hz
S	Main input power S-phase	
T	Main input power T-phase	
U	Main output power U-phase	Main power 3-phase output Variable frequency and variable voltage
V	Main output power V-phase	
W	Main output power W-phase	
G	Ground	

3. Keypad Operation and Modes

Chapter 3 describes setup, keypad display and functions, and how to change modes.

3.1 Keypad

This section describes keypad display and functions.

■ Keypad Display

The keys on the keypad and their functions are as follows:

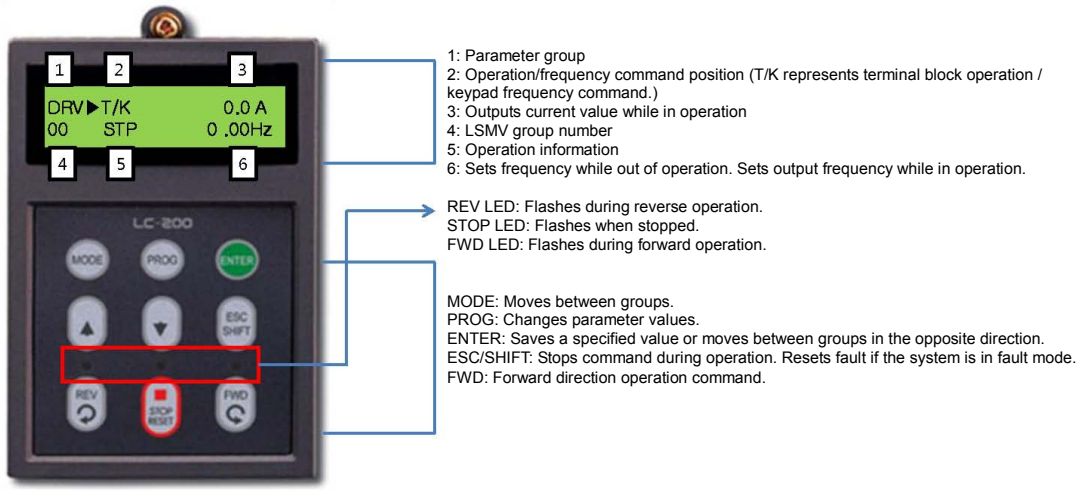
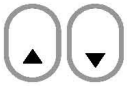
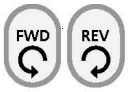


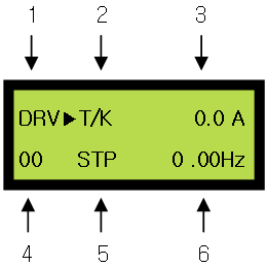
Figure 3-1 Composition of Keypad and Key Names

■ Composition of Keypad

Classification	Sign	Function Name	Functional Description
Key	MODE	Mode key	▪ Moves between groups. ▪ Moves from code within the group to top level code (00).
	PROG	Program key	▪ Changes parameter value.
	ENTER	Enter key	▪ Saves the changed value after you press the program key. ▪ Moves between groups in the opposite direction when the program key is not pressed.

Classification	Sign	Function Name	Functional Description
		Up key/down key	▪ Move between codes. ▪ Also increase (up key) or decrease (down key) the value of a parameter.
		SHIFT/ESC key	▪ Functions as a SHIFT key in settings mode. ▪ Functions as an ESC key and moves to DRV-00 if not in settings mode.
		Forward key/ reverse key	▪ Performs forward operation command. ▪ Performs reverse operation command.
		Stop/reset key	▪ Functions as a stop command key during operation. ▪ Functions as a fault reset key when a fault occurs.
LED		Reverse indicator	▪ Comes on during reverse operation. ▪ Flashes during acceleration/deceleration. ▪ Comes on during operation at constant speed.
		Stop/trip indicator	▪ Comes on when not in operation. ▪ Flashes when a fault occurs.
		Forward indicator	▪ Comes on during forward operation. ▪ Flashes during acceleration/deceleration. ▪ Comes on during operation at constant speed.

■ Keypad Display Explanation



Item	Display Explanation
1	▪ Represents parameter groups. There are DRV, FU1, FU2, I/O, and CEL groups.
2	▪ Indicates operation/frequency command position. For example, T/K indicates that terminal operation command/keypad frequency command is set. ▪ Operation command position: • K: Operation command by keypad. • T: Operation command by terminal. • R: Operation command by built-in RS-485. • O: Operation command by option. ▪ Frequency command position: • K: Frequency command by keypad. • V: Analog frequency command (V1: 0 - 12 V) or V+I command. • W: Analog frequency command (-12 - 12 V). • I: Analog frequency command (I: 4 - 20 mA) • R: Frequency command by built-in RS-485. • U: Input up terminal during up/down operation. • D: Input down terminal during up/down operation. • S: Stop during up/down operation • O: Frequency command by option. • J: Jog terminal input. • 1~15: Multi-step speed target frequency. (Jog is not included.)
3	▪ Indicates output current during drive operation.
4	▪ Indicates a group code. Moves codes from 0-99 using ⇧ (up), ⇩ (down) keys.
5	▪ Indicates operation status. • STP: Drive stopped. • FWD: Operates in forward direction. • REV: Operates in reverse direction. • DCB: In DC braking. • LOP: Command loss by option. (DPRAM error) • LOR: Command loss by option. (Communications network error) • LOV: Analog frequency command loss (V1: 0 - 12 V, -12 - 12 V) • LOI: Analog frequency command loss (I: 4 - 20 mA) • SEN: In sensorless, vector (speed, torque) mode. • CMP: CAN mode in COMPARE. • NOR: Normal operation of the drive is possible. • FLT: Normal operation of the drive is not possible because of a fault. • TUN: Tuning Lsigma in auto tuning. • FLY: Inspecting counter electromotive force when making a flying start. • TST: In test mode
6	▪ Indicates a set frequency when the drive stops. ▪ Indicates a set frequency when the drive is in operation.

■ Setting Up and Changing Parameters

The drive has different built-in parameters. When you use the keypad for operation, you can set parameters or enter appropriate values according to the load and operating conditions. For more details, refer to Chapter 6, LSMV Drive Functions.

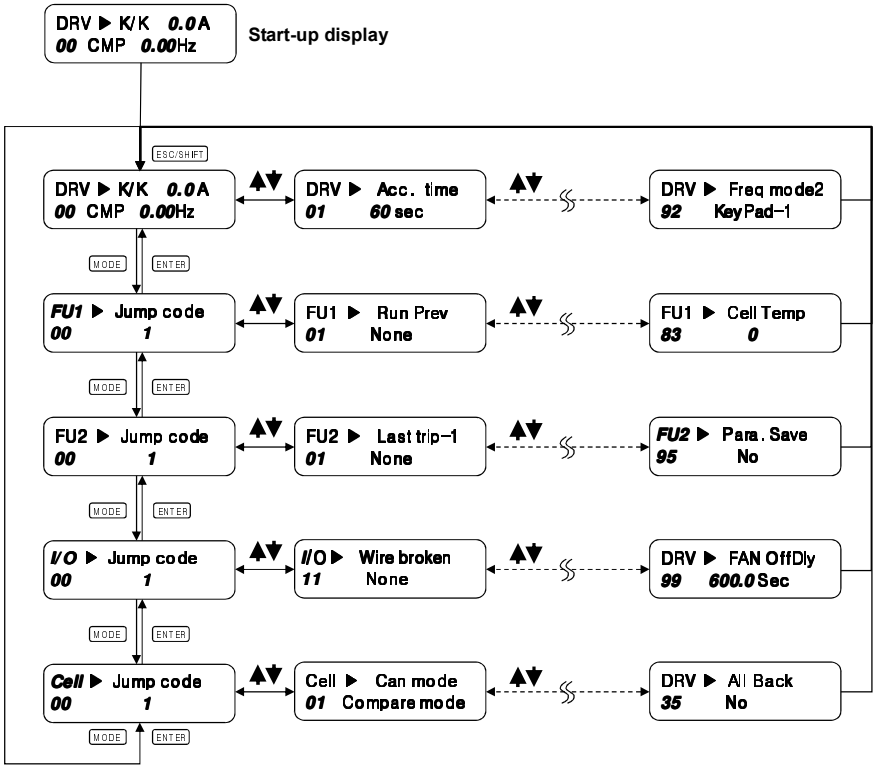


Figure 3-2 Setting up parameters and changing groups

To set up parameters, perform the following steps:

1. First, move to the code that is applicable to the group you want to change.
2. Press PROG key. The cursor (■) flashes.
3. Set the desired data value with ESC/SHIFT key and ▲▼ key. Then press ENTER key to save the data.

Note

Data is not changed in the following cases:

- If you enter data that you cannot change during operation. (Refer to Chapter 5, LSMV Parameters List.)
- [FU2-94] parameter lock is set and you cannot change the value.

- For example, setting up output frequency.

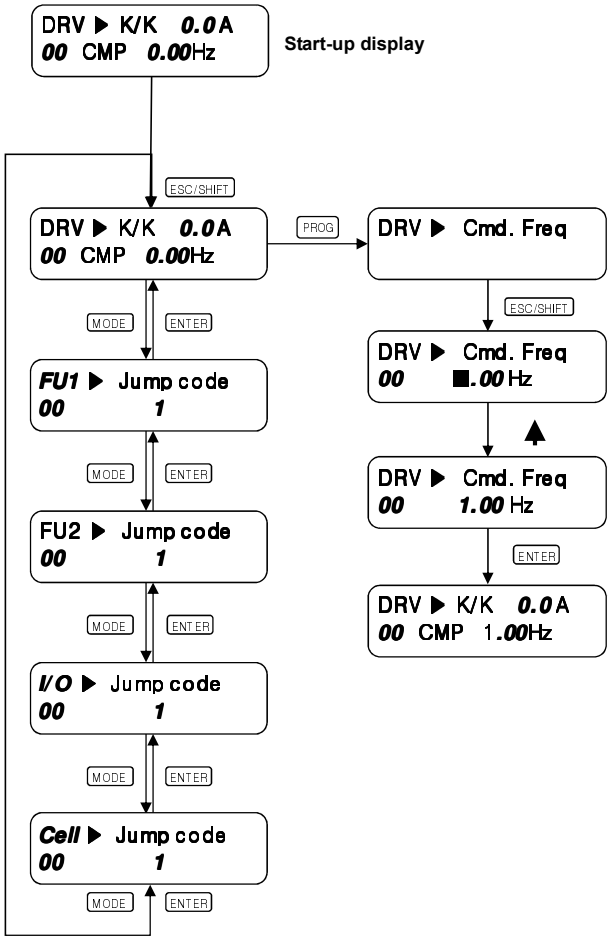


Figure 3-3 Parameter Setup

3.2 Operation mode

■ Keypad Operation

Turn the power on and check that the operation and frequency commands are displayed as follows: If operation and frequency commands are not displayed as shown as follows, set to the keypad operation mode. Set [DRV-03] operation mode to the Keypad, and [DRV-04] frequency mode to Keypad-1.

```
DRV ▶ K/K      0.0 A
00    STP    0.00Hz
```

Set the target frequency to 60.00 Hz with PROG, UP, DOWN, SHIFT and ENT keys. A set frequency is displayed when the drive stops.

```
DRV ▶ K/K      0.0 A
00    STP   60.00Hz
```

Press FWD or REV key. The motor starts to rotate and an output frequency and an output current are displayed.

```
DRV ▶ K/K     50.0 A
00    FWD   60.00Hz
```

Press the STOP/RESET key. The motor decelerates and then it stops. The frequency at this time is the set frequency.

```
DRV ▶ K/K      0.0 A
00    STP   60.00Hz
```

■ Terminal Operation

Turn the power on and make sure the target frequency and frequency command are displayed as follows. If the displayed target frequency and frequency command are not the same as follows, set to terminal operation mode. Set [DRV-03] operation mode to Fx/Rx-1, and [DRV-04] frequency mode to V1.

```
DRV ▶ T/V      0.0 A
00    STP    0.00Hz
```

Turn on operation command signal FX (or RX). LED (FWD key or REV key) on the keypad is on.

```
DRV ▶ T/V      0.0 A
00    FWD    0.00Hz
```

Gradually increase frequency set value to MAX frequency. Keypad displays output frequency (60.00 Hz), operating direction (FWD or REV), and output current.

```
DRV ▶ T/V      5.0 A
00    FWD   60.00Hz
```

If you slowly reduce frequency set value, the frequency decelerates. When the frequency reaches 0.00 Hz, the drive stops operation and the motor stops rotating.

```
DRV ▶ T/V      0.0 A
00    FWD    0.00Hz
```

Turn off operation command FX (or RX).

■ Parallel Operation with Terminal and Keypad

To assign operation command to terminal, and frequency command to keypad, set [DRV-03] operation mode to Fx/Rx-1 and [DRV-04] frequency mode to Keypad. At this point, the frequency set signal of terminal, forward rotation keys, reverse rotation keys, and stop keys on the keypad are disabled.

Turn on the power and then make sure the target frequency and frequency command are displayed as follows. If the displayed target frequency and frequency command are not the same as follows, change the settings as shown. Set [DRV-03] operation mode to Fx/Rx-1, and [DRV-04] frequency mode to Keypad.

```
DRV ▶ T/K      0.0 A
00    STP    0.00Hz
```

Turn on operation command signal FX (or RX). LED (FWD key or REV key) on the keypad is on.

```
DRV ▶ T/K      0.0 A
00    FWD    0.00Hz
```

Set the target frequency with the keypad. Set the target frequency to 60.00 Hz with PROG, (UP), SHIFT, and ENT keys.

The motor rotates at 60 Hz. LED (FWD key or REV key) on the keypad flashes during acceleration / deceleration.

```
DRV ▶ Cmd. freq        DRV ▶ Cmd. freq        DRV ▶ T/K      5.0 A
00        ▮   0.00Hz   00        60.00Hz      00    FWD   60.00Hz
```

Turn off operation command signal FX (or RX). LED (STOP key) on the keypad is on.

```
DRV ▶ T/K      0.0 A
00    STP   60.00Hz
```

Note

You can set the operation command signal with the keypad and set the target frequency with the terminal.
Set [DRV-03] operation mode to Keypad, and [DRV-04] frequency mode to V1 or I.

4. LSMV Test Operation

Chapter 4 describes procedures required to operate the LSMV series product.

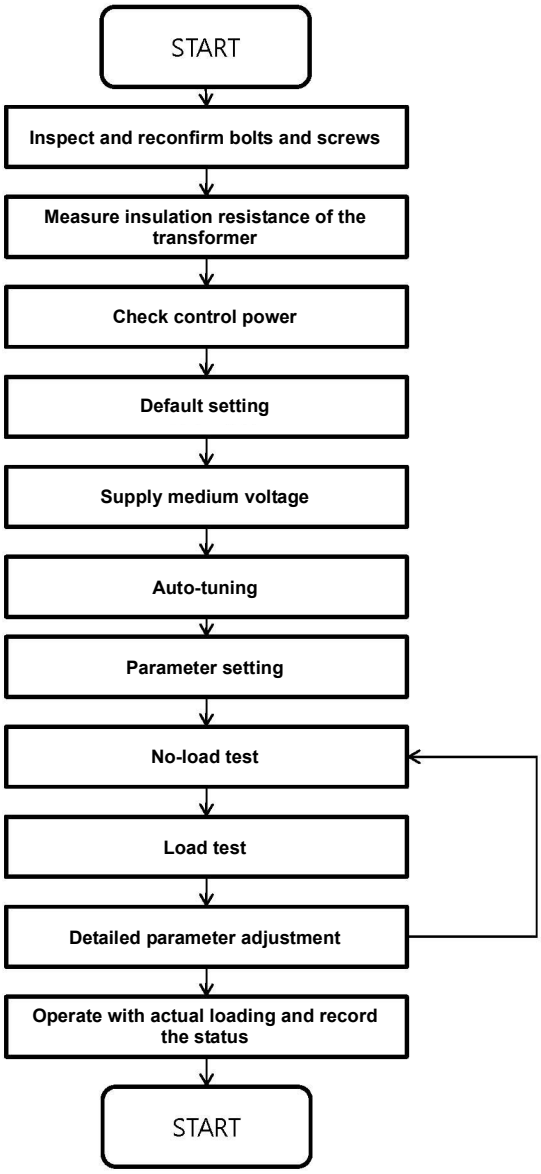


Figure 4-1 LSMV Test Operation Flow Chart

4.1 Test Operation Procedures

Test operation of LSMV series product requires you to comply with the following sequence:

■ Confirm Tightness of Bolts and Screws

- When you complete LSMV installation and wiring, visually inspect to make sure there are no damaged or parts inside the panel. Tighten any loose screws or bolts.

■ Measure Transformer Insulation Resistance

- Disconnect the drive input cable. Measure insulation resistance on input side terminal of transformer using 1000 V Megohm tester. Check if the measured value is 30 MΩ or higher.
- A circuit for input voltage detection is configured on the input side of transformer. Disconnect the voltage sensing circuit before you measure the insulation resistance of the drive.

■ Supply Control Power

- Before you supply control power, do the following:
  - Check if the voltage value of the control power is correct.
  - Check the terminal of the control circuit and the control cable are properly connected.
  - When using PG (Panel GROUND), check the PG is correctly connected.
- After you supply control power, do the following:
  - Measure the input voltage of the control part.
  - If input voltage value is different to the plan, turn off the switch of the transformer's input part and measure output voltage by adjusting tab.
  - Check that the cooling fan is working.
    - Rotating direction
    - Vibration
    - Flux
    - Movement of the fan cover

■ Check Display Status

- Keypad Display

  When a fault occurs on the drive, the keypad displays detailed information. If a problem with the drive occurs, refer to Troubleshooting in Chapter 7 for the solution. The following figure shows a typical keypad display when a fault occurs.

The content of the display varies according to the type of fault.
The image on the left shows a display when BX occurs.

Figure 4-2 Keypad Display When a Fault Occurs

■ Configure Basic Functions

- Set up basic functions

  In order to perform basic operation of the drive, set up the basic LSMV functions in the following order:

Table 4-1 Basic LSMV Settings

Order	Item	Code Number	Functional Description	Range	Default Value
1	Setting Accel/Decel time	DRV-01 DRV-02	Sets basic accel/decel time.	0 - 6000 s	180 s
2	Operation mode	DRV-03	Defines method of operation command.	KEYPAD FX/RX-1 FX/RX-2 Int.485	KEYPAD
3	Frequency mode	DRV-04	Defines method of frequency command.	KEYPAD-1 KEYPAD-2 V1 I V1+I Pulse Int.485	KEYPAD-1
4	Power frequency	FU1 - 20	Sets input power frequency of the drive.	40 - 120 Hz	60 Hz
5	Max. frequency	FU1 - 21	Seta maximum output frequency of the drive.	40 - 120 Hz	60 Hz
6	Base frequency	FU1 - 22	Sets base frequency of the motor.	30 - 120 Hz	60 Hz
7	Starting frequency	FU1-23	Sets starting frequency of the drive.	0.01 - 10 Hz	0.5 Hz
8	Motor voltage	FU2-31	Sets rated voltage of the motor.	0 - 12000 V	6,600 V
9	Number of poles	FU2-32	Sets the number of poles in the motor.	2 ~ 12	4

Order	Item	Code Number	Functional Description	Range	Default Value
10	Motor slip	FU2-33	Sets rated slip of the motor.	0 - 10 Hz	2 Hz
11	Setting Motor Rated current	FU 2-34	Sets rated current of the motor. (RMS)	1 - 1000 A	100 A
12	No-load current	FU2-35	Sets no-load current of the motor. (RMS)	1 - 300 A	30 A

- Sets up control mode.
  - V/F control mode

    The initial value of control mode is V/F. For operation in V/F control mode, set the following functions in addition to the basic functions.

Order	Item	Code Number	Functional Description	Range	Default Value
1	Forward torque boost	FU2-47	Set quantity of forward direction torque boost.	0 ~ 5%	1.0%
2	Reverse torque boost	FU2-48	Set quantity of reverse direction torque boost.	0 ~ 5%	1.0%

  - Slip compensation control mode

    Set to "Slip compen" from control mode setting [FU2-40] to operate. Operation with slip compensation control allows a constant motor speed regardless of load variation.

  - Control mode of sensorless vector

    Set to "Sensorless" from control mode setting [FU2-40] to operate. To operate with sensorless control, perform auto tuning immediately after medium voltage is supplied.

Order	Item	Code Number	Functional Description	Range	Default Value
1	Auto-tuning	FU2-42	Perform auto tuning.	No Yes	No

  - No-load current (used for sensorless vector control) cannot be set by auto tuning. To solve this issue, input no-load current when setting to V/F control mode. (For stable operation of the drive, correctly confirm no-load current and slip frequency of the motor beforehand.)
  - Auto tuning automatically tunes stator resistor (Rs) and leakage inductance (Lsigma) values when the motor is stopped. It then displays the values as % impedance.

- Supply Input Power to LSMV
  - Before you supply input power, do the following:
    - Make sure LSMV input power is correct.
    - Check the main terminal of LSMV to make sure input/output are correctly connected (R/S/T & U/V/W).
  - After you supply input power, do the following:
    - Measure input voltage for each cell.
    - If input voltage of a cell exceeds 630 V ± 5%, reconfirm LSMV input power and modify the tab of the input transformer.

- Confirm LSMV input power in [DRV-80].
- Check that the keypad display is normal.

- Check no-load operation.
  - Keypad Operation

    Make sure the load is separated in the motor, and set [DRV-03] to KeyPad. Check the motor and surrounding conditions of the motor room. If conditions are normal, operate the drive with the keypad.

    - Check that the motor rotates in the right direction.
    - Check that the keypad displays faults.
    - Increase the frequency by 10 Hz at a time, and check the output waveform of the drive.
    - Check functions for emergency stop and protection.
  - Terminal Operation

    Set [DRV-03] to FX/RX-1 and operate the drive the same way as keypad operation. Always check the motor and its surrounding conditions when you operate the drive.

    - When you operate the drive, supply RUN command and input reference frequency (Target Frequency).
- Check Loaded Operation
  - Make sure the motor stops completely, and then connect the motor to a machine.
  - Check the motor side and load side connection one more time.
- Check Operating Conditions
  - Check that the motor rotates in the right direction.
  - Gradually increase the frequency to make sure the motor works normally.
  - Make sure there are no abnormal conditions such as vibration or noise when the frequency and rotating direction are changed.
  - Make sure the output current of the drive is not too high.
  - If the motor generates serious vibration and hunting, modify the parameter value for the anti-hunt algorithm with the LSMV test operator.

5. LSMV Parameters List

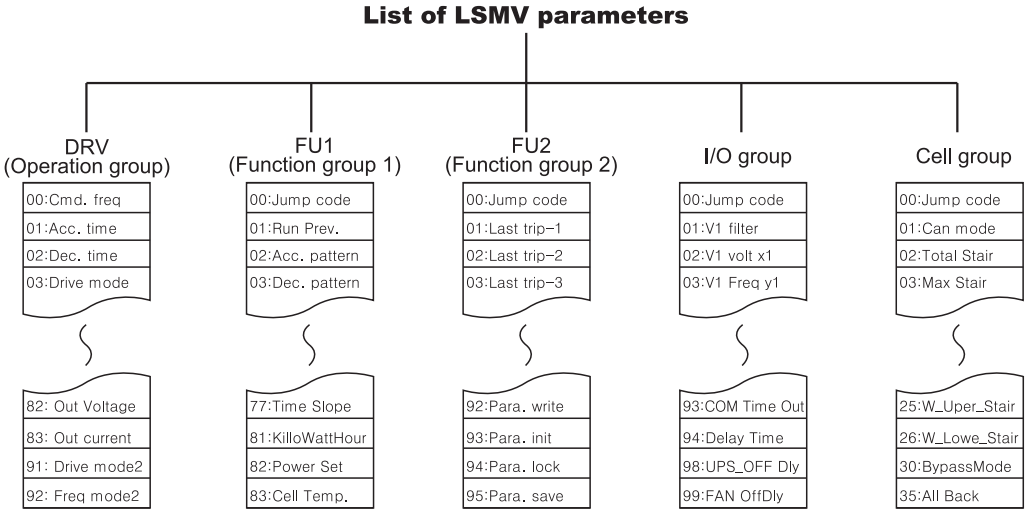


Figure 5-1 Composition of LSMV Parameters

Item	Description
DRV (operation group)	Basic parameters needed for operation, such as target frequency and Accel/Decel time, etc.
FU1 (function group 1)	Parameters used to set basic functions such as Accel/Decel pattern and operation method, etc.
FU2 (function group 2)	Parameters used to set applied functions, such as frequency jump, auto tuning and motor configuration, etc.
I/O Group	Parameters used to construct sequence like multi-function terminal set up.
Cell group	Parameters needed for setting communications with cells and for cell settings.

5.1 DRV Group

Code DRV	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
00	9100	Command frequency Output frequency	Cmd. freq	While out of operation: Indicates frequency command. During operation: Indicates output frequency.		0 Hz	○	
01	9101	Acceleration time	Acc. time	The time taken to reach the acceleration reference frequency.		60 s	○	
02	9102	Deceleration time	Dec. time	The time taken to reach 0 Hz from reference frequency.		180 s	○	
03	9103	Operation mode	Drive mode	Sets operation command.		KeyPad	X	
04[1)]	9104	Frequency mode	Freq mode	Sets frequency command.		KeyPad -1	X	
05	9105	Multi-step speed frequency 1	Step Freq-1	Defines multi-function input terminal (M1-M15) and performs multi-step speed operation.		10.00 Hz	○	
06	9106	Multi-step speed frequency 2	Step Freq-2			20.00 Hz	○	
07	9107	Multi-step speed frequency 3	Step Freq-3			30.00 Hz	○	
08	9108	Output current	Current	Indicates root mean square values (RMS) of drive output current during operation.	* [A]	* [A]	*	
09	9109	Motor speed	Speed	Indicates motor speed during operation.	* [rpm]	* [rpm]	*	
10	910A	DC link voltage	DC link Vtg	Indicates DC_link voltage of a cell.	* [V]	* [V]	*	
11	910B	User selection display	User disp	Displays the value set from [FU2-81] user selection (output voltage of output power).		Output voltage [V]	*	
12	910C	Current trip display	Fault	Displays current trip status of the drive.	*	*	*	

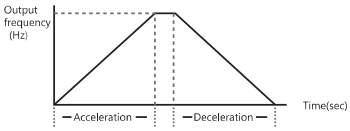
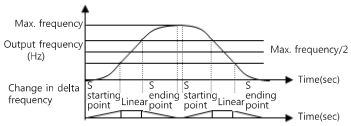
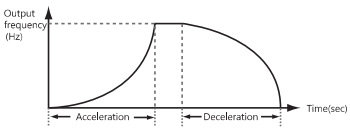
Code DRV	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
16	9110	High voltage signal selection	High Vol Sel	Select method to receive power on signal. (Either with contact or with sensing value)		Hard Wear	X	
82	9152	Output voltage	Out Voltage	Displays voltage of high voltage output.		0 V		
91[2)]	915B	Operation mode 2	Drive mode2	Defines [IO-14 to 28] terminal function. The function is related to LOC/REM setting.		Fx/Rx-1	X	
92	915C	Frequency mode 2	Freq mode2			KeyPad -1	X	

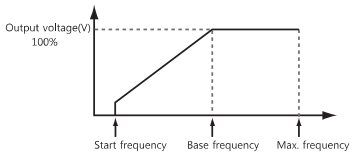
1) [DRV-05~07] display area shown when multi-step speed operation is set in [IO-14~28].
2) This mode is used when setting LOC/REM in [IO-13] terminal input.

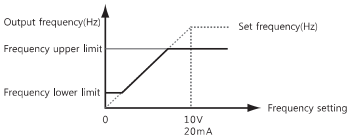
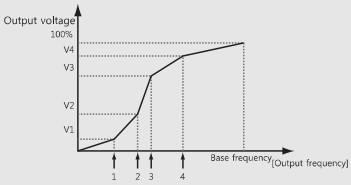
Note

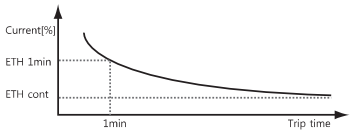
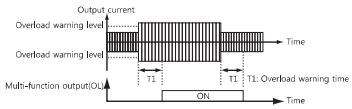
Codes in shaded rows (▭) are hidden codes that are displayed only when setting corresponding codes.

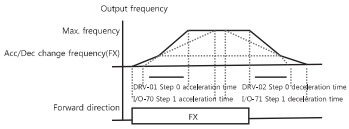
5.2 FU1 Group

Code FU1	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
00	9200	Jump code	Jump code	Moves directly to the code you want to use.		1	○	
01	9201	Forward/reverse rotation prohibition	Run Prev.	Prevents the motor from rotating in the opposite direction. For loads that drive in a single direction.		None	X	
02	9202	Accelerating pattern	Acc. pattern	Selects appropriate Accel/Decel pattern for the purpose. ▪ Linear:Linear Accel/Decel pattern  [Linear acc/dec pattern] ▪ S-curve: An S shape Accel/Decel pattern. Requires approximately 40% more time than linear Accel/Decel.  [S-curve acc/dec pattern] ▪ U-curve: A U shape Accel/Decel pattern. Use this curve when smooth operation is needed for Accel/Decel.  		Linear	X	
03	9203	Decelerating pattern	Dec. pattern			Linear	X	
04	9204	S-curve start point gradient	Start Curve			50%	X	
05	9205	S-curve end point gradient	End Curve			50%	X	
06[1)]	9206	Start mode	Start mode	Selects drive start method. ▪ Accel: When you start the drive, operate taking acceleration time. ▪ Dc-start: When you start the drive, perform DC excitation first and then accelerate operation. ▪ Flying-start: Start while the motor is rotating.		Accel	X	

Code FU1	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
07	9207	DC excitation time at start	DcSt time	Indicates DC excitation time at the time of start.		1.0 s	X	
08	9208	DC excitation quantity at start	DcSt value	Indicates the quantity of DC excitation at the time of start.		33%	X	
09[2)]	9209	Stop mode	Stop mode	Selects drive stop method. ▪ Decel: Drive stops by decelerating. ▪ Dc-brake: From below the braking frequency, drive stops by supplying DC to the motor. ▪ Free-run: Block output voltage of the drive to let the motor free run and then stop.		Free Run	X	
10	920A	Output blocking time before DC braking	DcBlk time	Used when you want to stop the drive by supplying DC voltage to the motor in order to adjust stopping accuracy such as positioning according to the load. Decelerate to DC braking frequency, which is set when DC braking is selected as a [FU1-09] stop method, and then perform DC braking at that frequency. ▪ Output blocking time before DC braking: The time drive output is blocked before starting DC braking. ▪ DC braking time: Time to supply DC to the motor. ▪ DC braking quantity: Quantity of DC that is supplied to the motor.		5.00 s	X	
11	920B	DC braking frequency	DcBr freq			0.50 Hz	X	
12	920C	DC braking time	DcBr time			1.0 s	X	
13	920D	DC braking quantity	DcBr value			50%	X	
20	9214	Power frequency	Line Freq	Set input power frequency. Set it to 50 Hz or 60 Hz.		60.00 Hz	X	
21	9215	Maximum frequency	Max Freq	Set reference frequency for rated torque of the motor. ▪ Max Freq.: The maximum frequency that the motor can operate. ▪ Base Freq.: The frequency from where the drive's rated voltage is output. ▪ Start Freq.: The frequency where output voltage of the drive begins to output. 		60.00 Hz	X	
22	9216	Base frequency	Base Freq			60.00 Hz	X	
23	9217	Start frequency	Start Freq			0.50 Hz	X	

Code FU1	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
24[3)]	9218	Frequency upper/lower limit selection	Freq limit	This function restricts the target frequency of the drive. Output frequency of the drive is set between the upper limit and lower limit. If the frequency is set out of the upper/lower limit range, it is converted to upper/lower limit value. 		No	X	
25	9219	Lower limit frequency	F-limit Lo			0.50 Hz	○	
26	921A	Upper limit frequency	F-limit Hi			60.00 Hz	X	
40[4)]	9228	V/F pattern	V/F pattern	Select the appropriate output characteristic (V/F characteristic) according to usage or load. ▪ Linear: Suitable for constant torque where output voltage and output frequency are changing to scale. ▪ Square: Suitable for the load of fan and pump which load size changes in proportion to the square of frequency. ▪ User V/F: You arbitrarily set the ratio in special circumstances.		Linear	X	
41	9229	User V/F frequency 1	User freq 1	Used when you arbitrarily set ratio of output voltage to frequency. Each of the four types of frequencies and voltages can be set between starting frequency and base frequency. 		15.00 Hz	X	
42	922A	User V/F voltage 1	User volt 1			25%	X	
43	922B	User V/F frequency 2	User freq 2			30.00 Hz	X	
44	922C	User V/F voltage 2	User volt 2			50%	X	
45	922D	User V/F frequency 3	User freq 3			45.00 Hz	X	
46	922E	User V/F voltage 3	User volt 3			75%	X	
47	922F	User V/F frequency 4	User freq 4			60.00 Hz	X	
48	9230	User V/F voltage 4	User volt 4			100%	X	

Code FU1	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
50	9232	AC input voltage correction	VAC	Set when input voltage is very different from the standard input.		100.0 %	X	
53	9235	Select electronic thermal	ETH select	Protects the motor from overheating without adding extra thermal relay to outside. Blocks the drive's output and displays trip message after electronic thermal starts. ▪ ETH 1 min: The amount of current which will be a standard to judge that the motor is overheated when load current is flowing continuously for one minute. ▪ ETH cont: The amount of current which will be a standard to judge that the motor is not overheated and in thermal equilibrium, even if load current is flowing continuously. ▪ Self-cool: This is generally set when using a fan that is attached to an induction motor. ▪ Forced-cool: Set to drive the motor cooling fan with a separate power supply.  [Electronic thermal characteristics curve]		Yes	○	
54	9236	One minute level of electronic thermal	ETH 1 min			150%	○	
55	9237	Continuous operation level of electronic thermal	ETH cont			120%	○	
56	9238	Motor cooling method	Motor type			Self-cool	○	
57	9239	Overload alarm level	OL level	Issues an alarm signal using the multi-function output terminal if the output current of drive stays for overload warning time with a value higher than the overload warning level.  				
58	923A	Overload warning time	OL time				○	
59[5)]	923B	Overload trip selection	OLT select	Cuts the drive output off and displays trip message if the output current of drive stays for overload trip time with values that are higher than the overload limit level.		No	○	
60	923C	Overload trip level	OLT level	Sets overload trip level.		120%	○	
61	923D	Overload trip time	OLT time	Sets overload trip time.		60.0 s	○	

Code FU1	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
62	923E	Input/output open-phase protection	Trip select	Bit setting ▪ Bit 0 (Output open-phase protection) • 1: Do not protect output open-phase. • 0: Protect output open-phase. ▪ Bit 1 (Input open-phase protection) • 1: Do not protect input open-phase. • 0: Protect input open-phase.				
64	9240	Current level for stall prevention	Stall level	Divide the stall prevention function for motor into acceleration, constant speed, and deceleration sections, and then use the combination of these.			X	
70	9246	Accel/Decel switching frequency	Acc/Dec ch F	Set when you want to operate the drive with a changed Accel/Decel slope. If Accel/Decel switching frequency is set, change Accel/Decel slope at the point where the output frequency is passing Accel/Decel switching frequency. 		0.00 Hz	X	
71	9247	Accel/Decel reference frequency	Acc/Dec Freq	Changes Accel/Decel reference frequency of the drive. ▪ Max Freq.: The time taken from 0 to Max. Frequency. ▪ Delta Freq.: The time taken from random frequency to next target frequency.		Max Freq	X	
75[6)]	924B	Instantaneous power interruption	Ride-Throu	Allows continued operation even if the power condition is not good or power is instantaneously interrupted due to a lightning surge.		No	X	
76	924C	Instantaneous power interruption time	Shot time S	1 corresponds to 5 ms.		1	X	
77	924D	Instantaneous power interruption voltage gradient.	Time Slope	High bit is output voltage gradient when decelerating. Low bit is the gradient of output voltage rise after power returns.		AA	○	
79	924F	Output Power	Out Watt	Displays the current output power.				
81	9251	Accumulated electric power	KilloWatt Hour	Represented in KWH. There may be some errors.				

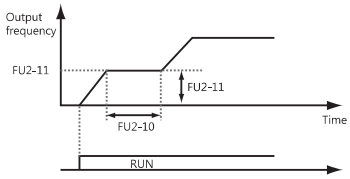
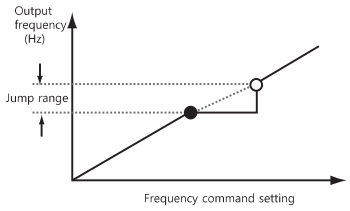
Code FU1	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
82	9252	Electric power correction	Power Set	Electric power correction is required because accumulated electric power is expressed as the sum of instantaneous electric power.		100.0 %		
83	9253	Drive temperature	Cell Temp.	Displays temperature of the cell that has the highest temperature among 3-phase cells in each layer.				

1) [FU1-07~08] display area shown when the start mode is set to [Dc-start] in [FU1-06].
2) [FU1-10~13] display area shown when the stop mode is set to [DC-brake] in [FU1-09].
3) [FU1-25,26] display area shown when Freq limit is set to [Yes] in [FU1-24].
4) [FU1-41~48] display area shown when the V/F pattern is set to [User V/F] in [FU1-40].
5) [FU1-60~61] display area shown when OLT select is set to [Yes] in [FU1-59].
6) [FU1-76,77] display area shown when instantaneous power interruption Ride-Throu is set to “Yes" in [FU1- 75]

Note

Codes in shaded rows (▭) are hidden codes that are displayed only when setting corresponding codes.

5.3 FU2 Group

Code FU2	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
00	9300	Jump code	Jump code	Moves directly to the code you want to use.				
01	9301	Trip history 1	Last trip-1	Trip history saves up to the past 5 trips. A smaller number indicates a more recent trip.		None	*	
02	9302	Trip history 2	Last trip-2				*	
03	9303	Trip history 3	Last trip-3				*	
04	9304	Trip history 4	Last trip-4				*	
05	9305	Trip history 5	Last trip-5				*	
06	9306	Erase trip history	Erase trips	Deletes trip history.		No	○	
10	930A	Dwell time	Dwell time	Temporarily stops and restarts acceleration when driving large load. 		0.0 s	X	
11	930B	Dwell frequency	Dwell Freq			5.00 Hz	X	
12[1)]	930C	Frequency jump selection	Jump Freq	Allows jump of the frequency that causes resonance when you want to prevent resonance from motor vibration. Sets three of jump frequency sections. 		No	X	
13	930D	Lower limit of first frequency	jump lo 1			10.00Hz	○	
14	930E	Upper limit of first frequency	jump Hi 1			15.00Hz	○	
15	930F	Lower limit of second frequency	jump lo 2			20.00Hz	○	
16	9310	Upper limit of second frequency	jump Hi 2			25.00Hz	○	
17	9311	Lower limit of third frequency	jump lo 3			30.00Hz	○	
18	9312	Upper limit of third frequency	jump Hi 3			35.00 Hz	○	

Code FU2	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
21	9315	Flying start percentage	Flying perc	Use the motor speed estimation function when the motor is in free run, or when you want to operate before the motor stops.		~ 160 50%	X	
25[2)]	9319	Restart after fault reset	Reset start	Automatically restarts after a trip takes place.		No	X	
26	931A	Number of restart	Retry number	Keeps delay time for the number and issues Run command if the number of auto-restarts after a trip is specified.		1	X	
27	931B	Restart delay time	Retry delay			1.0 s	X	
31	931F	Motor voltage	Motor Volt	▪ Motor related constants ▪ Slip frequency [Hz] = Rated frequency [Hz] - (Rated motor speed [rpm] * P/120) P: Number of motor poles		6,600 V	X	
32	9320	Number of poles on the motor	Pole number			4	X	
33	9321	Rated slip of the motor	Rated-Slip			2.00 Hz	X	
34	9322	Rated current of the motor (rms)	Rated-Curr			100.0 A	X	
35	9323	No-load current of the motor (rms)	Noload-Curr			30.0 A	X	
38	9326	Motor revolution display gain	RPM factor	When changing display of motor speed to revolution speed (r/min) or machine speed (m/min), calculate the speed of revolution using this function. Speed of revolution = 120 * F/P * motor revolution display gain				
40[3)]	9328	Select control mode	Control mode	Sets how to control the drive. ▪ V/F: Keeps the ratio of output voltage and output frequency of the drive consistent. ▪ Slip compen (slip compensation): Keeps a constant motor speed by slip compensation function regardless of changes in load. ▪ Sensorless: Used when enough torque is needed at startup and at low speed, or when load is changes significantly.		V/F	X	
41	9329	Sensorless mode	Sensor Mode	Selects sensorless control method.		Sensor_ Less	*	

Code FU2	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
42	932A	Auto-tuning	Auto tuning	Automatically measures motor parameters required for control, such as stator resistor and leakage inductance, to ensure selected control mode operates at full performance.		No	X	
43	932B	Stator resistor	%Rs			1.90% (initial value)	X	
44[4)]	932C	Leakage inductance	%Lsigma			12.00% (initial value)	X	
45	932D	Sensorless current P gain	SL P-gain	Used to adjust sensorless P and I gains. ▪ P gain: Proportional Gain of speed controller ▪ I gain: Integral gain of speed controller		600	X	
46	932E	Sensorless current I gain	SL I-gain			4	X	
47	932F	Quantity of forward torque boost	Fwd boost	Increase the quantity of boost to operate for a load that needs starting torque at low speed.		1.0%	X	
48	9330	Quantity of reverse torque boost	Rev boost			1.0%	X	
80	9350	Select display when turned on.	PowerOn disp	Selects an item which appears on the keypad first from DRV group when power is supplied to the drive.		0	○	
82	9352	Software version	LS-MV S/W	Displays the software version of the drive.		Ver 1.2	*	
83	9353	Elapsed time from the last trip	LastTripTime	Displays the time elapsed from the last trip to present.		*	X	
84	9354	Power supply time	On-time	Displays how long power is supplied so far.		*	X	
85	9355	Operation time	Run-time	Displays how long the drive is operated so far.		*	X	
91	935B	Read parameters	Para. read	Saves controller's parameters in keypad memory.		No	X	
92	935C	Write parameters	Para. write	Downloads parameters from keypad memory to controller.		No	X	
93	935D	Initialize parameters	Para. init	Initializes parameters to default values.		No	X	

Code FU2	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
94	935E	Prohibit parameter setting	Para. lock	Used to prevent accidents that may occur when other users modify existing operation related parameters.		0	○	
95	935F	Save parameters	Para. save	Used to save current parameters.		No	X	

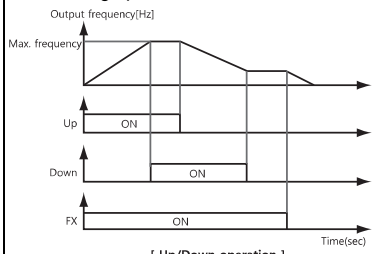
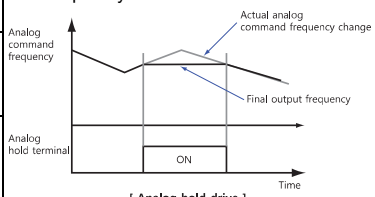
1) [FU2-13~17] display area shown when Jump Freq is set to [YES] in [FU2-12].
2) [FU2-26, 27] display area shown when reset start is set to [YES] in [FU2-25].
3) [FU2-41] display area shown when control mode is set to [Sensorless] in [FU2-40].
4) [FU2-45, 46] is used when sensorless mode is Torque Vector Mode.

Note

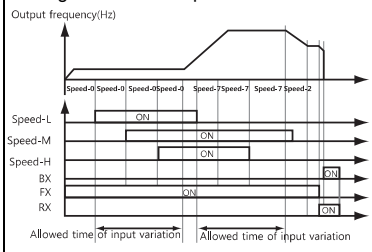
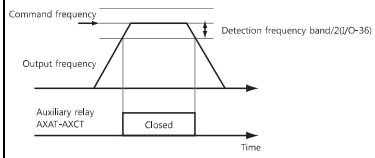
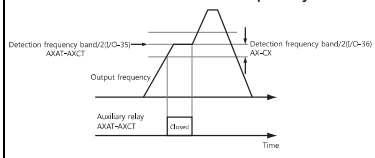
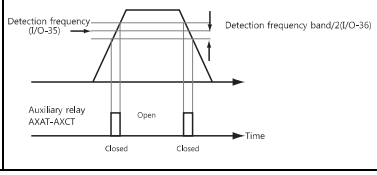
Codes in shaded rows (▭) are hidden codes that are displayed only when setting corresponding codes.

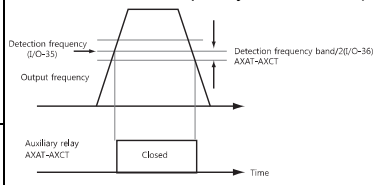
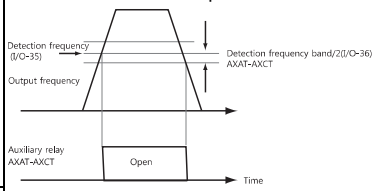
5.4 I/O Group

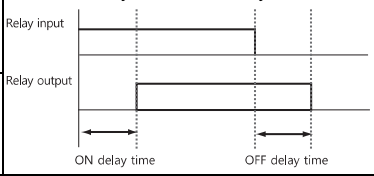
Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
00	9400	Jump code	Jump code	Moves directly to the code you want to use.		1	○	
01[1)]	9401	Time constant of V1 input filter	V1 filter	Sets value for built-in filter of V1 terminal while frequency command is set from outside.		10 ms	○	
02	9402	Minimum input voltage of V1	V1 volt x1	Sets the input voltage according to the minimum frequency for V1.		0.00 V	○	
03	9403	Frequency corresponding to V1 Min. voltage.	V1 Freq y1	Sets an output frequency corresponding to VI, the minimum input voltage.		0.00 Hz	○	
04	9404	Maximum input voltage for V1	V1 volt x2	Sets the input voltage V1corresponding to the maximum frequency.		10.00 V	○	
05	9405	Frequency corresponding to Max. voltage V1.	V1 Freq y2	Sets output frequency corresponding to VI, the maximum frequency input voltage.		60.00 Hz	○	
06	9406	I input filter time constant	I filter	Sets value for built-in filter of I terminal while frequency command is set from outside.		10 ms	○	
07	9407	Minimum input current I	I curr x1	Sets the input current I corresponding to a minimum frequency.		4.00 mA	○	
08	9408	Frequency corresponding to a minimum input current I	I Freq y1	Sets output of the frequency corresponding to the input current for a minimum frequency.		0.00 Hz	○	
09	9409	Maximum input current I	I curr x2	Sets the input current I for a maximum frequency.		20 mA	○	
10	940A	Frequency/torque that corresponds to maximum current I	I Freq y2	Sets the output frequency corresponding to the input current I for a maximum frequency.		60.00 Hz	○	
11	940B	Select a standard for loss of analog command speed.	Wire broken	▪ None: Do not use operation mode function when frequency command is lost. ▪ half of x1: If analog command value becomes lower than half of the minimum set value, it is considered as frequency command loss. ▪ below x1: If analog command value becomes lower than the minimum set value, it is considered as frequency command loss.		None	○	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
12	940C	Operation mode in case of command speed loss	Lost command	▪ None: Continue operation in case of frequency command loss. ▪ Free Run: Stop free run in case of frequency command loss. ▪ Stop: Deceleration stop in case of frequency command loss		None	○	
13	940D	Time to judge command loss	Time out	The time to judge the analog frequency command loss.		1.0 s	○	
14	940E	Set multi-function input terminal M0.	M0 define	▪ FX: Sets the command terminal as a forward operation terminal. ▪ RX: Sets the command terminal as a reverse operation terminal. ▪ RST: Sets the terminal as a reset fault terminal after trip. ▪ JOG: Sets the terminal as a jog operation terminal. ▪ BX: Sets the internal setting terminal as an emergency stop terminal. ▪ Speed-L, M, H and X: Refer to multi-step speed operation. ▪ XCEL-L, M and H: Multi-step acceleration/deceleration ▪ Up/down (upward and downward operation): Enables acceleration, deceleration, and constant speed operation with terminal combination by defining operation terminal.  [Up/Down operation] ▪ 3-wire: Operates by setting the multi-function input terminal to 3-wire. ▪ Analog hold: Keeps the analog frequency value.  [Analog hold drive] ▪ Ana.Change: Analog operation command changes if the set terminal value is entered.		RST	○	
15	940F	Set multi-function input terminal M1	M1 define			Ext Trip1	○	
16	9410	Set multi-function input terminal M2	M2 define			FX	○	
17	9411	Set multi-function input terminal M3	M3 define			RX	○	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
18	9412	Set multi-function input terminal M4	M4 define	▪ XCEL stop: Accel/Decel stops if the set terminal is on. ▪ LOC/REM: Use when you want to make both frequency command and operation command in two forms. ▪ Door-Open: Used for safety when the panel door is open. ▪ Trans.OHW: Sets warnings against transformer overheating. ▪ Trans.OHT: Sets trip against transformer overheating. ▪ Motor OHT: Sets trip against motor overheating. ▪ Fan Trip: Sets trip against a fan failure. ▪ Ext Trip1,2: Blocks drive output and outputs a failure message if the set terminal is on. ▪ High Voltage: Indicates 6600 V is supplied as a drive input. ▪ Run Enable: Can perform RUN command when set terminal is on. ▪ Control LV: Indicates whether control power is being supplied through UPS. ▪ None: No function is in use.		Trans. OHT	○	
19	9413	Set multi-function input terminal M5	M5define			Fan Trip	○	
20	9414	Set multi-function input terminal M6	M6 define			High Voltage	○	
21	9415	Set multi-function input terminal M7	M7 define			Run Enable	○	
22	9416	Set multi-function input terminal M8	M8 define			Control LV	○	
23	9417	Set multi-function input terminal M9	M9 define			None	○	
24	9418	Set multi-function input terminal M10	M10 define			None	○	
25	9419	Set multi-function input terminal M11	M11 define			None	○	
26	941A	Set multi-function input terminal M12	M12 define			None	○	
27	941B	Set multi-function input terminal M13	M13 define			None	○	
28	941C	Set multi-function input terminal M14	M14 define			BX	○	
29	941D	Input terminal display	In status	Multi-function input terminal display which shows the input status of the control terminal. ▪ [I/O-29]: Shows low 11 bit information. ▪ [I/O-30]: Shows high 4 bit information.		00000000 000	*	
30	941E	Input terminal display	In status_H			0000	*	
31	941F	Multi-function input terminal Filter time constant	Ti Filt Num	Sets responsiveness of input terminal (M0-M14).		15 ms	○	
32	9420	Select hardware configuration of input terminal	In No/Nc Set	Selects input contact type of control input terminal.		00000000 000	X	
33	9421	Select hardware configuration of input terminal	H No/Nc Set			0000	X	

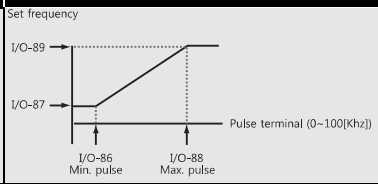
Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
34	9422	Input terminal polling time	In CheckTime	Sets valid time of multi-function input. Inputs after the allowed time for input change are recognized as valid inputs starting with the first input. 		1 ms	X	
35	9423	Detected frequency	FDT freq	Use the frequency detection function by utilizing auxiliary contact output with multi-functions.		30.00 Hz	○	
36	9424	Detected frequency band	FDT band			10.00 Hz	○	
37	9425	Output setting of multi-function auxiliary contact (Aux terminal)	Aux mode1	▪ FDT-1: Detect if the output frequency reached command frequency.  ▪ FDT-2: Works if FDT-1 conditions are satisfied and output frequency is the same as the detected frequency.  ▪ FDT-3: Works when the bandwidths of output frequency and detected frequency are in the following condition: Absolute value (detected - output frequency) ≤ Detected frequency bandwidth / 2 		Ready	○	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
38	9426	Output setting of multi-function auxiliary contact	Aux mode2	▪ FDT-4 • When accelerating: Output frequency ≥ Detected frequency • When decelerating: Output frequency > (Detected frequency – Detected frequency bandwidth / 2) 		FAN RUN	○	
39	9427	Output setting of multi-function auxiliary contact	Aux mode3	▪ FDT-5: Reverse output of FDT-4 		RUN	○	
40	9428	Output setting of multi-function auxiliary contact	Aux mode4	▪ OL: Outputs a signal when output current exceeds the overload warning level during operation. ▪ IOL: Outputs an alarm signal when output current reaches the time of regulated level (120% 1 minute), with rated current of the drive as a standard, during operation. ▪ Stall: Outputs a signal when a stall occurs during drive operation. ▪ OV: Outputs a signal when DC link voltage of the drive is higher than overvoltage (1050 V). ▪ LV: Outputs a signal if input voltage of the drive is below the standard. ▪ OH: Outputs a signal if the drive overheats and the temperature exceeds the overheat standard. ▪ Lost command: Outputs a signal when frequency command is lost. ▪ Run: Outputs a signal when the drive is in operation. ▪ STOP: Outputs a signal when the drive stops. ▪ Steady: Outputs a signal when the drive is at constant speed. ▪ SpeedSearch: Outputs a signal when searching the drive speed. ▪ Ready: The drive is in operable status. ▪ Warning: Outputs a signal when Trans.OHW, etc., are in warning action. ▪ FAN RUN: Outputs fan operating signal		Warning	○	
41	9429	Output setting of multi-function auxiliary contact	Aux mode5			None	○	
42	942A	Output setting of multi-function auxiliary contact	Aux mode6			None	○	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
43	942B	Output setting of multi-function auxiliary contact	Aux mode7	when high voltage is ON READY. ▪ NORMAL: This is a CAN communication mode. The drive is in operable status. ▪ OCT: Outputs a signal when an over current trip is working. ▪ Cell ByPass: Outputs a signal when any one of the cells that are applied to the inverter is bypassed. ▪ Run_MV: Terminal status is similar to run. When restarting with cell bypass, gate output is not performed in actual drive. However, while bypass is valid, the drive outputs with continuous driving signal instead of a stop signal.		None	○	
44	942C	Output setting of multi-function auxiliary contact	Aux mode8			None	○	
45	942D	Output terminal display	Out status	Displays AXA-AXC1 - 8 and status of fault relays, 3OAT and 3OCT.		00000000 0	*	
46	942E	Fault relay operation (3A, 3B, 3C terminal)	Relay mode	Apply these for use of relay fault output when a drive trip occurs. High bits: Trip related ▪ 0: Does not operate when drive trips. ▪ 1: Operates according to user selection. ▪ Low bits: Low voltage trip related ▪ 0: Does not operate in a low voltage trip. ▪ 1: Operates in low voltage trip.		10	○	
47	942F	Fault relay On delay	Relay On	Sets fault relay on and off delay time. 		0.0 s	X	
48	9430	Fault relay Off delay	Relay Off			0.0 s	X	
49	9431	Analog output A	SDA A read	Selects the output type of analog out board DAout A terminal.		NONE	O	
50	9432	Analog output A shift percentage	SDA A shift	Sets the output gain percentage of analog out board DAout A.		100%	O	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
51	9433	Analog output B	SDA B read	Selects the output type of analog out board DAout B terminal.		NONE	O	
52	9434	Shift percentage of analog output B	SDA B shift	Sets the output gain percentage of analog out board DAout B.		100%	O	
53	9435	Analog output C	SDA 1	Selects the output type of analog out board DAout C terminal.		None	O	
54	9436	Shift of analog output C	SDA 1 shift	Sets the output gain of analog out board DAout C.		10	O	
55	9437	Analog output D	SDA 2	Selects the output type of analog out board DAout D terminal.		None	O	
56	9438	Shift of analog output D	SDA 2 shift	Sets the output gain of analog out board DAout D.		10	O	
57[2)]	9439	Set jog frequency	Jog Freq	Sets the jog operation frequency.		10.00 Hz	○	
58	943A	Multi-step speed frequency 4	Step Freq-4	If you want a jog combined with a multi-speed operation, define M0-M14 input terminal to perform multi-step speed operation. Command speed is determined as follows according to the combination of JOG, Speed-L, Speed-M, Speed-H, and Speed-X terminals. ※ Refer to page 6-23. ▪ 0: OFF, 1: ON, ▪ X: Not considered (JOG takes priority) ▪ S Speed-L: Least significant bit of input for multi-step speed setting ▪ S Speed-M: Medium bits of input for multi-step speed setting ▪ S Speed-H: Significant bits of input for multi-step speed setting ▪ S Speed-X: Most significant bit of input for multi-step speed setting		40.00 Hz	○	
59	943B	Multi-step speed frequency 5	Step Freq-5			50.00 Hz	○	
60	943C	Multi-step speed frequency 6	Step Freq-6			40.00 Hz	○	
61	943D	Multi-step speed frequency 7	Step Freq-7			30.00 Hz	○	
62	943E	Multi-step speed frequency 8	Step Freq-8			20.00 Hz	○	
63	943F	Multi-step speed frequency 9	Step Freq-9			10.00 Hz	○	
64	9440	Multi-step speed frequency 10	Step Freq-10			20.00 Hz	○	
65	9441	Multi-step speed frequency 11	Step Freq-11			30.00 Hz	○	
66	9442	Multi-step speed frequency 12	Step Freq-12			40.00 Hz	○	
67	9443	Multi-step speed frequency 13	Step Freq-13			50.00 Hz	○	
68	9444	Multi-step speed frequency 14	Step Freq-14			40.00 Hz	○	
69	9445	Multi-step speed frequency 15	Step Freq-15			30.00 Hz	○	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
70	9446	Multi-step acceleration time 1	Dec time-1	You can change Accel/Decel time while operating the drive by setting multi-function input terminal to XCEL-L, XCEL-M, and XCEL-H. While operating the drive you can select external contact input with multi-functions (M1, M2, M3) as multi-step Accel/Decel, and apply Accel/Decel time from one to seven using these external contact inputs. ※ Refer to page 6-25.		60 s	○	
71	9447	Multi-step deceleration time 1	Acc time-1			180 s	○	
72	9448	Multi-step acceleration time 2	Dec time-2			90 s	○	
73[3)]	9449	Multi-step deceleration time 2	Acc time-2			270 s	○	
74	944A	Multi-step acceleration time 3	Acc time-3			120 s	○	
75	944B	Multi-step deceleration time 3	Dec time-3			360 s	○	
76	944C	Multi-step acceleration time 4	Acc time-4			150 s	○	
77	944D	Multi-step deceleration time 4	Dec time-4			450 s	○	
78	944E	Multi-step acceleration time 5	Acc time-5			120 s	○	
79	944F	Multi-step deceleration time 5	Dec time-5			360 s	○	
80	9450	Multi-step acceleration time 6	Dec time-6			90 s	○	
81	9451	Multi-step deceleration time 6	Acc time-6			270 s	○	
82	9452	Multi-step acceleration time 7	Dec time-7			60 s	○	
83	9453	Multi-step deceleration time 7	Acc time-7			180 s	○	
84[4)]	9454	Pulse mode selection	P pulse set	Setting up command frequency by pulse ▪ Pulse set: Sets signals for four times multipliers or one time multiplier. ▪ P filter: Sets time constant for built-in filter of pulse terminal while setting the frequency that is input from outside. ▪ P pulse x1: Sets pulse frequency of P input from where minimum frequency is generated. ▪ P Freq y1: Sets output frequency corresponding to minimum input pulse of P input. ▪ P pulse x2: Set pulse frequency of P input from where maximum frequency is generated. ▪ P Freq y2: Set output frequency corresponding to maximum input pulse of P input.		(A)	X	
85	9455	Time constant of pulse input filter	P filter			10 ms	O	
86	9456	Minimum frequency of pulse input	P pulse x1			0.0 kHz		
87	9457	The frequency corresponding to minimum frequency of pulse	P Freq y1			0.00 Hz	○	
88	9458	Maximum frequency of pulse input	P pulse x2			10.0 kHz	○	

Code I/O	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
89	9459	The frequency corresponding to maximum frequency of pulse	P Freq y2			60.00 Hz	○	
90	945A	Drive ID	Inv No.	Sets drive ID for communications between the drive and computer to communicate with RS-485.		1	○	
91	945B	Communications speed	Baud rate	Sets RS-485 communications speed.		38400 bps	○	
92	945C	Operation mode in case of command speed loss	COM Lost Cmd	Sets operation method in case of command loss during RS-485 communications. ▪ None: Continues to operate. ▪ Free Run: Stops free run ▪ Stop: Deceleration stop		None	○	
93	945D	Time to judge command loss	COM Time Out	If specified time is over it is considered communications command loss.		1.0 s	○	
94	945E	Communications response delay time	Delay Time	If the communications are not smooth when using RS-232 to RS-485 converter, set delay time based on the type of converter.		5 ms	○	
98	9462	UPS Off time	UPS_OFF Dly	It is configured to use UPS to prevent drive trips due to power outage in case of instantaneous power interruption. Set UPS_OFF Dly time with the discharged time in consideration. After this time has passed, Control LVT trip occurs and the drive stops.		60 s	○	
99	9463	Fan off time	FAN OffDly	Even if you normally stop the drive after high voltage power is supplied for operation, or if you turn off high voltage power for servicing, heat remains in the transformer and cells. Therefore, run the panel fan for a specified time and then turn it off.		600.0 s	○	

1) Shaded parts are shown based on the selection in Freq mode of [DRV-04].
2) Shaded parts are shown when [multi-step speed] is selected in [IO-14 to 28] terminal setting.
3) Shaded parts are shown when [acceleration/deceleration] is selected in [IO-14 to 28] terminal setting.
4) Shaded parts are shown if [Pulse] is set in Freq mode of [DRV-04].

Note

Codes in shaded rows (▭) are hidden codes that are displayed only when setting corresponding codes.

5.5 Cell Group

Code CEL	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
00	9500	Jump code	Jump code	Moves directly to the code you want to use.		1	○	
01	9501	Select CAN mode	Can mode	Display status of CAN communication mode.		Compare mode	X	
02	9502	Total layers	Total Stair	Indicates number of layers of cells.		1	X	
03	9503	Maximum layers	Max Stair	Maximum layers of cells used for operation.		1	X	
04	9504	U-phase communications status	U CAN Status	Connection status of communications between cells in U, V, W phases and the master.		00000000 0000	X	
05	9505	V-phase communications status	V CAN Status			00000000 0000	X	
06	9506	W-phase communications status	W CAN Status			00000000 0000	X	
07	9507	Status of U-phase protective operation	U ProtStatus	Fault status of cells in U, V and W phase.		00000000 0000	X	
08	9508	Status of V-phase protective operation	V ProtStatus			00000000 0000	X	
09	9509	Status of W-phase protective operation	W ProtStatus			00000000 0000	X	
10	950A	Cell setting	Go Setting	Manually set the cell bypass.		No	X	
11	950B	U-phase bypass	BPU 87654321	Used when setting bypass in U, V, and W phases.		00000000 0000	X	
12	950C	V-phase bypass	BPV 87654321			00000000 0000	X	
13	950D	W-phase bypass	BPW 87654321			00000000 0000	X	
16	9510	Status of U-phase bypass	BPU 12 to 1	Used when confirming status of bypass in U, V, and W phases.		00000000 0000	X	
17	9511	Status of V-phase bypass	BPV 12 to 1			00000000 0000	X	
18	9512	Status of W-phase bypass	BPW 12 to 1			00000000 0000	X	
21	9515	Status of upper cell layers in U-phase	U_Uper _Stair	Indicates upper cell layers in U-phase after bypass.		0000		
22	9516	Status of cell layers in U-phase.	U_Lowe _Stair	Indicates lower cell layers in U-phase after bypass.		0000		

Code CEL	Communications Address	Function Name	Keypad Display	Functional Description	Range	Default Value	Changeable during Operation	Remarks
23	9517	Status of upper cell layers in V-phase.	V_Uper _Stair	Indicates upper cell layers in U-phase after bypass.		0000		
24	9518	Status of cell layers in V-phase.	V_Lowe _Stair	Indicates lower cell layers in V-phase after bypass.		0000		
25	9519	Status of upper cell layers in W-phase	W_Uper _Stair	Indicates upper cell layers in W-phase after bypass.		0000		
26	951A	Status of cell layers in W-phase	W_Lowe _Stair	Indicates lower cell layers in W-phase after bypass.		0000		
30	951E	Bypass mode selection	Bypass Mode	▪ No: Bypasses by user selection. ▪ ManualBypass: ▪ When designated fault occurs, press RESET key from master for automatic bypass. ▪ Auto-Bypass: ▪ When designated fault happens, checks overall faults and then bypasses automatically to keep operable status.		No	X	
35	9523	Cell status reinstating	All Back	Initializes the bypass		No	X	

6. Functional Configurations of LSMV Drive

LSMV drive has many functions. This chapter describes the most frequently used functions in detail.

6.1 Configure Basic Functions

In the basic functions part, configuration parameters essential to LSMV drive operation are configured. If you do not set a parameter, it is set to the default value that is configured when the product is shipped from the factory. We recommend you use the default values unless you have a particular reason to change them.

■ Common Settings

Common settings refer to common parameter settings that are not relevant to the control method and that need to be configured and confirmed by the user.

Item	Code Number	Functional Description
Power frequency	FU1-20	Sets input power frequency of the drive.
Maximum frequency	FU1-21	Sets maximum output frequency of the drive.
Base frequency	FU1-22	Sets base frequency of the motor.
Start frequency	FU1-23	Sets frequency for starting operation.
Motor voltage	FU2-31	Sets rated voltage of the motor.
Motor rated current	FU2-34	Sets rated current of the motor.
Motor no-load current	FU2-35	Sets no-load current of the motor.
Operation mode	DRV-03	Sets a method of operation command. Sets a method of operation command. Selects one from Keypad, Fx/Rx-1, Fx/Rx-2, and Int 485.
Frequency mode	DRV-04	Sets a method for frequency command.
Setting Accel/Decel time	DRV-01, DRV-02	Sets basic Accel/Decel time.

■ About V/F Control

The initial value of control mode is V/F mode. Complete the common settings under V/F control mode and then check the following functions to use V/F control.

6.2 Frequency Setting Methods

There are three ways to set target frequency on a drive: operation with keypad, command by communications, and frequency setting with analog input signal.

■ Keypad Frequency Setting

The following parameters are used when setting up frequency with the keypad.

Item	Code Number	Value	Functional Description
Frequency mode	DRV-04	Keypad-1 Keypad-2	Sets power frequency.
Maximum frequency	FU1-21	Decides according to the situation	Sets maximum output frequency of the drive.
Base frequency	FU1-22	Same as previous	Sets base frequency of the motor.
Start frequency	FU1-23	Same as previous	Sets frequency for starting operation.
Motor voltage	FU2-31	Same as previous	Sets rated voltage of the motor.
Motor rated current	FU2-34	Same as previous	Sets rated current of the motor.
Motor no-load current	FU2-35	Same as previous	Sets no-load current of the motor.
Operation mode	DRV-03	Same as previous	Sets a method of operation command. Selects one from Keypad, Fx/Rx-1, Fx/Rx-2, and Int 485.

■ Frequency setting via V1

This method sets command frequency of the drive via V1 terminal on the analog input board which is a kind of master controller.

Code	Displayed Message	Function Name	Functional Description
I/O-01	V1 filter	Time constant of V1 input filter	Sets time constant for built-in filter of V1 terminal while inputting frequency settings from outside.
I/O-02	V1 volt x1	Minimum input voltage	Sets V1 input voltage from which the minimum frequency is generated.
I/O-03	V1 freq y1	Frequency corresponding to minimum input voltage	Output frequency that corresponds to V1 minimum input voltage.
	V1 [**] y1	Control amount corresponding to minimum input voltage	Target control amount that corresponds to V1 minimum input voltage.
I/O-04	V1 volt x2	Maximum input voltage	Sets V1 input voltage from which the maximum frequency is generated.
I/O-05	V1 freq y2	Frequency corresponding to the maximum input voltage	Output frequency that corresponds to V1 maximum input voltage.
	V1 [**] y2	Control amount corresponding to maximum input voltage	Target control amount that corresponds to V1 maximum input voltage.

Note

Increase the value of the filter time constant if the drive is affected by noise which causes unstable operation.
However, the responsiveness may be reduced if you increase the value of time constant too much.

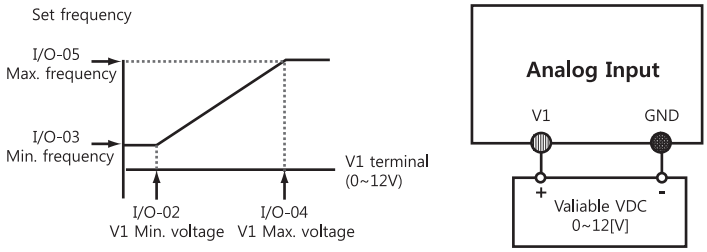


Figure 6-1 Frequency commands by voltage and wiring diagram

■ Frequency Setting via Current (I Terminal)

This method sets command frequency of the drive via I terminal on the analog input board which is a kind of master controller.

Code	Displayed Message	Function Name	Functional Description
I/O-06	I filter	I input filter time constant	Sets time constant for built-in filter of I terminal while inputting frequency settings from outside.
I/O-07	I curr x1	Minimum input current I	Sets minimum input current I from which the minimum frequency is generated.
I/O-08	I Freq y1	Frequency corresponding to minimum input current I	Output frequency that corresponds to minimum input current I.
	I [**] y1	Control amount corresponding to minimum input current I	Target control amount that corresponds to minimum input current I.
I/O-09	I curr x2	Maximum input current I	Sets maximum input current I from which the maximum frequency is generated.
I/O-10	I Freq y2	Frequency corresponding to maximum input current I	Output frequency corresponding to maximum input current I.
	I [**] y2	Control amount corresponding to the maximum input current I	Target control amount that corresponds to maximum input current I.

Note

Increase the value of the filter time constant if the drive is affected by noise which causes unstable operation.
However, the responsiveness may be reduced if you increase the value of time constant too much.

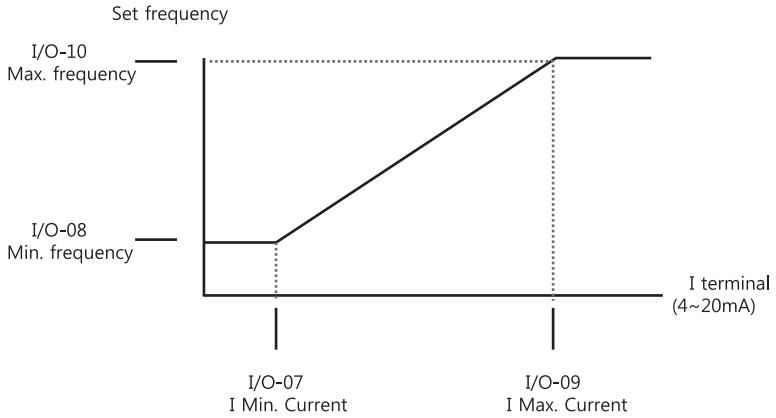


Figure 6-2 Frequency commands by current

■ Frequency Setting via Pulse

This method sets command frequency with “EN_AT, EN_BT”, the control terminal on analog input board. IT is used when setting [Pulse] in [DRV-04] frequency mode.

Code	Displayed Message	Function Name	Functional Description
DRV-04	Freq Mode	Frequency mode	Select a mode for command frequency setting of the drive.
I/O-84	P Pulse Set	Set pulse mode	Sets use of either four times multiplier signal or one time multiplier signal.
I/O-85	P filter	Time constant of pulse input filter	Sets time constant for built-in filter of pulse terminal while inputting frequency settings from outside.
I/O-86	P pulse x1	Minimum input pulse P	Set pulse frequency of input P from where minimum frequency is generated.
I/O-87	P Freq y1	Frequency corresponding to minimum input pulse P	Output frequency that corresponds to the minimum input pulse P.
	P [**] y1	Control amount corresponding to minimum input pulse P	Target control amount that corresponds to the minimum input pulse P.
I/O-88	P pulse x2	Maximum input pulse P	Sets pulse frequency of input P from where maximum frequency is generated.
I/O-89	P Freq y2	Frequency corresponding to maximum input pulse P	Output frequency that corresponds to maximum input pulse P.
	P [**] y2	Control amount corresponding to maximum input pulse P	Target control amount that corresponds to the maximum input pulse P.

Note

Increase the value of the filter time constant if the drive is affected by noise which causes unstable operation. However, the responsiveness may be reduced if you increase the value of time constant too much.

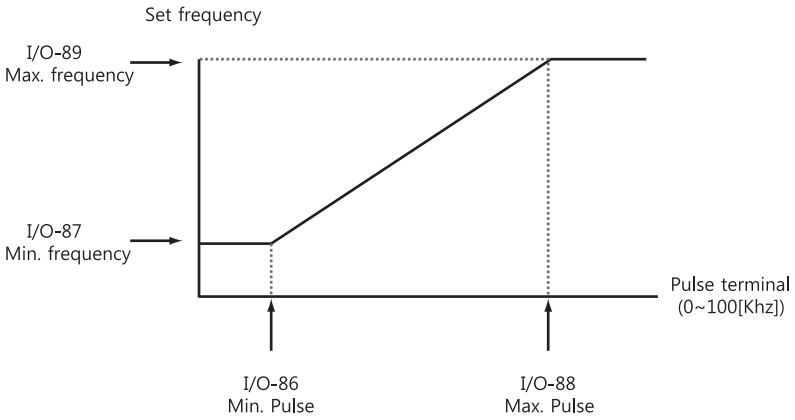


Figure 6-3 Frequency commands via pulse

■ Frequency Setting via Communications

Frequency command can be performed via RS-485, an internal communications function that is built-in by default on the master controller. Use this by connecting to “S+”, “S-” of the terminal. To communicate between the drive and computer via RS-485, set Drive ID to [I/O-90]. Set [I/O-91] communications speed to RS-485 communications speed.

Code	Display	Function Name	Default Value	Setting
DRV-04	Freq Mode	Frequency setting	0	Init. 485 (setting)
I/O-90	Inv. no	Drive ID	1	1 ~ 250
I/O-91	Baud rate	Communications speed	38400 bps (Changeable for different situations)	1200 bps 2400 bps 4800 bps 9600 bps 19200 bps 38400 bps
I/O-94	Delay Time	Communications delay time	5 ms	2 - 1200 ms

6.3 Operation Command Methods

There are four command methods to operate LSMV drives. They are as follows:

DRV-03 Data setting	Functional Description
Keypad	Operates and stops using keypad.
Fx/Rx-1	Operates and stops with external control terminal command (FX, RX). ▪ FX: Forward operation and stop command terminal ▪ RX: Reverse operation and stop command terminal
Fx/Rx-2	Operates and stops by changing the function of external control terminal (FX, RX). ▪ FX: Operation and stop command terminal ▪ RX: Forward/Reverse selection terminal
Int. 485	Operates and stops via built-in RS-485 communications. (MV SystemView)

■ Operation command by keypad

For more details about how to use keypad, refer to Chapter 3.

DRV-03 Data Setting	Functional Description
Keypad (setting)	Operates and stops using keypad.

- FWD key on keypad: Forward operation of motor
- REV key on keypad: Reverse operation of motor
- STOP key on keypad: Stops the motor.

■ Operation command by terminal

DRV-03 Data Setting	Functional Description
Fx/Rx-1 (setting) Fx/Rx-2 (setting)	Operates and stops using terminal.

2 data settings in IO-14 to 28	Functional Description
FX setting RX setting	Can operate and stop the drive according to terminal signal that is set to FX, RX.

- Fx/Rx – 1: Operate and stop with external control terminal command (FX/RX).
  - Fx: Forward operation and stop command terminal
  - Rx: Reverse operation and stop command terminal

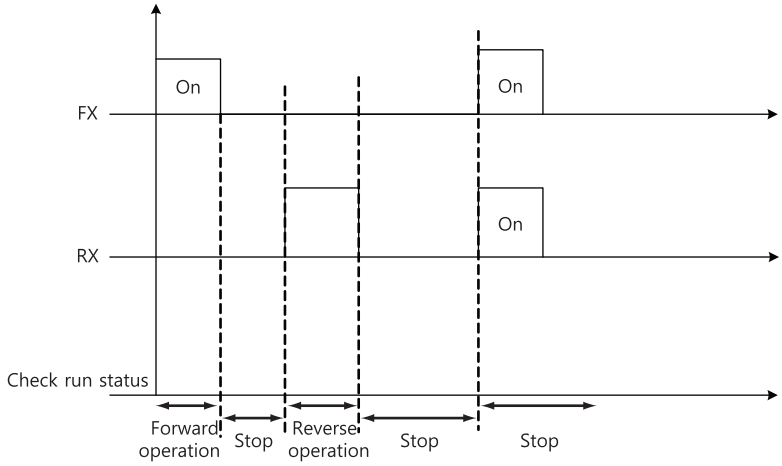


Figure 6-4 Terminal block operation (Fx/Rx-1)

- Fx/Rx – 2: Operates and stops by changing the function of external control terminal (FX, RX).
  - FX: Operation and stop command terminal
  - RX: Forward/reverse selection terminal

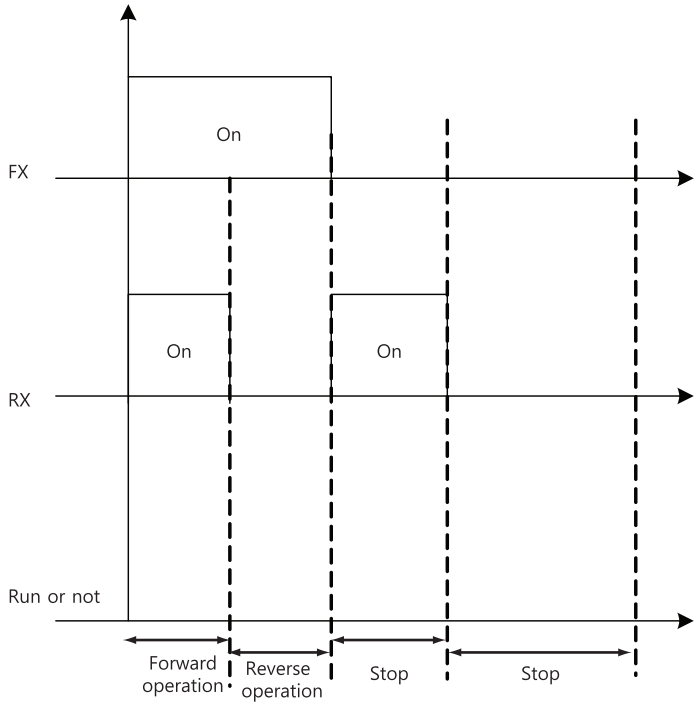


Figure 6-5 Terminal block operation (Fx/Rx-2)

■ Operation Command via Communications

Int. 485 : Operates and stops via built-in RS-485 communications.

6.4 Start mode

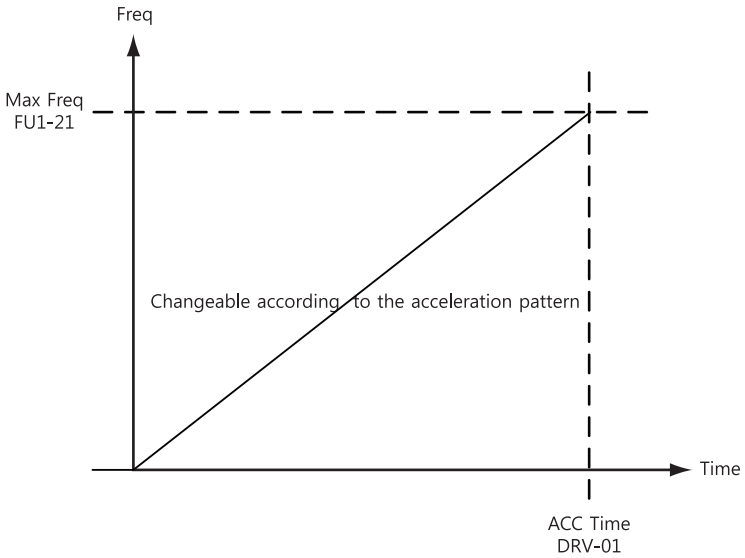
There are three ways to start the drive: ACC, DC-start and flying-start.

- ACC: This is the most frequently used acceleration method. This method accelerates with an increase of frequency or voltage as time passes.
- DC-Start: This method is used when you restart a motor which has been rotating for a long period with high load inertia and frequency of less than 1 - 2 Hz after stopping it. It is also used for motor excitation when using the sensorless control method.
- Flying-start: This method finds the motor frequency in the drive while the motor rotates (when Free Run drive gate is off), and then operates up to a target frequency. This method is used when you need to operate the drive without stopping the motor.

■ ACC Start

This is an acceleration method where frequency increases as time passes. The acceleration pattern is explained as follows:

FU1-06	Start mode accel (setting)	
Related functions	DRV-01	Acceleration time
	FU1-02	Acceleration pattern setting
	FU2-71	Accel/Decel reference frequency



■ DC-Start

FU1-06	Start mode DC-start (setting)	
Related functions	DRV-01	Acceleration time
	FU1-07	DC-start time
	FU1-08	Amount of DC current

Note

Be sure to set the amount of DC excitation so that it does not exceed the rated current of the drive. Otherwise, it may cause motor overheating, overload trip and output open-phase.

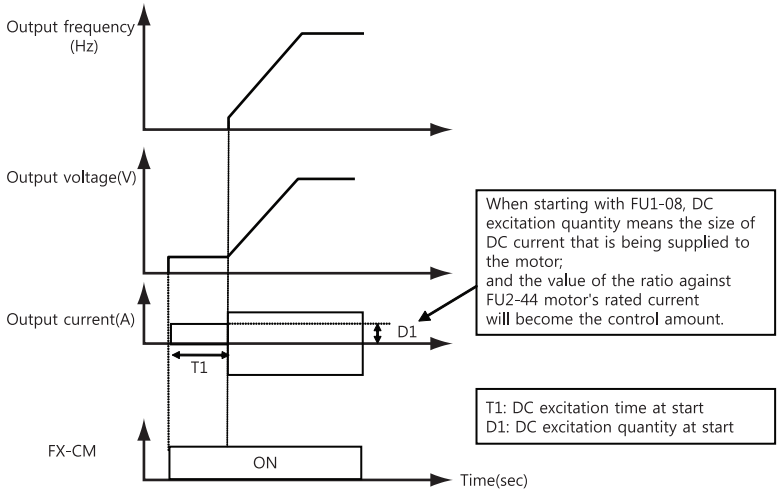


Figure 6-6 DC excitation upon start up

■ Flying-Start

FU1-06	Start mode DC-start (setting)	
Related functions	DRV-02	Deceleration time
	FU2-21	Speed search current amount
	FU2-34	Motor rated current

FU2-21	Flying start percentage (speed search)	
Flying perc	Initial value	50%
	Range	50 ~ 160%

Use the speed search function when you want to operate the drive while the motor is in Free Run (while the motor is stopped). [FU2-21] Flying start percentage is the percentage value of the amount of current against rated current of the motor [FU2-34] during speed search.

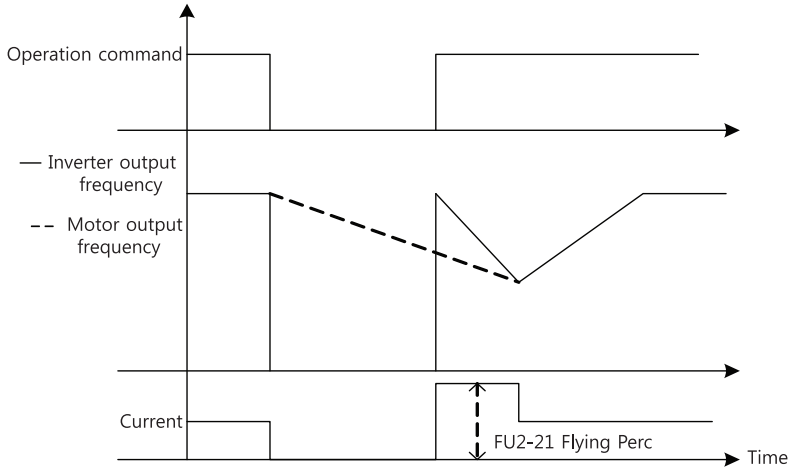


Figure 6-7 Flying-Start

Note

- If you set a small percentage value (current amount) while loading is large, speed search may not perform correctly.
- It does not work if there is a fault.

6.5 Stop mode

There are three ways to stop the drive: Free Run, DC-Brake and Decel.

- Free Run: This method blocks the drive gate when performing the stop command, and it does not apply any voltage or frequency to the motor. It stops only by inertia and load of the motor.
- DC-Brake: This method performs deceleration stop while the frequency is higher than the specified frequency, and then supplies DC current to stop after specified frequency is reached.
- Decel: This method sends a stop command and then uses frequency deceleration to stop.

■ Stops free run

FU1-09	Stop mode Free Run (setting)	
Related functions	DRV-02	Deceleration time

If you issue a stop command during drive operation, drive gate is blocked, and voltage and frequency output become 0.

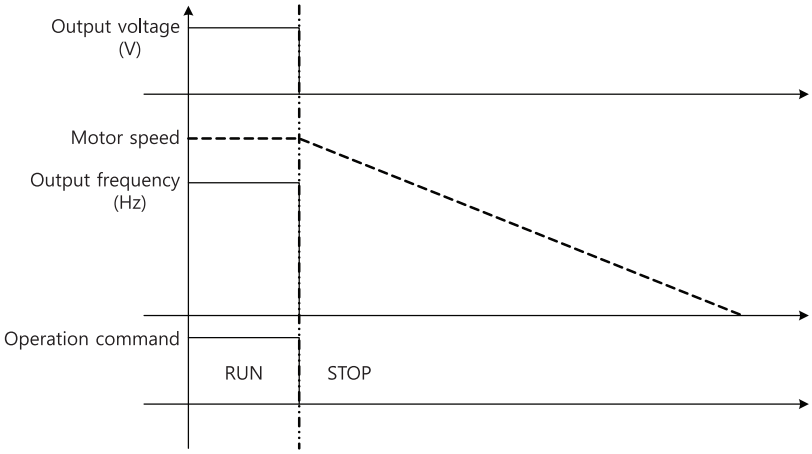


Figure 6-8 Free Run stop

■ Decel Stop

FU1-09	Decel stop mode (setting)	
Related functions	DRV-02	Deceleration time

When the drive receives a stop command, it decelerates the frequency to 0 Hz according to DRV-02 deceleration time and output frequency ratio.

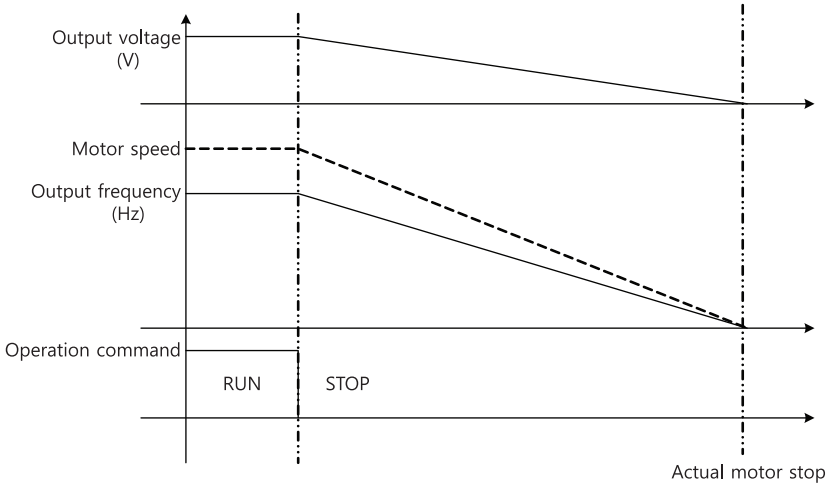


Figure 6-9 Decel stop

■ Stop via DC-Brake

FU1-10	Output blocking time before DC braking	
FU1-11	DC braking frequency	
FU1-12	DC braking time	
FU1-13	DC braking quantity	
Related functions	FU1-09	Stop mode
	FU2-34	Rated current of the motor

DC-Brake stop is used when you want to stop the drive by supplying DC voltage to the motor in order to adjust stopping accuracy, such as positioning according to the load.

- When DC braking is selected in [FU1-09] stop mode, it decelerates to the DC braking frequency that is set in [FU1-11]DC braking frequency when stopped. It then performs DC braking action at that frequency.
- When the load is high, make DC braking quantity small and DC braking timing long. When the load is low, make DC braking quantity large and DC braking timing short. Be careful when you use a high-inertia load.
- [FU1-10] output blocking time before DC braking indicates the time taken to block drive output before you start DC braking.
- [FU1-12] DC braking time indicates the time required to supply DC to the motor.
- [FU1-13] DC braking quantity indicates the DC quantity supplied to the motor.
- [FU2-34] is the rated current standard of the motor.

Note

- Do not set the DC braking quantity above the rated current of the drive. It may cause motor overheat or overload trip.
- Do not set DC braking frequency too high. (Recommended range: 0 - 5 Hz) It may affect braking performance.
- If you set short output blocking time before DC braking, it may cause drive trip.

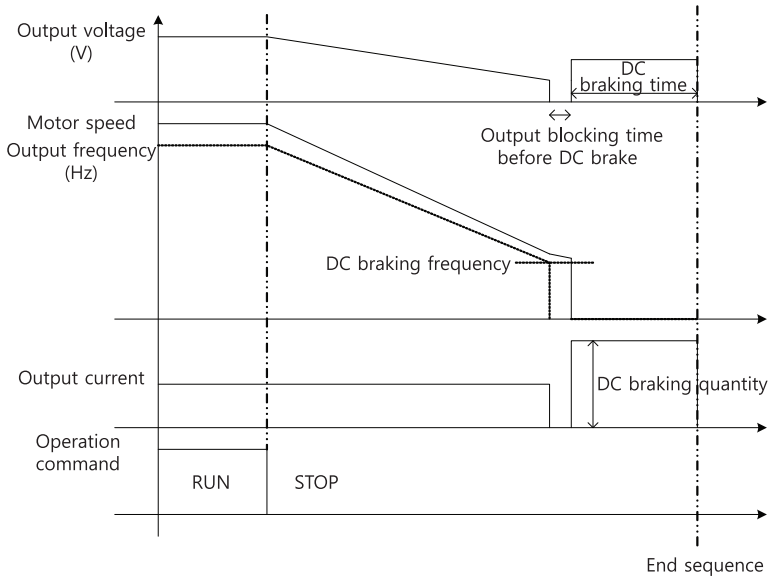


Figure 6-10 Stop via DC-Brake

6.6 Frequency Accel/Decel Curve

FU1-02~03	Accel/Decel Pattern	
Related functions	FU1-71	Accel/Decel reference frequency

FU1-02,03 Setting Data	Functional Description
Linear	Linear Accel/Decel pattern. Used for general purposes. (Factory default value)
S-curve	▪ S-shape Accel/Decel pattern Takes about 40% longer than linear Accel/Decel. ▪ Has shock-resistant effect. Therefore, prevents things from shaking on a device such as conveyor. ▪ If Accel/Decel reference frequency is set to maximum frequency, you can choose the slope by separately setting points on a curve for start and for the target frequency. Various S shapes are available by setting slopes for the starting point and ending point. ▪ S-shape becomes more perfect if Accel/Decel reference frequency is set to delta frequency, because in this case Accel/Decel time is applied according to the set frequency. ▪ FU1-04 is the slope for the S curve starting point. ▪ FU1-05 is the slope for S curve ending point.
U-curve	▪ U shape Accel/Decel pattern. Use when smooth operation is needed for Accel/Decel.

■ Linear

FU1-02~03	Accel/Decel Pattern	
Related functions	FU1-02	Linear (acceleration setting)
	FU1-03	Linear (deceleration setting)

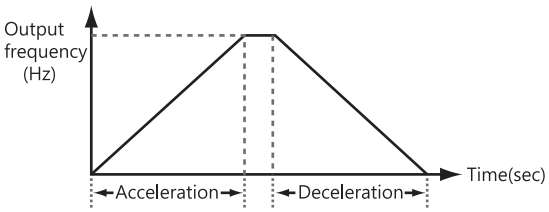


Figure 6-11 Linear Accel/Decel pattern

■ S-curve

FU1-02~03	Accel/Decel Pattern	
Related functions	FU1-02	S-curve (acceleration setting)
	FU1-03	S-curve (deceleration setting)

FU1-02~03	Accel/Decel pattern (S-curve)	
Related functions	DRV-01	Accel time (time for acceleration)
	DRV-02	Decel time (time for deceleration)
	FU1-04	Curve start point
	FU1-05	Curve end point

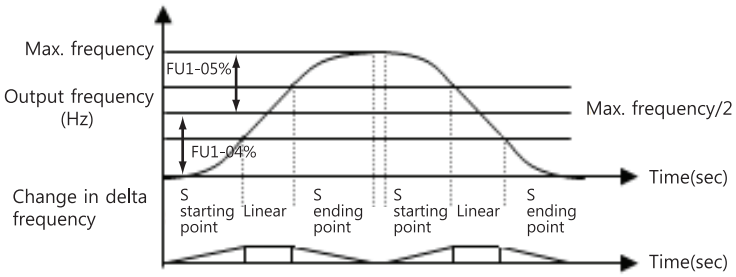


Figure 6-12 S-Curve Accel/Decel pattern

The following are S-curve related formulas. These become longer than Accel/Decel time that is set when increasing percentage values of [FU1-04]and [FU1-05].

- Actual acceleration time = set acceleration time + set acceleration time * starting point slope/2 + set acceleration time * ending point slope/2
- Actual deceleration time = set deceleration time + set deceleration time * starting point slope/2 + set deceleration time * ending point slope/2

■ U-curve

FU1-02~03	Accel/Decel Pattern	
Related functions	FU1-02	U-curve (acceleration setting)
	FU1-03	U-curve (deceleration setting)

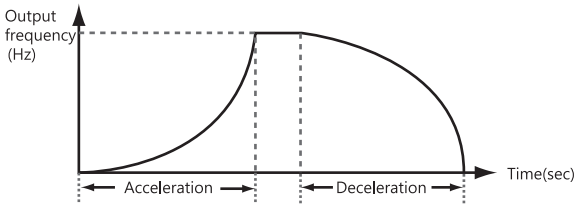


Figure 6-13 U-curve Accel/Decel pattern

U-curve Accel/Decel processes Accel/Decel in a shape shown in the previous figure.

6.7 Frequency Limit Function

Set the following parameters to use frequency limit function.

FU1-24	Frequency upper/lower limit selection	
FU1-25	Lower limit frequency	
FU1-26	Upper limit frequency	
Related functions	FU1-21	Maximum frequency

Code	Displayed Message	Default Value	Range
FU1-24	Freq limit	No	No/Yes
FU1-25	F-limit Lo	0.5 Hz	Starting frequency to frequency upper limit
FU1-26	F-limit Hi	60 Hz	Frequency lower limit to maximum frequency

This function restricts the target frequency of the drive. Output frequency of the drive is restricted to within the range between the upper limit and the lower limit. If the frequency of the drive is set out of the range between the upper limit and the lower limit range, the target frequency is set to the upper limit or the lower limit. If frequency is set below the lower limit, the drive operates with the lower limit value. It accelerates/decelerates normally if the frequency is lower than the lower limit.

6.8 Setting Fault Detection

MV drives have different functions for fault detection. Fault detection functions include user-selected fault detection, as well as self fault detection by the drive.

■ Overcurrent (Output OCT)

Blocks drive output if the output is more than 140% of the rated current for the drive. (Basic fault detection)

■ Protect cell overcurrent (DC-Link OVT)

Blocks drive output when DC-Link voltage of the cell exceeds 1050 V. (Basic fault detection)

■ Input Overvoltage Protection (Input OVT)

Blocks drive output when the voltage of the transformer input terminal is higher than 120% of the specified reference voltage. (Basic fault detection)

■ Input Low Voltage Protection (Input LVT)

Blocks drive output when voltage of transformer input terminal is lower than 70% of specified standard voltage. (Basic fault detection)

■ Overload Trip (Over Load)

Blocks drive output if the drive output exceeds the OLT (overload) level and the OLT (overload) time that you set for the rated current of the motor. (User defined fault detection)

FU1-59	Overload trip selection	
FU1-60	Overload trip level	
FU1-61	Overload trip time	
Related functions	FU2-34	Motor rated current
	I/O-37 to 44	Output setting of multi-function auxiliary contact

If the output current of the drive continues for the overload restriction time with a value that is higher than the overload limit level, it cuts off the drive output and displays a trip message. Overload trip functions [FU1-59~61] block drive output and display trip messages. Theses functions detect abnormalities in the load.

Code	Displayed Message	Function Name	Default Value	Range
FU1-59	OLT select	Overload trip selection	No	No/Yes
FU1-60	OLT level	Overload trip level	120%	30 ~ 150%
FU1-61	OLT time	Overload trip time	60 s	0 - 60 s

Note

- The value of the overload trip level is set as a percentage of the rated current of the motor.
- Overload trip only works when the heat sink temperature becomes higher than a certain temperature.

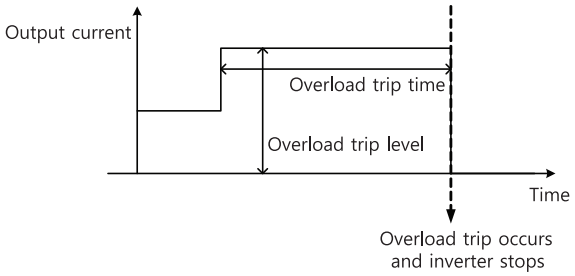


Figure 6-14 Overload trip

■ Transformer Overheat (Trans Over Heat)

The PT resistance value around the core of the transformer varies according to temperature change. Therefore, calculate the temperature of the transformer with this attribute. It compares this temperature and the transformer overheat temperature that is set in the converter installed on the panel, and then sends it to the drive as a contact signal. The drive receives the signal on the DI board and processes it as a fault. (User defined fault detection)

I/O-14~28	Transformer overheat setting
	Trans. OHT setting

■ Cell Overheat (Cell Over Heat)

Each cell is equipped with a temperature detector. The detector senses cell temperature. Each cell sends this temperature information to master controller using communications. Temperature information from the cell higher than 75 ℃ is considered a fault. (Basic fault detection)

■ Cell Fault

Each cell is equipped with a controller. A cell detects various faults through the controller, and sends detected fault information to the master controller via communications. The master controller then collects and processes the fault information received from the cell. (Basic fault detection)

■ Electronic Thermal (E-thermal)

This function protects the motor from overheat without adding extra thermal relay from outside. The drive calculates the logical temperature rise from different parameters. It judges if the motor is overheating taking load current into consideration. After electronic thermal starts, it blocks the drive output and displays a trip message. (User defined fault detection)

FU1-53~56	Electronic thermal	
Related functions	FU2-34	Motor rated current

Code	Displayed Message	Function Name	Default Value	Range
FU1-53	ETH select	Select electronic thermal	Yes	No/Yes
FU1-54	ETH 1 min	One minute level of electronic thermal	150%	Continuous operation level of electronic thermal - 200%
FU1-55	ETH cont	Electronic thermal Continuous operation level	120%	Electronic thermal level for 1 minute to 50.
FU1-56	Motor type	Motor cooling method	Self-cool	Self-cool/forced-cool

Electronic thermal level is set as a percentage value of [FU2-34] rated current of the motor.

[FU1-54] electronic thermal level for one minute is the volume of current that serves as a standard for judging motor overheat when current continuously flows for a minute.

[FU1-55] electronic thermal level for continuous operation is the volume of current that serves as a standard for judging no motor overheating and thermal equilibrium, even if load current is flows continuously. Generally, it is set to rated current of the motor (100%) and less than [FU1-54] electronic thermal level for 1 minute. It can operate continuously up to specified level.

To perform the electronic thermal function, [FU1-56] motor cooling method requires setting correctly.

Self-cool: Generally set when using a fan that is attached to an induction motor. The cooling quality deteriorates if the motor is run at low speed. The motor overheats more quickly at low speed than at high speed, even if the same volume of current is used. Therefore, the value set for the permissible continuous current of [FU1-55] electronic thermal level for continuous operation decreases by frequency as shown in the following graph, and electronic thermal function will work.

Forced-cool: Set to drive the motor cooling fan with separate power supply. Regardless of the target frequency, the value set for the permissible continuous current of [FU1-55] electronic thermal level for continuous operation is applied.

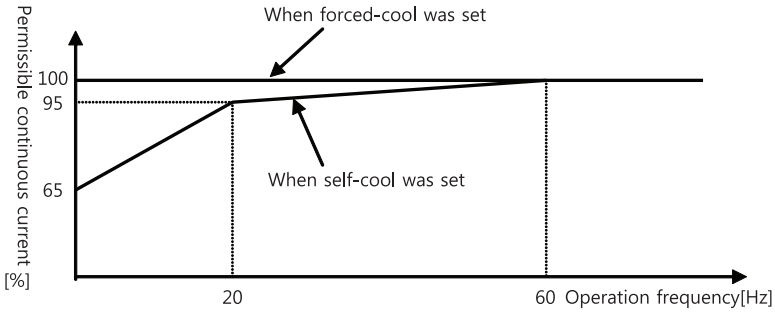


Figure 6-15 Characteristics of permissible continuous current reduction by frequency

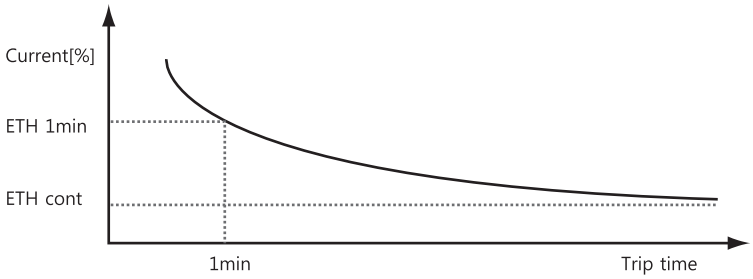


Figure 6-16 Characteristic curve of the electronic thermal level

Note

- It calculates and accumulates I^2T even when there are significant changes in output current due to load variation or frequent acceleration/deceleration, and therefore protects the motor.

External Fault 1, 2 (Ext. Trip 1, Ext. Trip 2)

These can configure a sequence circuit on the DI board according to the methods you define for fault stop and sequence setting, and process a fault. This fault detection function provides a contact signal from outside to process a fault. (User defined fault detection)

I/O-14~28	Ext. Trip
I/O-14~28	Ext. Trip 1, Ext. Trip 2 (setting)

Input Open-Phase (InPhase Open)

Blocks drive output if input (R, S and T) open-phase occurs in the transformer. Check input open-phase by detecting input voltage of the transformer. Detect faults with input open-phase if there is a phase that has 10% or less of transformer input voltage while high voltage is supplied. (Basic fault detection)

Output Open-Phase (OutPhase Open)

Blocks drive output if output (U, V and W) open-phase occurs to the driver. Check open-phase by detecting output current of the drive. (User defined fault detection)

BX Protection (BX)

This fault detection emergency stops the drive. Similar to an Ext. trip, it is implemented with a contact from outside. It detects a fault if a contact signal is received from outside. (User defined fault detection)

I/O-28	M14 Define
I/O-14~28	BX (setting)

Communications Error (COM Error, CPU Error)

Displays a fault when communications between the main board of the drive and keypad is inadequate. (Basic fault detection)

Communications Error 2 (CAN Error)

Displays a fault when communications between the master and each cell is inadequate. When a fault occurs, it stops the drive with Free Run. You can check in the master which cell is causing a communications problem. (Basic fault detection)

CEL-04	U CAN Status
CEL-05	V CAN Status
CEL-06	W CAN Status

Drive Overload (Inv.OLT)

Blocks drive output when output current of the drive exceeds regulated level (rated current 120% for 1 minute). It has the characteristic of inverse time operation. (User defined fault detection)

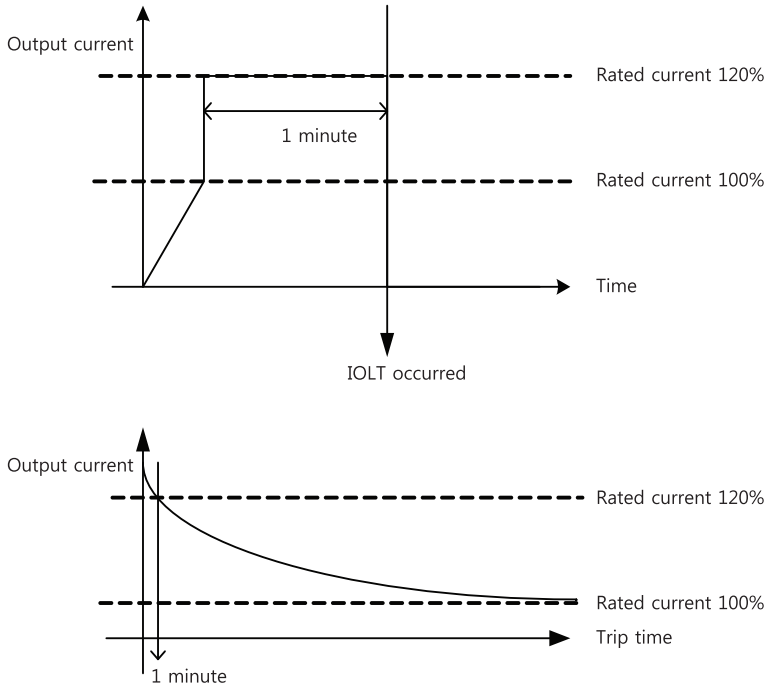


Figure 6-17 Drive overload (Inv. OLT) trip

■ Ground Fault Current Protection (Ground Fault)

If drive's output wire (input wire for motor) is grounded or insulation of the motor deteriorates and stays this way longer than set GFT level and GFT trip time that is set on the drive, it is processed as a fault and drive output is blocked. (User defined fault detection)

■ Fan Error (Fan Trip)

This fault is used to stop drive when the fan that is installed on the system panel for drive cooling is broken. Similar to an Ext. trip, it is implemented with a contact from outside. It detects a fault if a contact signal is received from outside. (User defined fault detection)

I/O-14~28	M Define
I/O-14~28	Fan trip (setting)

■ UPS Control Power Shortage (Control LVT)

Generally, high voltage power for the transformer input terminal and low voltage power for controller operation are supplied to a drive. UPS keeps constant low voltage power on the controller part in case of instantaneous power interruption or unstable power supply. This is a user-defined fault that blocks output when the drive cannot operate due to insufficient capacity of UPS used to supply power. When an input power and control power problem signal is received via input terminal (DI), contact signal will be sent via the terminal. If the user-defined time has passed, it issues a fault detection signal.

I/O-14~28	M define
I/O-14~28	Control LV (setting)

I/O-98	UPS off time
I/O-14~28	Time by UPS capacity (setting)

6.9 Input Terminal Settings

I/O-14~28	Selects multi-function input terminal.
I/O-32	Selects normal open / normal close.
I/O-33	Allowed time for input change

Code	Displayed Message	Default Value	Range
I/O-14	M0 define	SPEED-L (multi-step speed - low)	Refer to the following table:
I/O-15	M1 define	SPEED-M (multi-step speed - medium)	″
I/O-16	M2 define	SPEED-H (multi-step speed - high)	″
I/O-17	M3 define	RST	″
I/O-18	M4 define	Ext Rrip1	″
I/O-19	M5 define	JOG	″
I/O-20	M6 define	FX	″
I/O-21	M7 define	RX	″
I/O-22	M8 define	None	“
I/O-23	M9 define	None	“
I/O-24	M10 define	Trans. OHT	“
I/O-25	M11 define	Fan Trip	“
I/O-26	M12 define	High Voltage	“
I/O-27	M13 define	Run_Enable	“
I/O-28	M14 define	BX	“

Defines multi-function input terminal functions. The following functions can be defined in multi-function input terminals M0, M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M12, M13 and M14.

■ Range of Multi-Function Input Terminal Setting and Function Names

I/O-14 to 28 Value	Function Name	I/O-14 to 28 Value	Function Name
FX	Forward run/stop	Analog hold	Hold analog command frequency
RX	Reverse run/stop	Ana Change	Analog input change
RST	Reset	XCEL stop	Prohibit Accel/Decel
JOG	Jog	LOC/REM	Select local/remote
BX	BX (emergency stop)	Door Open	Panel door open trip
Speed-L	Multi-step speed - low	Trans.OHW	Transformer overheat information
Speed-M	Multi-step speed - medium	Trans.OHT	Transformer overheat trip
Speed-H	Multi-step speed - high	Motor OHT	Motor overheat trip
Speed-X	Multi-step speed - additional selection	Fan Trip	Fan trip
XCEL-L	Multi-step Accel/Decel - low	Ext Trip1	External trip 1
XCEL-M	Multi-step Accel/Decel - medium	Ext Trip2	External trip 2
XCEL-H	Multi-step Accel/Decel - high	High Voltage	High voltage input

I/O-14 to 28 Value	Function Name	I/O-14 to 28 Value	Function Name
Up	Increase (up-down)	Run Enable	Selects availability of operation command
Down	Decrease (up-down)	Control LV	Supplies control power by UPS
3-Wire	3 wire	None	Does not have any function

- FX: Sets the terminal as a forward operation command terminal.
- RX: Sets the terminal as a reverse operation command terminal.
- Reset: Sets the terminal as a terminal to reset trip when a trip situation occurs.
- JOG: Sets the terminal as a jog operation terminal.
- BX: Sets internally set terminal as an emergency stop terminal.

Note

If BX terminal is input, the motor will Free Run. To restart the motor, do not reset BX until the motor in Free Run completely stops. Otherwise, it may cause an overvoltage fault.

- Speed-L, Speed-M, Speed-H, Speed-X (Multi-step speed): Refer to [DRV-05 to 07], [I/O-15 to 29], [I/O-58 to 69] multi-step speed operation.

I/O-57 to 69	Jog frequency / multi-step speed operation	
Related functions	DRV-04	Frequency mode
	DRV-05 to 07	Multi-step 1, 2, 3 speed
	I/O-14 to 28	Selects multi-function input terminal.
	I/O-31	Filter time constant of input terminal
	I/O-34	Allowed time for input change

- It defines input terminals M0, M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M12, M13 and M14 for multi-step speed operation. The command speed is determined as on the following table according to the combination of terminals of JOG, Speed-L, Speed-M, Speed-H and Speed-X.

Related Code	Speed-X	Speed-H	Speed-M	Speed-L	JOG	Command Speed
DRV-00	0	0	0	0	0	Speed-0
I/O-57	X	x	x	x	1	Jog frequency
DRV-05	0	0	0	1	0	Speed-1 (speed 1)
DRV-06	0	0	1	0	0	Speed-2 (speed 2)
DRV-07	0	0	1	1	0	Speed-3 (speed 3)
I/O-58	0	1	0	0	0	Speed-4 (speed 4)
I/O-59	0	1	0	1	0	Speed-5 (speed 5)
I/O-60	0	1	1	0	0	Speed-6 (speed 6)
I/O-61	0	1	1	1	0	Speed-7 (speed 7)
I/O-62	1	0	0	0	0	Speed-8 (speed 8)
I/O-63	1	0	0	1	0	Speed-9 (speed 9)
I/O-64	1	0	1	0	0	Speed-10 (speed 10)
I/O-65	1	0	1	1	0	Speed-11 (speed 11)

Related Code	Speed-X	Speed-H	Speed-M	Speed-L	JOG	Command Speed
I/O-66	1	1	0	0	0	Speed-12 (speed 12)
I/O-67	1	1	0	1	0	Speed-13 (speed 13)
I/O-68	1	1	1	0	0	Speed-14 (speed 14)
I/O-69	1	1	1	1	0	Speed-15 (speed 15)

- 0 : OFF, 1: ON, x: Not considered (JOG takes priority.)
- Speed-L: Least significant bit of input for multi-step speed setting
- Speed-M: Medium bits of input for multi-step speed setting
- Speed-H: Significant bits of input for multi-step speed setting
- Speed-X: Most significant bit of input for multi-step speed setting

Note

Speed-0 command speed is a value reflected from the setting in [DRV–04].

DRV-04 Data Setting	Speed 0 Frequency of DRV-00	Frequency Command Position
Keypad-1	Digital command frequency	Keypad setting
Keypad-2	Digital command frequency	Keypad setting
V1	Analog command frequency	Terminal input
Pulse	Analog command frequency	Terminal input
I	Analog command frequency	Terminal input
V1+I	Analog command frequency	Terminal input
Int. 485	Communications command frequency	Terminal input

For example:

- M1 input terminal = Speed-L
- M2 input terminal = Speed-M
- M3 input terminal = Speed-H
- M4 input terminal = Jog setting
- M5 input terminal = BX
- M7 input terminal = FX
- M8 input terminal = RX setting

Multi-step speeds are set in [DRV-05 to 06] and [I/O-37 to 69], and perform multi-step speed operation as follows.

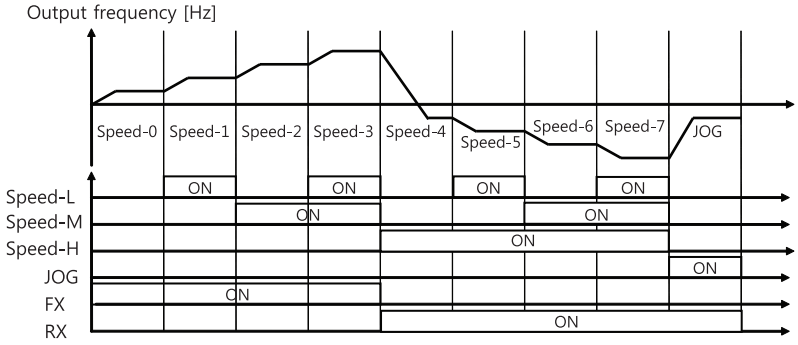


Figure 6-18 Jog and multi-step speed operation

- XCEL-L, XCEL-M, XCEL-H (multi-step Accel/Decel): Refer to [I/O-70 to 83] Accel/Decel time 1 to 7.

I/O-70~83	No. 1 to 7 Accel/Decel time	
Related functions	DRV-01, 02	No. 0 Accel/Decel time
	FU1-71	Accel/Decel reference frequency
	FU1-72	Accel/Decel time unit change
	I/O-14 to 28	Selects multi-function input terminal.
	I/O-32 to 33	Selects normal open / normal close.
	I/O-34	Allowed time for input change

You can set the multi-function input terminal to XCEL-L, XCEL-M and XCEL-H to combine these while in operation, and then change the Accel/Decel time of [I/O-70 to 83] from 1 to 7 time setting values for Accel/Decel. It can be changed to Accel/Decel time, which is predefined by an external contact signal. Selects multi-step Accel/Decel for multi-function external contact input (M1, M2 and M3) and uses this external contact input while operating the drive to apply Accel/Decel time 1 to 7.

Code	Displayed Message	Function Name	XCEL-H	XCEL-M	XCEL-L	Default Value
DRV-01	Acc time	No. 0 Acc time	0	0	0	60 s
DRV-02	Dec time	No. 0 Dec time	0	0	0	180 s
I/O-70	ACC-1	No. 1 Acc time	0	0	1	60 s
I/O-71	DEC-1	No. 1 Dec time	0	0	1	180 s
I/O-72	ACC-2	No. 2 Acc time	0	1	0	90 s
I/O-73	DEC-2	No. 2 Dec time	0	1	0	270 s
I/O-74	ACC-3	No. 3 Acc time	0	1	1	120 s
I/O-75	DEC-3	No. 3 Dec time	0	1	1	360 s
I/O-76	ACC-4	No. 4 Acc time	1	0	0	150 s
I/O-77	DEC-4	No. 4 Dec time	1	0	0	450 s
I/O-78	ACC-5	No. 5 Acc time	1	0	1	120 s
I/O-79	DEC-5	No. 5 Dec time	1	0	1	360 s
I/O-80	ACC-6	No. 6 Acc time	1	1	0	90 s
I/O-81	DEC-6	No. 6 Dec time	1	1	0	270 s
I/O-82	ACC-7	No. 7 Acc time	1	1	1	60 s
I/O-83	DEC-7	No. 7 Dec time	1	1	1	180 s

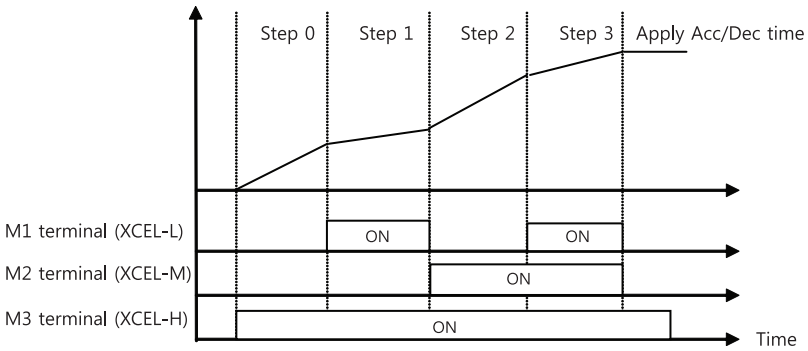


Figure 6-19 Applying Accel/Decel time

- Up/down (upward and downward operation): Define with up and down operation terminals and combine the terminals to perform acceleration, deceleration and constant speed operation as shown in the following figure. The upper limit is maximum frequency.

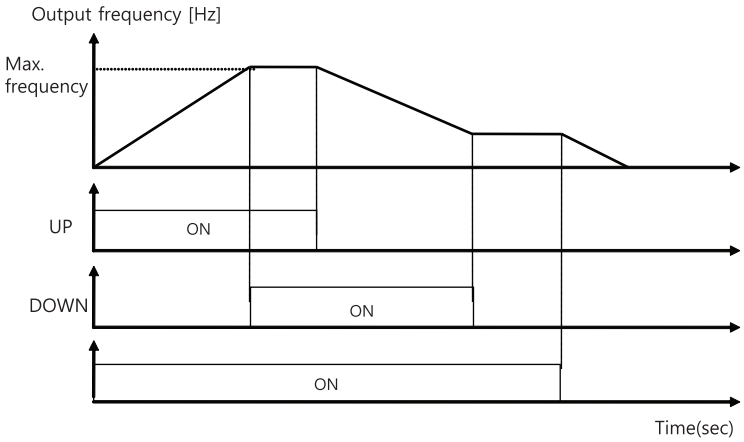


Figure 6-20 UP/DOWN operation

- 3-wire: Operates by setting multi-function input terminal to 3-wire. A simple sequence circuit shown as follows can be configured using the push button switch.

  (For example, M1 terminal is set to FX, M2 terminal to RX, and M3 terminal is set to 3-wire.)

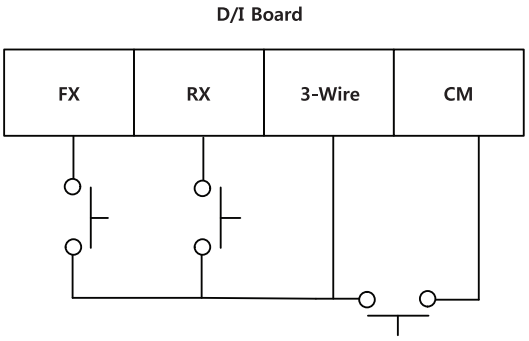


Figure 6-21 Connection example of 3-wire operation

You can configure and use a circuit on a digital input board as above.

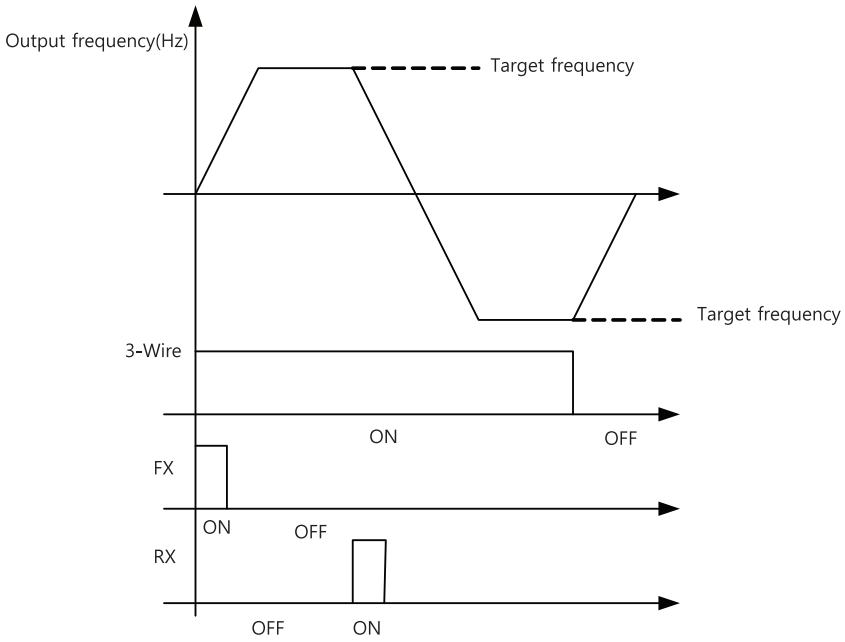


Figure 6-22 3-Wire operation

- Analog hold

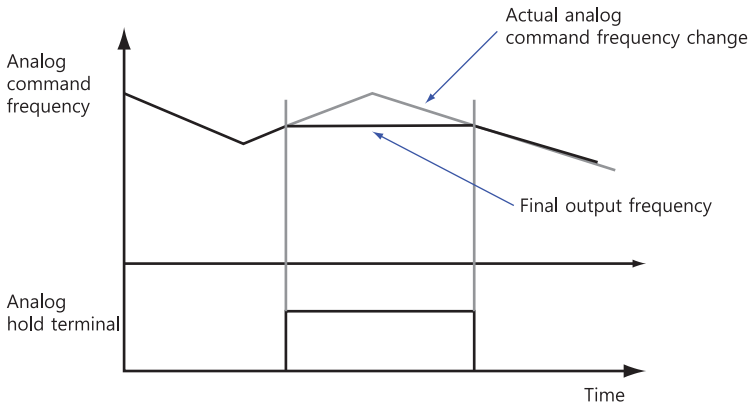


Figure 6-23 Analog Hold operation

If an analog frequency is set and a terminal that is set to “Analog hold” is ON, the analog frequency value at this time is kept. This can be applied when command frequency change is not needed in a constant speed section after the drive is accelerated. In addition, the set terminal must be OFF so that the analog frequency value continues to be reflected. Use this function in a place with lots of noise, or in a place where you can operate without reflecting analog command frequency when analog frequency value fluctuates.

- Ana change: Analog operation command is changed if set terminal is input. In V1+I operation, the default value is V1. When set terminal is ON, it is changed to I operation.

- LOC/REM: Use when you want to make two types of frequency command and operation command. Set frequency command and operation command separately in [DRV-03, 04]and [DRV-91, 92]. If the terminal that was set while the drive is stopped is ON, the drive is converted to manual operation without changing parameters. The frequency command for manual operation is applied by the value

specified in [DRV-91] frequency operation mode 2. The value specified in [DRV-91] operation mode 2 is applied to operation stop command.

Note
▪ Speed-0 command speed is a value reflected from the setting in [DRV–04].

- XCEL stop: Stops Accel/Decel if set terminal is ON.
- Door Open: Use this for safety when the drive panel door is open.
- Trans. OHW: Warning for transformer overheat. This is a signal received from the external output system. (Can be used for interlocking with auxiliary relay.)
- Trans. OHT: Trip for transformer overheat. Blocks drive output and generates a fault message if set terminal is ON.
- Motor OHT: Trip for motor overheat. Blocks drive output and generates a fault message if set terminal is ON. (Can be used as an external latch trip.)
- Fan Trip: Trip for fan fault. Blocks drive output and generates a fault message if set terminal is ON.
- Ext Trip1 (external trip1): Blocks drive output and generates a fault message if set terminal is ON. (Can be used as an external latch trip.)
- Ext Trip 2 (external trip 2): Blocks drive output and generates a fault message if set terminal is ON. (Can be used as an external latch trip.)
- High Voltage: Used to check when high voltage input is needed if the set terminal is ON and high voltage power is supplied to the drive. Receives signal from the system.
- Run Enable: Can carry out RUN command when set terminal is ON.
- Control LV: Indicates whether control power was supplied.
- None: No function is in use.

■ Viewing Status of the Terminal

I/O-29 to 30	Display of multi-function input terminal

I/O-29 to 30	Display of multi-function input terminal	
Related functions	I/O-32 to 33	Selects normal open / normal close.
	I/O-34	Allowed time for input change

Displays input status of control terminal. Lower 11 bits of information will be displayed on [I/O-29], keypad input terminal information. Upper 4 bits of information will be displayed on [I/O-30].

Input Terminal	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0
	10 bit	9 bit	8 bit	7 bit	6 bit	5 bit	4 bit	3 bit	2 bit	1 bit	0 bit
0 : OFF 1 : ON	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Input Terminal	M14	M13	M12	M11
	14 Bit	13 Bit	12 Bit	11 Bit
0 : OFF 1 : ON	0/1	0/1	0/1	0/1

■ Changing Responsiveness of I/O 14 to 28 Input Terminal

I/O-31	Filter time constant of multi-function input terminal

- Related functions:
  - [I/O-14 to 28] selects multi-function input terminal.
  - [I/O-32 to 33] selects normal open / normal close
  - [I/O-34] sets responsiveness of input terminals (M0, M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M12, M13 and M14) for allowed time for input change. It is effective to use in a place with lots of noise. Increasing the time constant value makes the response time of input terminal slower.

Code	Displayed Message	Function Name	Default Value	Range
I/O-31	Ti Filt Num	Filter time constant of multi-function input terminal	15 ms	2~1000 ms

■ Reversing or Changing Multi-Function Input Contact

I/O-32 to 33	Selects normal open / normal close.	
Related functions	I/O-14 to 28	Selects multi-function input terminal.
	I/O-34	Allowed time for input change

- Selects either normal open (contact A) or normal close (contact B) as an input contact type of control terminal M0, M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M12, M13 and M14.
- Selects input contact type of keypad.

Input Terminal	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0
	10 bit	9 bit	8 bit	7 bit	6 bit	5 bit	4 bit	3 bit	2 bit	1 bit	0 bit
0 : NO 1 : NC	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Input Terminal	M14	M13	M12	M11
	14 bit	13 bit	12 bit	11 bit
0 : NO 1 : NC	0/1	0/1	0/1	0/1

- [I/O -32] selects either normal open (contact A) or normal close (contact B) as an input contact type of lower 11 bits. Upper 4 bits select either normal open (contact A) or normal close (contact B) as an input contact type in [I/O 33].

■ Changing Valid Input Time for Multi-Function Input

- With multi-function input selected (e.g., when doing multi-step speed operation or multi-step Accel/Decel operation), this setting recognizes the input after the time allowed for input change as a valid input with the first input as a starting point. (Changes made within the valid input time are not recognized as signals.)

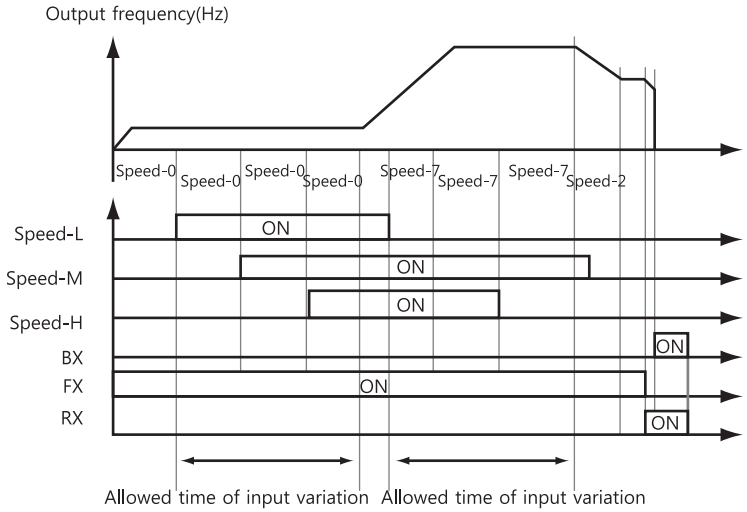


Figure 6-24 Change of allowed time for input

■ Changing Functions on Output Terminal of Multi-Function Auxiliary Contact (AXAT-AXCT)

I/O-37 to 44	Output setting of multi-function auxiliary contact (AXAT-AXCT)	
Related functions	I/O-14 to 28	Selects multi-function input terminal.

Code	Displayed Message	Function Name	Default Value	Range
I/O-37	Aux mode1	Output 1 of multi-function auxiliary contact	Ready	Refer to the following table:
I/O-38	Aux mode2	Output 2 of multi-function auxiliary contact	FAN RUN	Refer to the following table:
I/O-39	Aux mode3	Output 3 of multi-function auxiliary contact	NORMAL	Refer to the following table:
I/O-40	Aux mode4	Output 4 of multi-function auxiliary contact	Run	Refer to the following table:
I/O-41	Aux mode5	Output 5 of multi-function auxiliary contact	Warning	Refer to the following table:
I/O-42	Aux mode6	Output 6 of multi-function auxiliary contact	None	Refer to the following table:
I/O-43	Aux mode7	Output 7 of multi-function auxiliary contact	None	Refer to the following table:
I/O-44	Aux mode8	Output 8 of multi-function auxiliary contact	None	Refer to the following table:

- When the condition of the item selected among various functions is satisfied through the auxiliary contact, it starts to work (short circuit). The auxiliary contact is a multi-function output terminal.

I/O 37 to 44 Data Setting	Functional Description	I/O 37 to 44 Data Setting	Functional Description
None	None	Lost Command	Command frequency loss
FDT-1	Reaches the command frequency	Run	During operation
FDT-2	Reaches an arbitrary frequency	Stop	Drive stopped.
FDT-3	Match frequency	Steady	At constant speed
FDT-4	Frequency detection 1	SpeedSearch	During speed search
FDT-5	Frequency detection 2	Ready	Ready to operate
OL	Overload alarm	Warning	Warning
IOL	Drive overload alarm	FAN RUN	Fan operation
Stall	Stall	NORMAL	Operation available
OV	Overvoltage	OCT	Overcurrent trip
LV	Low voltage	Run_ MV	MV operation
OH	Drive overheat		

- FDT-1: Detects if the output frequency has reached the command frequency.

I/O-37 to 44	Output setting of multi-function auxiliary contact (AXAT-AXCT)	
Related functions	I/O-36	Detected frequency bandwidth (setting)

- Operating condition:

Absolute value (command frequency – output frequency) ≤ detected frequency bandwidth / 2

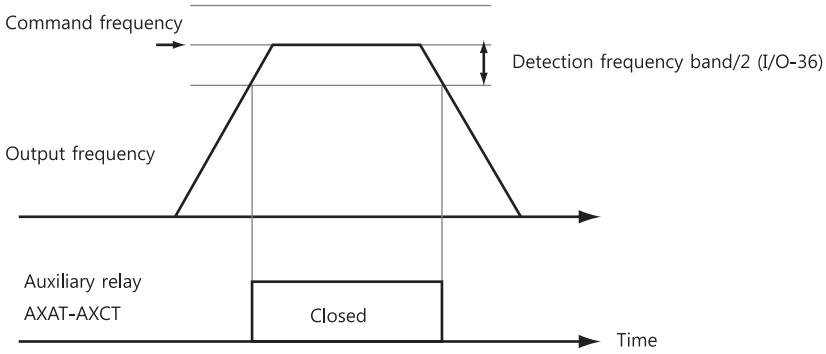


Figure 6-25 Frequency detection (FDT-1)

Note

- AXAT: A1 - A8
- AXCT: C1 - C8

- FDT-2: Works if FDT-1 condition is satisfied and output frequency is the same as the detected frequency. Select when you want to reach an arbitrary frequency.

I/O-37 to 44	Output setting of multi-function auxiliary contact (AXAT-AXCT)	
Related functions	I/O - 35	Detected frequency (setting)
	I/O - 36	Detected frequency bandwidth (setting)

- Operating condition: Conditions of FDT-1 and (absolute value (output frequency – detected frequency) ≤ detected frequency bandwidth / 2)

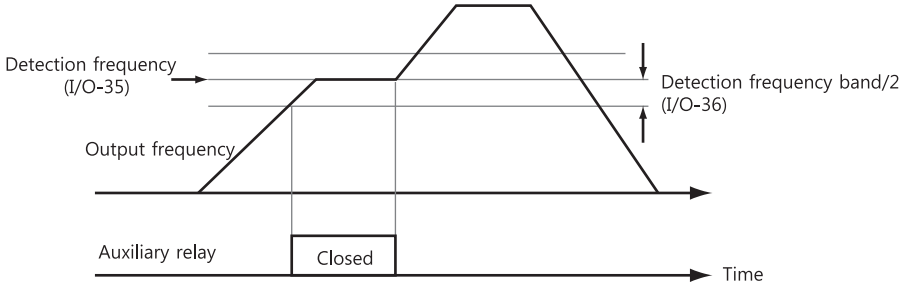


Figure 6-26 Frequency Detection(FDT-2)

- FDT-3: Works when output frequency, detected frequency and detected frequency bandwidth are in the following conditions. Select to use frequency match.

I/O-37 to 44	Output setting of multi-function auxiliary contact (AXAT-AXCT)	
Related functions	I/O - 35	Detected frequency (setting)
	I/O - 36	Detected frequency bandwidth (setting)

- Operating condition:

  Absolute value (detected frequency – output frequency) ≤ detected frequency band / 2

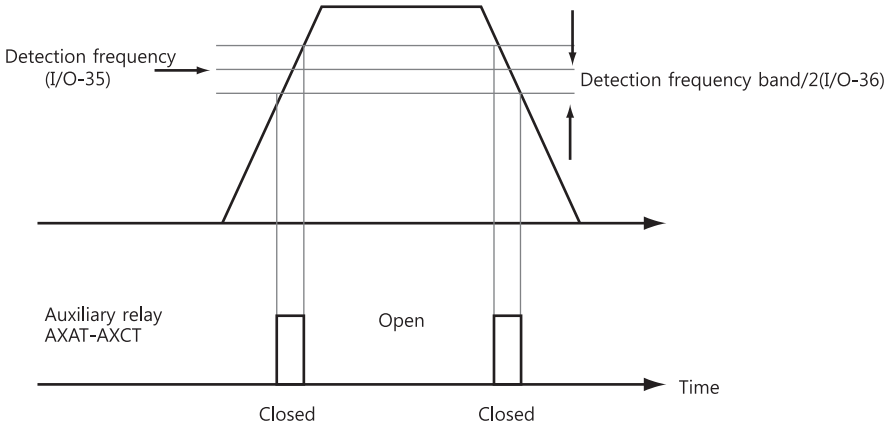


Figure 6-27 Frequency Detection(FDT-3)

- FDT-4: Works when output frequency, detected frequency and detected frequency bandwidth are in the following conditions. Select to use frequency detection.

I/O-37 to 44	Output setting of multi-function auxiliary contact (AXAT-AXCT)	
Related functions	I/O - 35	Detected frequency (setting)
	I/O - 36	Detected frequency bandwidth (setting)

- Operating condition:
  - When accelerating: Output frequency ≥ Detected frequency
  - When decelerating: Output frequency > (Detected frequency – Detected frequency bandwidth / 2)

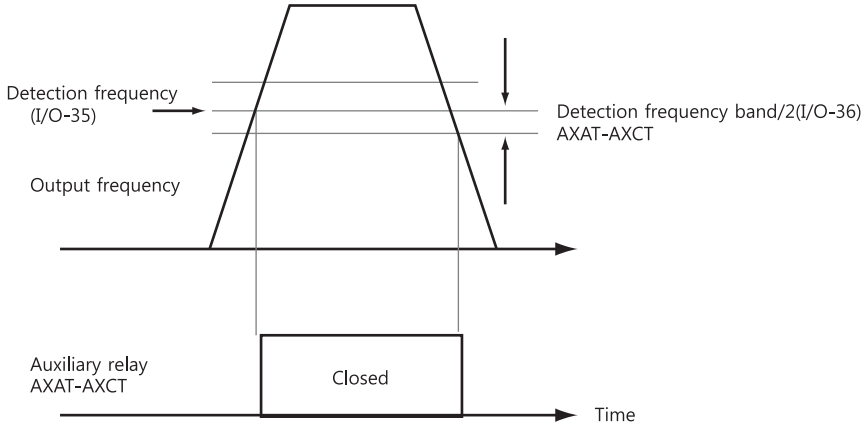


Figure 6-28 Frequency Detection(FDT-4)

- FDT-5: Reverse output of FDT-4. Select to use frequency detection.

I/O-37 to 44	Output setting of multi-function auxiliary contact (AXAT-AXCT)	
Related functions	I/O - 35	Detected frequency (setting)
	I/O - 36	Detected frequency bandwidth (setting)

- Operating condition:
  - When accelerating: Output frequency ≥ Detected frequency
  - When decelerating: Output frequency > (Detected frequency – Detected frequency bandwidth / 2)

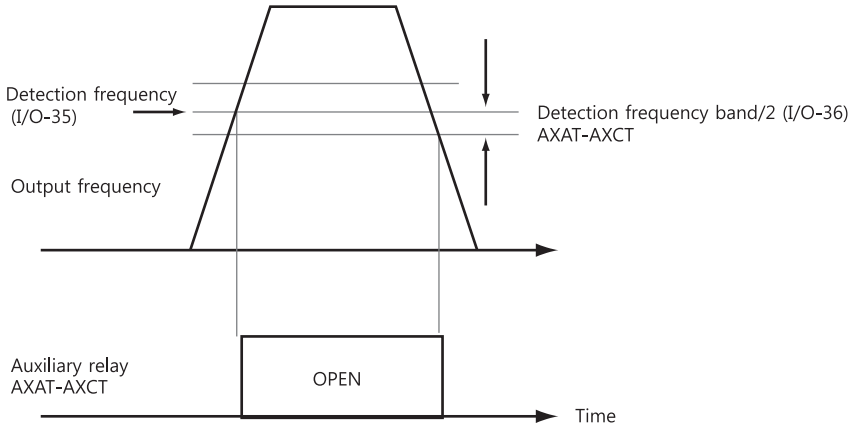


Figure 6-29 Frequency Detection(FDT-5)

- OL: Outputs signal when output current exceeds overload warning level during operation.
- IOL: Inv. Outputs a signal when there is a fault on Inv.OLT.
- Stall: Outputs a signal when a stall occurs drive operation.

FU1- 64	Current level for stall prevention	
Related functions	FU2-34	Motor rated current

Stall compares output current of the drive with rated current of the motor. If the output current of the drive becomes larger than the value specified in FU1-64, it reduces the frequency in order to lower output current of the drive, which is accelerating/decelerating at constant speed. This can be easily applied to loads on fans, pumps, etc. Stall prevention function is divided into two sections - acceleration / constant speed, and deceleration. Acceleration / constant speed determines stall by output current. Deceleration determines it by DC_Link voltage in each cell.

Code	Displayed Message	Function Name	Default Value	Range
FU1-64	Stall level	Stall prevention level	100%	30 ~ 150%

Note

- The value of overload trip level is set as a percentage of rated current of the motor.
- Do not set stall prevention level value higher than rated current of the motor.
- Acceleration stall takes a long acceleration time and the frequency can be changed.
- Constant speed stall may change the output frequency.
- Deceleration stall takes longer deceleration, or it may not decelerate but stay fixed.

- OV: Outputs a signal when there is a fault on DC_Link OVT.
- Input_LVT: Outputs a signal when there is a fault on input LVT.
- OH: Outputs a signal if the temperature increases above the overheat standard due to drive overheat.
- Lost command: Outputs a signal when frequency command is lost.
- Run: Outputs a signal when the drive is in operation. (Do not send a signal in case of DC braking and bypass.)
- Stop: Outputs a signal when the drive stops.

- Steady: Outputs a signal when the drive is in constant-speed operation.
- Speed search: Outputs a signal when the drive is in speed search.
- Ready: The drive is ready to operate. (This is always on when there is control power.)
- Warning: Trans. Outputs a fan operation signal after high voltage power is supplied to the drive.
- FAN RUN: Outputs a fan operation signal after high voltage power is supplied to the drive.
- NORMAL: Indicates that the CAN communications mode is normal and the drive is operable.
- OCT: Outputs a signal when an overcurrent trip occurs.
- RUN_MV: A function of which terminal status is similar to Run. When restarting via cell bypass, gate output does not come out from the actual drive. However, it outputs with a continuous driving signal instead of a stop signal as long as the bypass is valid.

6.10 Restart Methods after a Fault

FU2-25	Automatic restart after trip	
Related functions	FU1-06	Start mode
	FU2-21	Flying perc
	FU2-26	Retry number
	FU2-27	Retry delay

FU2-25	Automatic restart after trip	
Reset start	Initial value	No
	Range	No Yes

If [FU2-25] is set to No, the drive operates in the same way as the initial drive starting sequence even the trip is reset. If it is set to Yes and a trip (excluding any faults coming from outside, such as BX, FanTrip, Trans OH, etc.) occurs while operating the drive via terminal, the drive is automatically reset after a period that is enough to use counter electromotive force of the motor. The terminal is in operable status (ON) when the fault is reset, it performs drive operation commands a [FU2-26] Retry number of times for the duration of [FU2-27] Retry delay time. When a drive fault occurs, it blocks the drive's output. The motor performs Free Run. If you do not restart and directly operate at this time, it may cause an overcurrent trip. LSMV automatically uses flying start mode when it restarts. (It is not set by the user.)

If the BypassMode in [CEL-30] is set to ManualBypass or Auto-Bypass, it bypasses the faulty cell when a trip occurs due to cell fault or communications fault between master and cell. If ByPassMode is set to No, it cannot restart when a trip occurs due to cell fault or CAN error.

If Reset Start in [FU2-25] is set to Yes, it determines whether to restart after the fault is reset according to the operation command status before the trip and the operation command status after fault reset. Refer to the following figures to see how to determine whether to restart for communication/keypad operation and for terminal operation.

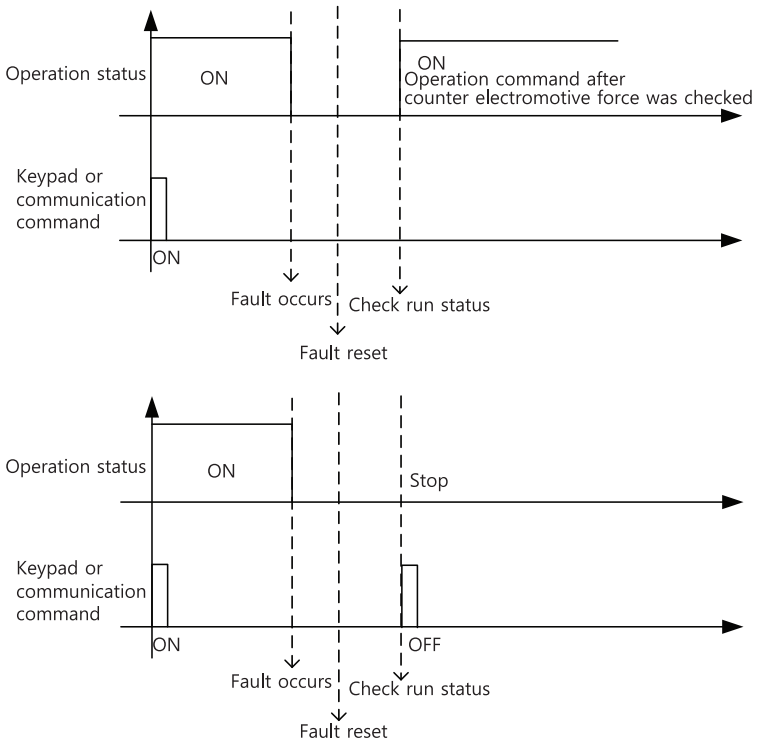


Figure 6-30 Reset fault and restart (communications/keypad operation)

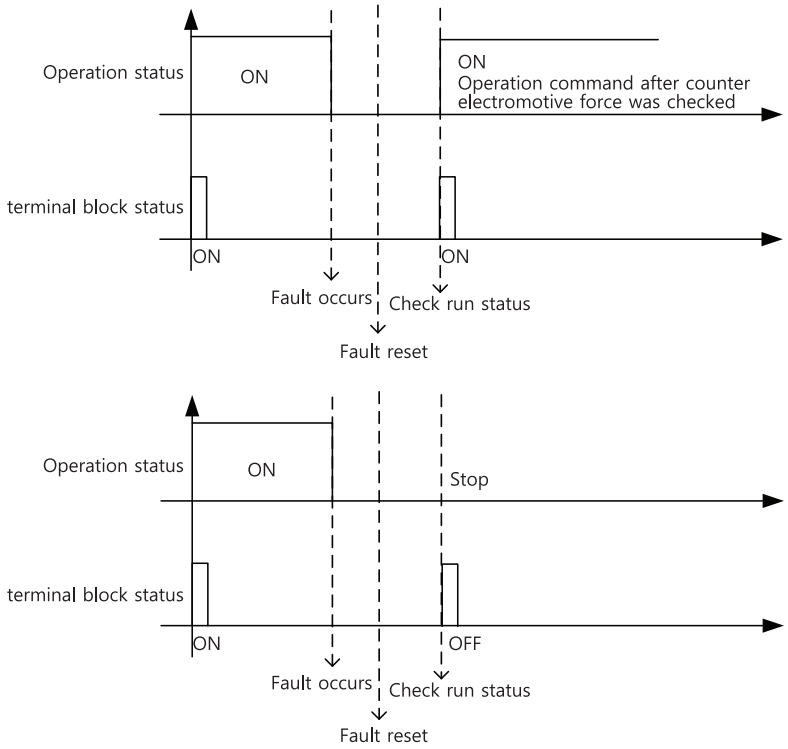


Figure 6-31 Reset fault and restart (terminal operation)

Note
Operation is performed with flying start mode after you reset a fault and determine whether to restart or not. Therefore, speed search related parameters must be set for smooth operation.

■ Restarting Repeatedly

FU2-26,27	Number of automatic restarts and delays after the trip	
Related functions	FU2-25	Reset start

If [FU2-25] Reset Start is set to Yes [FU2-26] Retry number is specified, it automatically tries to restart a number of times set in [FU2-26] when a trip occurs due to a fault. It will not restart if [FU2-26] Retry number is set to 0.

Code	Displayed Message	Function Name	Default Value	Range
FU2-26	Retry number	Number of automatic restarts after the trip	1	0 - 10 times
FU2-27	Retry delay	Automatic restart delay time after the trip	1.0 s	0.0 - 60.0 s

The Retry delay time set in [FU2-27] is a time interval between delays in carrying out Run command each time it tries to restart the number of times set in [FU2-26].

6.11 Cell Bypass Modes

Medium voltage drive is a series connection of low voltage single-phase drives. Therefore, if there is a cell fault, you can continue operation by bypassing just the faulty cell. There are three methods of bypass. Even if only one of three phases has a fault, also perform bypass for the cells on other phases to keep voltage balance.

CEL-35	Initializes the bypass

Code	Function Name	Default Value	Range
CEL-35	Bypass initialization setting	No	No Yes

CEL-30	Bypass mode selection

CEL-30 contents	Functional Description
No	Bypass by user selection.
ManualBypass	When scheduled fault [(NTC Open among cell faults), CAN Error] occurs, press the RESET key on the master controller to perform bypass automatically.
Auto-Bypass	When scheduled fault [(NTC Open, Fuse Open among cell faults), CAN Error] occurs, it automatically performs bypass after a certain time without involving the user and keeps the drive in operable condition.

Note

If you use ManualBypass or Auto-Bypass along with [FU2-25] reset start function for CEL–30, it allows restart after automatic reset trip and automatic bypass when there is a cell or communications fault.

■ When Mode is NO

CEL-30	Bypass mode selection	
Related functions	CEL- 10	Cell setting (Go setting)
	CEL – 11 to 13	Bypass setting
	CEL – 04 to 06	CAN communications status on U, V, and W phases
	CEL – 07 to 09	Cell fault status on U, V and W phases

If the ByPass mode is set to No, check the faulty cell or cell with poor CAN communication. A faulty cell can be checked through [CEL-07 to 09], and CAN communications error cell can be checked through [CEL-04 to 06]. If you set the Go setting to Yes, the maximum number of layers [CEL-03] decreases by max. number of bypasses performed on U, V and W phases. Cells on U, V and W phases are arranged by the maximum number of layers.

For example, If cell 1 and cell 3 on U phase are bypassed, it displays [CEL–11] bypass status on U phase and changes the maximum number of layers [CEL-03] to 4. And then V phase and W phase keep four layers, and the remaining two cells are forcibly bypassed.

Bypass status on U, V and W phases before Yes is selected for [CEL – 10] Go setting.

Code	Function Name	Display
CEL-03	Maximum layers	6
CEL-11	U-phase bypass	00000101

Code	Function Name	Display
CEL-12	V-phase bypass	00000000
CEL-13	W-phase bypass	00000000

Bypass status on U, V and W phases after Yes is selected for [CEL – 10] Go setting.

Code	Function Name	Display
CEL-03	Maximum layers	4
CEL-11	U-phase bypass	00000101
CEL-12	V-phase bypass	00000101
CEL-13	W-phase bypass	00000101

The order of bypasses when ByPass mode is No

CEL- 11 to 13	Bypass setting on U, V, and W phase

Code	Function Name	Default Value	Range
CEL-11	Selects bypass cell on U-phase.	000000000	00000000 / 111111111
CEL-12	Selects bypass cell on V-phase.	000000000	00000000 / 111111111
CEL-13	Selects bypass cell on W-phase.	000000000	00000000 / 111111111

Selects cells to bypass on U, V, and W phases.

CEL- 10	Performs the bypass.

Code	Function Name	Default Value	Range
CEL-10	Bypass perform selection.	No	No Yes

■ When Mode is Manual

If you press the RESET key after cell fault or communications error, it automatically performs bypass and the drive becomes operable.

■ When Mode is Auto

The drive performs bypass by itself after cell fault or communications error without pressing the RESET key.

■ Reset Bypass Mode for All Cells

CEL- 35	Initializes the bypass

Code	Function Name	Default Value	Range
CEL-35	Bypass initialization setting	No	No Yes

This is an algorithm for cell bypass initialization when the bypass is performed while the user did not intend to (when control power is off while high voltage power is being supplied), or to operate all cells normally after the cell fault is reset. This function has the same effect as setting all of [CEL–11 to 13] to 0 and then setting [CEL-10] Go setting to Yes.

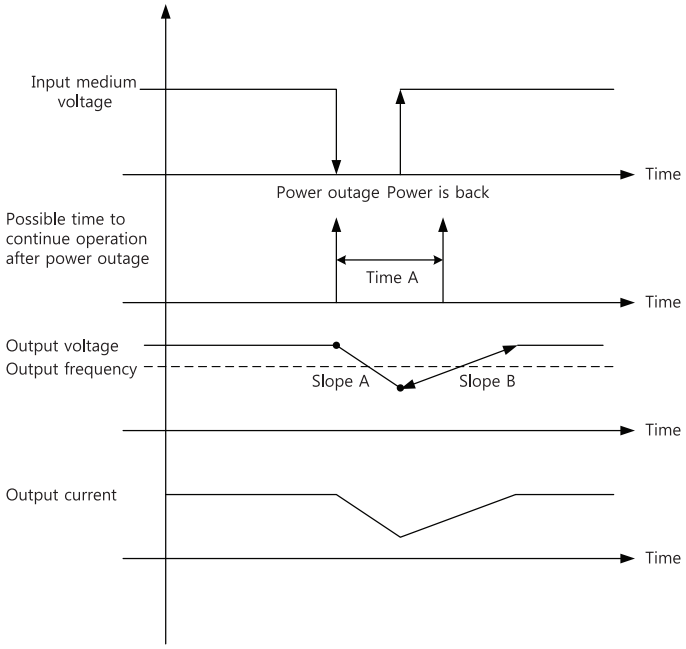
6.12 Dealing with Instantaneous Power Interruption

FU1-75	Ride-Throu	
Related functions	FU1-76	Instantaneous power interruption time
	FU1-77	Instantaneous power interruption Accel/Decel slope

The drive can be continuously operated, even if the power supply condition is poor or if there is instantaneous power interruption due to lighting surge, etc. Even after an instantaneous power interruption (input voltage sensing) is detected, the driver continues operation for the duration set in [FU1-76]. If the power interruption lasts longer than the specified time, input LVT trip occurs. Even if [FU1-76] instantaneous power interruption time is set, it may vary according to the load inertia and load amount. Therefore, [FU1-76] instantaneous power interruption time value is not absolute and the value is set by testing. The last frequency (the target frequency just before the instantaneous power interruption) is kept during instantaneous power interruption time. Lower the output voltage based on the Accel/Decel slope you set in [FU1-77]. When the power returns, increase the output voltage to the one that matches the frequency according to the acceleration slope you set in [FU1-77].

Code	Displayed Message	Function Name	Default Value	Range
FU1-75	Ride-Throu	Continuous operation in case of instantaneous power interruption	No	Yes No

To continuously operate even when there is instantaneous power interruption, [FU1-75] Ride-Throu requires setting to Yes. The graph below shows how to deal with instantaneous power interruption.



Time A = Instantaneous power interruption time while continuous operation is possible (User defined)

Slope A = Decreasing slope of output voltage during power interruption (User defined)

Slope B = Increasing slope of output voltage after power returns (User defined)

■ Duration of instantaneous power interruption

Code	Displayed Message	Function Name	Default Value	Range
FU1-76	Shot time S	Duration of instantaneous power interruption	1	1 ~ 1000

Set time 1 represents 5 ms. Therefore, the value 1000 corresponds to 5 seconds.

- Output voltage Accel/Decel slope when the power was instantaneously interrupted

Code	Displayed Message	Function Name	Default Value	Range
FU1 - 77	Time slope	Output voltage Accel/Decel slope	AA	00 - FF

Upper bits are the output voltage slope when decelerating. Lower bits are the output voltage increasing slope after the power returns.

7. Troubleshooting

This chapter describes solutions for problems that may occur when using LSMV series drives and motors.

7.1 Protective and Diagnostic Functions

Section 7 describes alarm functions of a drive. Alarm functions include fault detection, warning detection, operation error detection, and auto-set error detection.

If a warning alarm was sensed on LSMV drive, error details are displayed on the keypad monitor. You can check the error record on the menu even after the error is reset.

⚠ Warning

- Make sure the power is cut off before you open the transformer panel or power battery panel cover.
- Disconnect the device power voltage supply, open the cover and leave it open for at least 10 minutes before you touch inside of the transformer panel. Then check if the keypad for the cell is completely turned off. You may get an electric shock if you do not follow this warning.

■ Error and Alarm Detection

If the drive senses an error, error connection output starts and blocks drive output. (Stop by trip method will be selected. From this point on, this method will be used to handle these errors.) The trip information will be displayed on keypad or HMI. When a trip occurs, check the content on the following table and refer to the cause and solution of the error.

Reset errors before restarting the drive as follows:

- Check [FU2-01 to 05] on the keypad.
- Set [FU2-06] to Yes on the keypad to reset the trips.
- Warning alarm works as a form of contact A output, and it is detected as a type of drive protective function.
- When the cause of the alarm is removed, the system automatically returns to its original condition.

7.2 Trip Display

When a trip occurs in the drive, the protective function takes effect, issues an alarm, and displays the content of the trip on keypad. Reset when the protective function is working. Refer to the following table for keypad loader and 7-segmaent loader display.

■ Display of Master Controller Faults

Master displays faults on cells as cell fault collectively.

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.**

Protective function	Keypad loader	Contents
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. (Normal holding time by UPS capacity [IO-98 UPS_OFF_Dly] is configurable.)

■ Call 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.

■ Measures Against Trips

Protective function	Cause	Measure
Overcurrent	▪ Accel/Decel time is too fast compared to the load GD². ▪ Drive load is greater than the rating. ▪ Drive output is supplied while motor is in Free Run. ▪ Output short circuit and ground fault have occurred. ▪ Main circuit device overheats due to cooling fan failure.	▪ Set Accel/Decel time longer. ▪ Expand the drive capacity. ▪ Operate when the motor has stopped. ▪ Check the output wiring. ▪ Inspect the cooling fan. ⚠**Caution: Get rid of the cause before you try to restart. It may cause damage to the IGBT.**
Ground fault current Protection	▪ Drive's output wire has ground fault. ▪ Insulation of the motor has become deteriorated.	▪ Check the output wiring. ▪ Replace the motor.
Overvoltage protection	▪ Deceleration time is too short compared to the load GD². ▪ Regeneration load is on drive output side. ▪ Power voltage is high.	▪ Set deceleration time shorter. ▪ Check power voltage.
Overload trip	▪ Drive load is greater than the rating. ▪ Wrong drive capacity is set. ▪ Wrong V/F pattern is set.	▪ Expand the capacities for motor and drive. ▪ Set a correct drive capacity. ▪ Set a correct V/F pattern.
Drive overheat	▪ Cooing fan is broken or foreign substances are stuck in the fan. ▪ The cooling system has a problem. ▪ Ambient temperature is high.	▪ Replace the cooling fan or remove foreign substances. ▪ Check if there are foreign substances in the heat sink. ▪ Decrease the ambient temperature to less than 40 degrees Celsius.
Electronic thermal	▪ Motor is overheated. ▪ Drive load is greater than the rating. ▪ ETH set level is low. ▪ Wrong drive capacity is set. ▪ Wrong V/F pattern is set. ▪ Operated for long time with low speed.	▪ Reduce the load. ▪ Expand the drive capacity. ▪ Adjust the ETH level appropriately. ▪ Set a correct drive capacity. ▪ Set a correct V/F pattern.
External trip	▪ There is a fault from outside.	▪ Remove the cause of the problem on the circuit, which is connected to the external trip terminal, or the cause of abnormal external input.
Low voltage protection	▪ Power voltage is low. ▪ A load that is larger than the power capacity is connected to the power system. (For example, direct on line of a motor with a large starting current)	▪ Check power voltage. ▪ Change the transformer tab. Expand the power capacity.
Output open-phase	▪ Bad output wiring	▪ Check output wiring with Megger ohm tester.
Communications error	▪ Loose contact between the main board of the drive and the keypad connector ▪ Broken CPU on the main board of the drive ▪ There is a problem on CAN communication module. ▪ Poor optical cable. ▪ Cell fault has occurred.	▪ Check the connector. ▪ Replace the drive. ▪ Replace the module or perform bypass. ▪ Replace the optical cable. ▪ Replace the cell.
Operation method when frequency command is lost	▪ LOP (command loss by option), LOR (remote) ▪ LOV(V1), LOI(I), LOW(Pulse)	▪ Remove the cause of the trip.

Protective function	Cause	Measure
Drive overload	▪ Drive load is greater than the rating. ▪ Wrong drive capacity is set.	▪ Expand the capacities for motor and drive. ▪ Set a correct drive capacity.
Insufficient control power	▪ Commercial power supply is OFF. ▪ UPS capacity is insufficient.	▪ Take appropriate measures to supply the control power with commercial power supply.

⚠ Caution

If the trip is not cleared after you remove the cause and reset the system, contact an agency near you or A/S center.

■ Abnormal Conditions and Checklist

Condition	Check Points
The motor is not rotating	**Checking the Main Circuit** ▪ Is the power voltage inputting normally? (Is the LED on the body lit?) ▪ Is the motor correctly connected? **Checking Input Signal** ▪ Is the operation signal inputting? ▪ Are you inputting the forward and reverse rotations at the same time? ▪ Is the frequency set signal inputting? **Checking Parameter Set Value** ▪ Did you set the reverse rotation protection (FU1-1)? ▪ Is the operation mode (DRV-3) set correctly? ▪ Is the frequency not set to 0? **Checking Load** ▪ Is the load small? ▪ Is the motor part restricted? (Machine brake) **Other** ▪ Is a fault message displayed on the keypad and the STOP LED flashing?
Motor rotating in opposite direction	▪ Is the U, V, W order of output terminal correct? ▪ Is the operation signal (forward/reverse rotation) connection correct?
Distinct difference between rotation speed and set value	▪ Is the frequency set signal correct? (Measure input signal level.) ▪ Were the below parameters set correctly? Lower limit frequency [FU1-25], upper limit frequency [FU1-26], analog frequency gain [I/O-1 to 10], [I/O-84 to 89] ▪ Is the input signal line affected by external noise? (Use shield cable.)
Accel/Decel is not working smoothly.	▪ Is the Acc/Dec time set to short? ▪ Is the load small? ▪ Are current restrict and stall prevention functions not working because of large set value for torque boost [FU2-47,48]?
Motor current is large.	▪ Is the load small? ▪ Is the set value (manual) for torque boost small?
Rotation speed not increasing	▪ Is the set value for upper limit frequency [FU1-26] correct? ▪ Is the load small? ▪ Is the stall prevention function [FU1-64] not working because of a large set value for torque boost [FU1-47,48]?
Rotation speed change during operation	**Checking Load** ▪ Is the load fluctuating? **Checking Input Signal** ▪ Is the frequency set signal fluctuating? **Other** ▪ Is the wiring short when controlling V/F? (Longer than 500 m)

8. Maintenance and Inspection

8.1 Maintenance and Inspection

LSMV series has lots of parts. In order to make the best use of the drive, parts must be operated in appropriate ways. Continuous inspection of the drive is mandatory. It allows you to identify fault signals and take prompt and proper action. Our service for drive parts are limited to operation in normal conditions. If you use parts outside the service limitations, it may damage or break them. Replace parts within the warranty period. Otherwise, you cannot expect the drive to operate with the original features and handling methods.

Chapter 8 describes how to maintain and inspect the LSMV drive ensure reliability for longer.

⚠ Caution

- LSMV drive series is high voltage equipment. Turn the high voltage power supply system off and wait 10 minutes before you open the front cover of the panel on the power supply section. You may get an electric shock if you do not follow this caution.
- Make sure the LED is OFF, which is on the cell keypad at the front of the panel on the power supply section, and thoroughly inspect the power supply system when you start servicing and inspection work. (If you touch the panel immediately after you turn off the power, you may be at risk of electric shock from voltage residue in the capacitor.)
- Servicing, inspection and part replacement work requires professional engineers. They understand the drive structure and circuits.
- Check for tools, etc., left in the panel after servicing, inspection and part replacement work.

⚠ Caution

- Many devices on the control board are electric devices like CMOS-IC. They are very sensitive to static electricity. Handle the control board with care. (The control board may be seriously damaged by static electricity if you touch it with bare hands.)
- Always wear anti-static gloves when you touch or inspect the printed circuit board.
- Use insulation equipment such as an oscilloscope probe. Otherwise, the drive or measuring device may be damaged.

■ Warranty Period

The warranty period for LSMV series is explained as follows:

Warranty period: LSMV drive series is produced under thorough quality control and inspection processes by LS Industrial Systems technical team. Usually, the warranty period is 12 months from the date of product installation. If the date of installation is not entered, 18 months from the date of manufaturing will be applied. The warranty period may vary according to the terms of contract.

■ Daily Inspection

Inspect the following items daily while the system is operated.

Table 8-1 Daily Inspection

Location	Item	Things to Check
The entire system	Ambient temperature	Check ambient temperature, humidity, harmful gases and oil leakage.
	Entire LSMV	Check abnormal vibration and noise.
	Voltage of power supply system	Check voltage on the main circuit and control board.
Main circuit	Transformer	Check for abnormal smell and buzzing sound.
Cooling system	Cooling fan	Check abnormal vibration and noise.
		Check air filter.

Location	Item	Things to Check
Sign	Gauge	Make sure it produces accurate measures and indicators.

■ Periodic Inspections

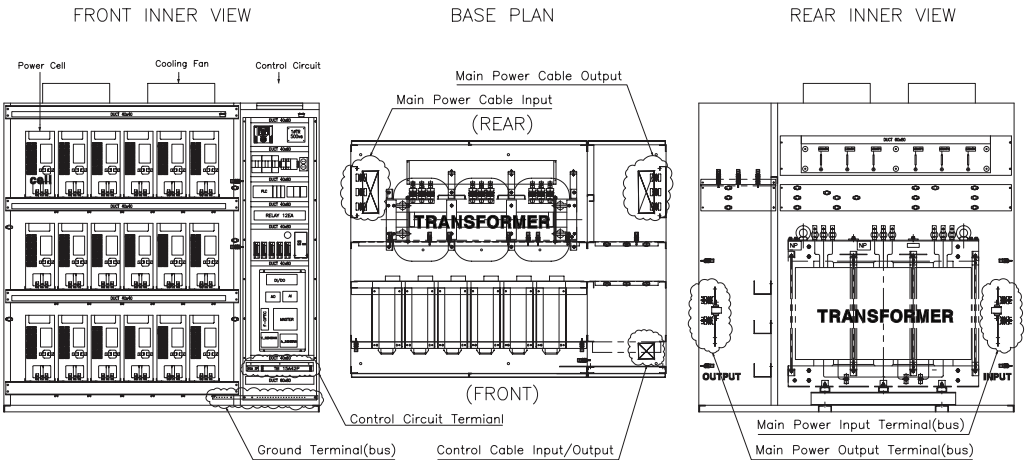
Check the following items for periodic inspections.

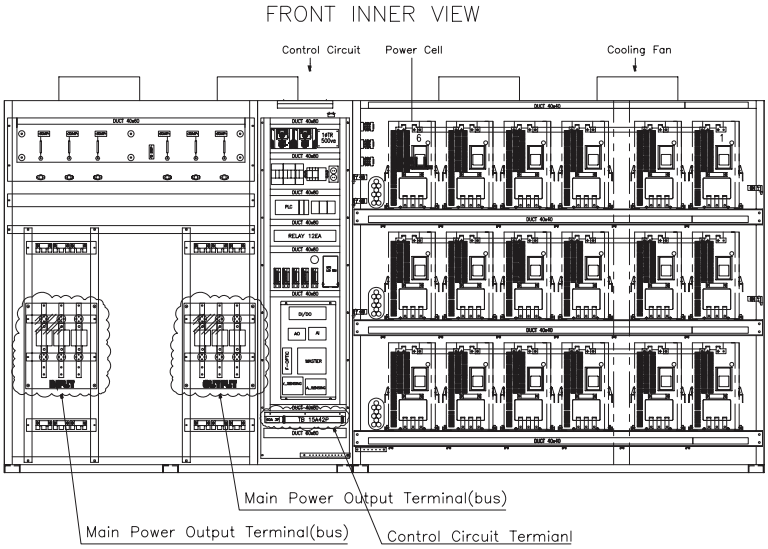
Turn off power supply system and confirm that all keypads at the front of the cell are turned off. Wait at least five minutes before you start the inspection. (Wait 10 minutes for high voltage power supply system.)

If you touch the terminal immediately after turning off the power supply system, you may get an electric shock.

Table 8-2 Periodic inspections (once a year)

Location	Item	Things to Check
Transformer panel Power section cell panel	Entire transformer and power section cell panel	Check the area between the main circuit terminal and the earth terminal with a megohmmeter.
		Check for missing screws, bolts or connectors.
		Check for overheating for each part.
		Clean the inside of the panel.
	Wire	Check for damage to cable coating or cable deterioration.
	Transformer	Check if both primary and secondary voltages are normal.
	Power supply section cell	Check whether the smoothing capacitor is leaking.
		Check if the smoothing capacitor has been expanded.
		Measure the capacitance of the smoothing capacitor.
		Check if there are any missing screws or bolts.
		Check if the main and control circuits have a regular fuse.
		Clean dust that built up around the heat sink.
		Check for problems within protection and indicator circuits.
Control panel	Operation	Check if it is working smoothly.
	Relay	Check that the timer is working properly.
		Check whether there is any damage in the contact section.
		Check for unusual smells and discoloration.
	Board	Check the voltage of the power supply system.
		Check abnormal vibration and noise.
Cooling system	Cooling fan	Check the operating direction.





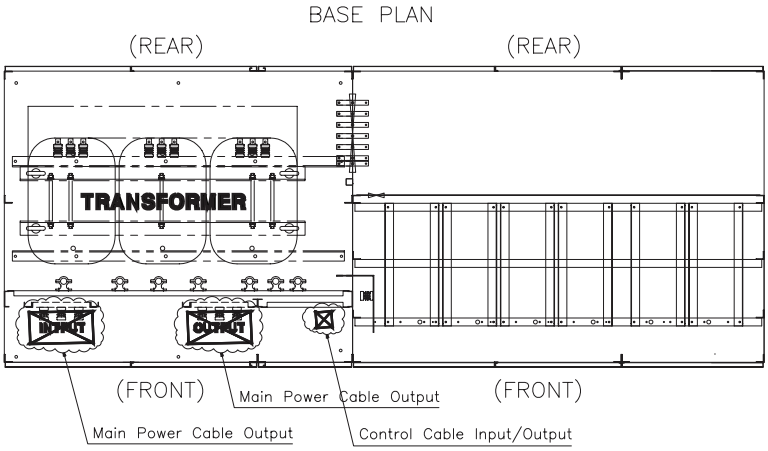


Figure 8-1 Part location

Items that need periodic inspections are described in detail as follows:

- Screws, bolts and connectors

  Loose I/O terminal bolts or connector board may cause drive failure or malfunction. Tighten screws and bolts firmly and insert the connectors.

  Check the following terminals and connectors.

  - High voltage I/O terminal
  - Input and output voltage protection circuits (high resistance section)
  - Transformer I/O terminal and basic voltage tab terminal
  - Transformer output terminal block
  - Cell I/O terminal of power supply section and optical cable connector
  - Screws, bolts and connectors in power supply section
  - Control power supply device input terminal
  - Control transformer I/O terminal
  - I/O terminal of cooling fan contactor
  - Control fuse I/O terminal
  - Screws, bolts and connectors on each control board
  - External I/O terminal

- Transformer

  Inspect the transformer as described as follows:

  - Check the outer case.
  - Tighten bolts for transformer I/O and basic voltage tab terminals again.
  - Measure the secondary transformer voltage.
  - Turn both control power supply and high voltage power supply systems on and measure the cell input voltage. Measure the cell input voltage of each power supply section with an AC range digital multimeter. (Measure the input voltage of R, S and T phases for cells in each power supply section.) Input voltage must be rated voltage (630 VAC) ±10 V. If the measured value exceeds the rated range, adjust the basic voltage tab. (Select +5, -5. or 0%.)

- Cell

  Inspect the cell as described as follows:

  - Check the outer case. Check for traces of discolor, smoothing capacitor leakage, loosening of the safety belt, and whether smoothing capacitor has been expanded.
  - Fasten bolts of input terminals L1, L2 and L3 one more time.
  - Fasten bolts of output terminals T1 and T2 one more time.
  - Reinsert optical cable connector.
  - Fasten screws and bolts in the power supply section cell panel again.
  - Check cell fuse and control circuit. Check for any that are loose or undone.
  - Clean cell heat sink.

- Measure input voltage of the power supply section cell.

- Air filter

  If the air filter is blocked by dust and foreign substances, it may result in abnormal increase of drive temperature. Check for dust and foreign substances in the air filter when you are carrying out daily inspection, and periodically clean it with neutral detergent.

- Control board

  Inspect the control board for the following:

  - Unusual smell or discoloration of the board
  - Loose screws or connectors

- Cooling fan

  Inspect the cooling fan as described as follows:

  - Check for abnormal vibration or noise.
  - Fasten bolts again.
  - Measure the motor's insulation resistance. Measured value must be less than 10 MΩ.
  - Check if there is abrasion on the motor bearing. The lifespan of the motor bearing is about 10,000 hours.

8.2 Parts Maintenance

In order to keep LSMV drive series in normal condition for as long as possible, we recommend that you replace the parts according to the standard replacement periods. A drive is composed of many parts. To use all drive functions without problems, all of these parts must work properly. Appropriate servicing is mandatory for electronic parts. Each part has its own replacement period according to the installation environment of the drive and how it is used.

The replacement period for each part is listed in the following table. Refer to the next page for the procedure for cooling fan replacement. To replace the following parts, contact a LSMV sales person. A trained professional technician will help you with parts replacement.

Table 8-3 Standard of part replacements

Part Name	Standard Replacement Period	Method of Replacement and Reference
Cooling fan	1 to 2 years (10,000 hours)	Bearing replacement (Motor and fan bearings)
Cell smoothing capacitor in power supply section	5 years	Replace with a new capacitor (when replacement is required after inspection)
Fuse	10 years	Replace with a new fuse
Aluminum capacitor of the printed circuit board	5 years	Replace with a new board (when replacement is required after inspection)
Circuit breaker and power fuse	-	When replacement is required after inspection

Note

- The standard replacement period may vary according conditions.
- Ambient Temperature: Average 30°C per year
- Load factor: Max. 80%
- Operation ratio: Max. 12 hours/day

8.3 Spare Parts

We recommand you prepare spare parts in advance, considering the LSMV installation environment and how it is used. The recommended spare parts are listed in Table 8.4 to Table 8.7.

To order spare parts, confirm names of parts and model names and contact a LS industrial Systems sales person.

Table 8-4 Recommended Spare Parts List (Board Related)

Part Name		Model Name	Remarks
Cell control board		PCB ASS'Y, CONTROL, MV-CELL	-
Cell SMPS board		PCB ASS'Y, SMPS, MV-CELL	Varies based on cell capacity.
Controller	Master board	PCB ASS'Y, CONTROL, MV-MASTER	-
	Analog input board	PCB ASS'Y, ANALOG INPUT, MV-MASTER	-
	Analog output board	PCB ASS'Y, ANALOG OUT, MV-MASTER	-
	Optical communications board	PCB ASS'Y, OPTIC, MV-MASTER	-
Digital input / output board		PCB ASS'Y, DIGITAL I/O, MV-MASTER	-
Current sensing board		PCB ASS'Y, CURRENT SENSING, MV-MASTER	Varies based on drive capacity.
Voltage sensing board		PCB ASS'Y, VOLTAGE SENSING, MV-MASTER	-
±5 V power supply device		VSF50-EE	-
±15 V power supply device		VSF50-EE	-
±24 V power supply device		VSF75-24-	-

Table 8-5 Recommended Spare Parts List (Main circuit related parts)

Part Name	Model Name	Remarks
35 A cell	PCM-630V35A	-
53 A cell	PCM-630V53A	-
88 A cell	PCM-630V88A	-
175 A cell	PCM-630V175A	-
260 A cell	PCM-630V260A	-
350 A cell	PCM-630V350A	-
438 A cell	PCM-630V438A	-

Table 8-6 Recommended Spare Parts List (Operation circuit related parts)

Part Name	Model Name	Remarks
MCCB	ABS32b 10 A	-
	ABS32b 30 A	-
	ABS32b 50 A	-
Lamp	DECO LAMP 10 W	-
Contactor	BKM-b 2P 6 A	-
Converter	KP200	(Distinguish V/I, I/I when you order.)
Terminal relay	SZR-MY4-N1	-

Table 8-7 Recommended Spare Parts List (Other Parts)

Part Name	Model Name	Remarks
Keypad	MAIN/KEYPAD LOADER	-
Optical cable	HFBR – RUD500Z	-
Cooling fan for panel	DVN-205	-
PLC	XBC-DR64H	
HMI	XP50-TTA/DC	
UPS	BR550GI	

8.4 Cooling Fan Replacement Procedure

Refer to Figure 8.3 for the procedure for cooling fan replacement.

■ Removing the Cooling Fan

1. Remove the cover next to the ventilation opening to separate the cable from the cooling fan and limit switch on top of the drive panel.
2. Remove the ventilation opening.
3. Remove screws from the cooling fan.
4. Remove the cooling fan by lifting it up.

■ Attaching a New Cooling Fan

1. Attach the new cooling fan in the reverse order of the removal procedure.
2. Make sure all cables are correctly connected to the cooling fan and the limit switch.
3. Fix the cable firmly so it does not touch the blades of the fan.

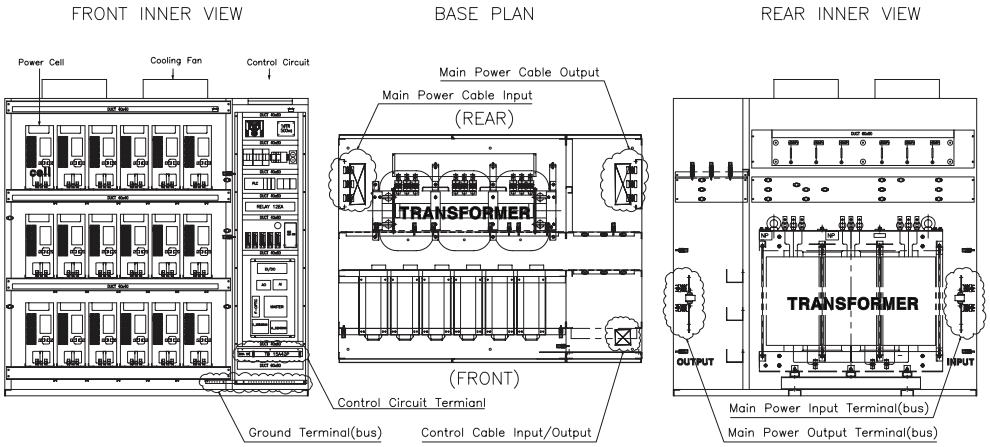


Figure 8-2 Fan replacement

8.5 Removing and Reinstalling a Cell

The procedure to remove a cell in the supply section is as follows: Refer to Figure 8.4 and Figure 8.5 for parts names.

1. Remove the 3-phase input wire (bus bar or wire) from input terminals R, S and T.
2. Remove the wire (bus bar or wire) from output terminals U and V.
3. Remove the optical cable from cell control board. (Do not damage the board when removing the power supply section cell.)
4. Remove fixed screws on the lower part of the power supply section cell.
5. Extend the lifter platform to put the power supply section cell down.
6. Fix the power supply section cell on the platform.
7. Lift up the power supply section cell from the panel. Be careful. The casters fixed on the bottom of the power supply section cell can interrupt cell removal.
8. Carefully pull out the power supply section cell. You may damage the cell if you pull it hard.
9. After the entire power supply section cell is put on the lifter platform, fix the platform and the cell using something like a belt to prevent the power supply section cell from falling.
10. Return the extended platform to its original form, lower the platform along with the power supply section cell, and then move the cell.
11. Check and replace parts and then reinstall the power supply section cell in reverse order.

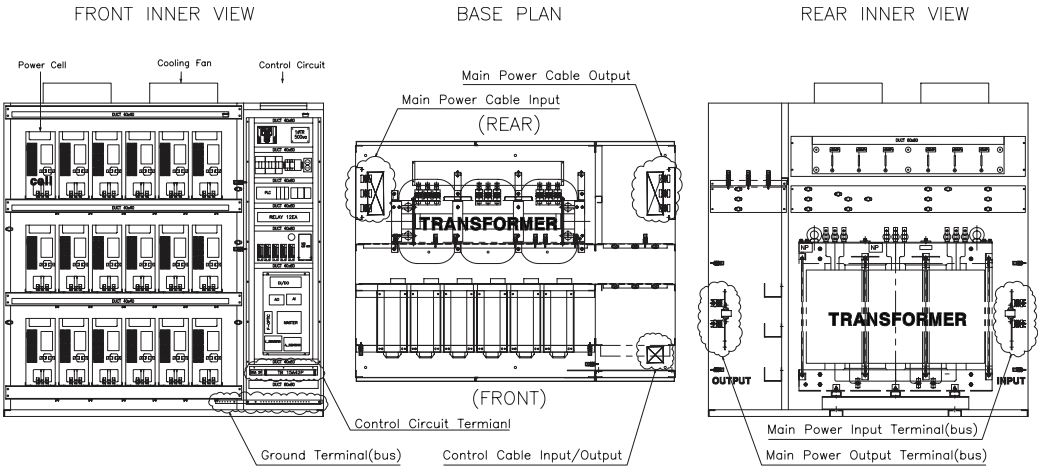


Figure 8-3 Cell replacement

9. LSMV Series Rating

9.1 Standard Ratings of LSMV Drive Series

Item		Standard Rating												
3 kV Class	LSMV-033S□□□ 60 Hz	200	300	400	500	600	750	1000	1200	1500	2000	2500	3000	3700
	LSMV-030F□□□ 50 Hz	200	300	400	500	600	750	1000	1200	1500	2000	2500	3000	3700
	Output Capacity (kVA)	200	300	400	500	600	750	1000	1200	1500	2000	2500	3000	3700
	Rated current (A)	35	53	70	88	105	131	175	218	260	350	438	525	657
	Maximum applicable motor capacity (kW)	160	250	330	410	500	620	850	1000	1250	1700	2080	2500	3150
4 kV Class	LSMV-041F□□□ 50 Hz	250	380	500	630	750	950	1200	1500	1900	2500	3100	3700	4700
	Output Capacity (kVA)	250	380	500	630	750	950	1200	1500	1900	2500	3100	3700	4700
	Rated current (A)	35	53	70	88	105	131	175	218	260	350	438	525	657
	Maximum applicable motor capacity (kW)	200	310	410	530	620	790	1000	1250	1580	2080	2650	3150	4000
6 kV Class	LSMV-066S□□□ 60 Hz	400	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	7500
	LSMV-060F□□□ 50 Hz	400	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	7500
	Output Capacity (kVA)	400	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	7500
	Rated current (A)	35	53	70	88	105	131	175	218	260	350	438	525	657
	Maximum applicable motor capacity (kW)	330	500	660	850	1000	1250	1700	2080	2500	3400	4100	5000	6200
10 kV Class	LSMV-033S□□□ 50 Hz	600	900	1200	1500	1800	2200	3000	3700	4500	6000	7500	9000	11000
	Output Capacity (kVA)	600	900	1200	1500	1800	2200	3000	3700	4500	6000	7500	9000	11000
	Rated current (A)	35	53	70	88	105	131	175	218	260	350	438	525	657
	Maximum applicable motor capacity (kW)	500	750	1000	1250	1500	1800	2500	3150	3800	5000	6200	7200	9300
Power factor		Approx. 95% (rated speed and load condition)												

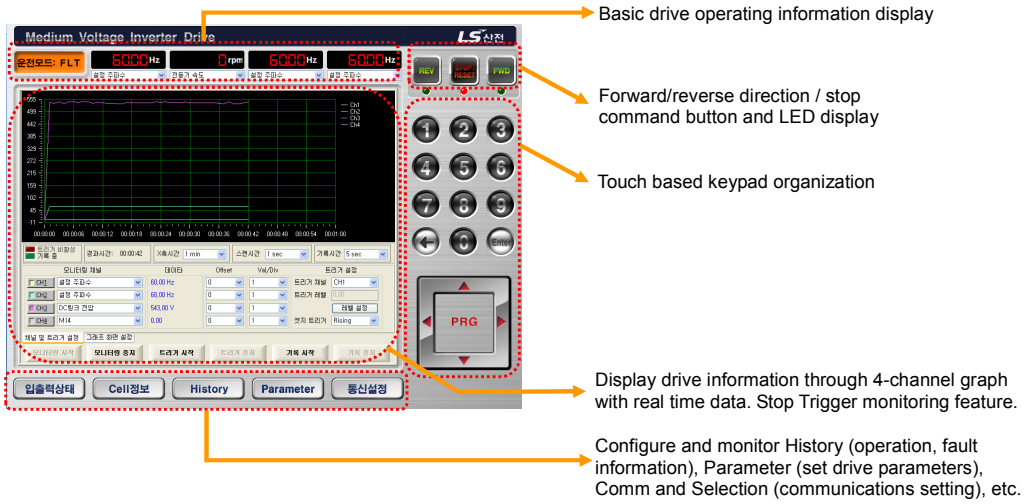
Item		Standard Rating
Efficiency		Approx. 97% (rated speed and load condition)
Input current THD		Satisfies IEEE Standard 519-1992
Input	Main circuit	3-phase 3 kV/3.3 kV/4.16 kV/6 kV/6.6 kV/10 kV ±10%, 50/60 Hz
	Control circuit	3-phase 220 V/380 V/440 V ±10%, 50/60 Hz ±5%
Output	Rated voltage	3-phase 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	±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
Manipulation	Keypad loader System monitoring	RS-232, Modbus-RTU, key input mode HMI (XP-50) basic installation
	MV system view	Option: Built-in touchscreen input-type wide-view angle 12.1-inch 144-color TFT-KEYPAD, 024×768 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... .
Communications function		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%

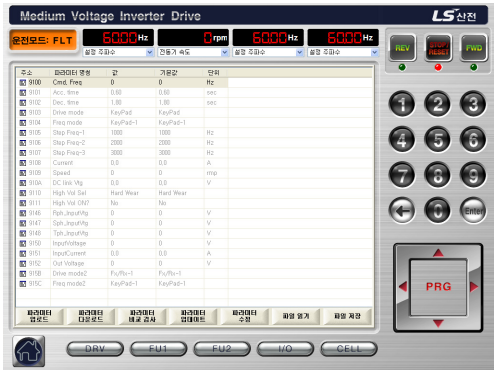
10. References

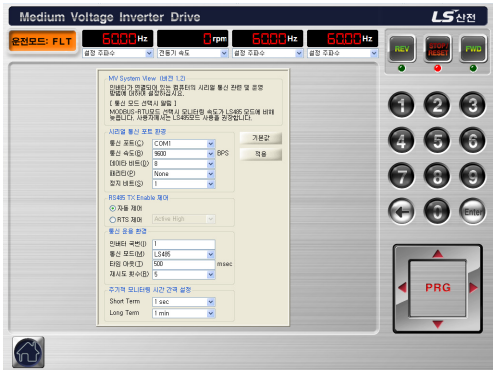
10.1 MV SYSTEM VIEW (Option)

MV SYSTEM VIEW is a PC (WINDOWS XP compatible) based software that controls and monitors MVD using RS485/232 communications line between MVD-PCs.

■ Screen Layout and Features







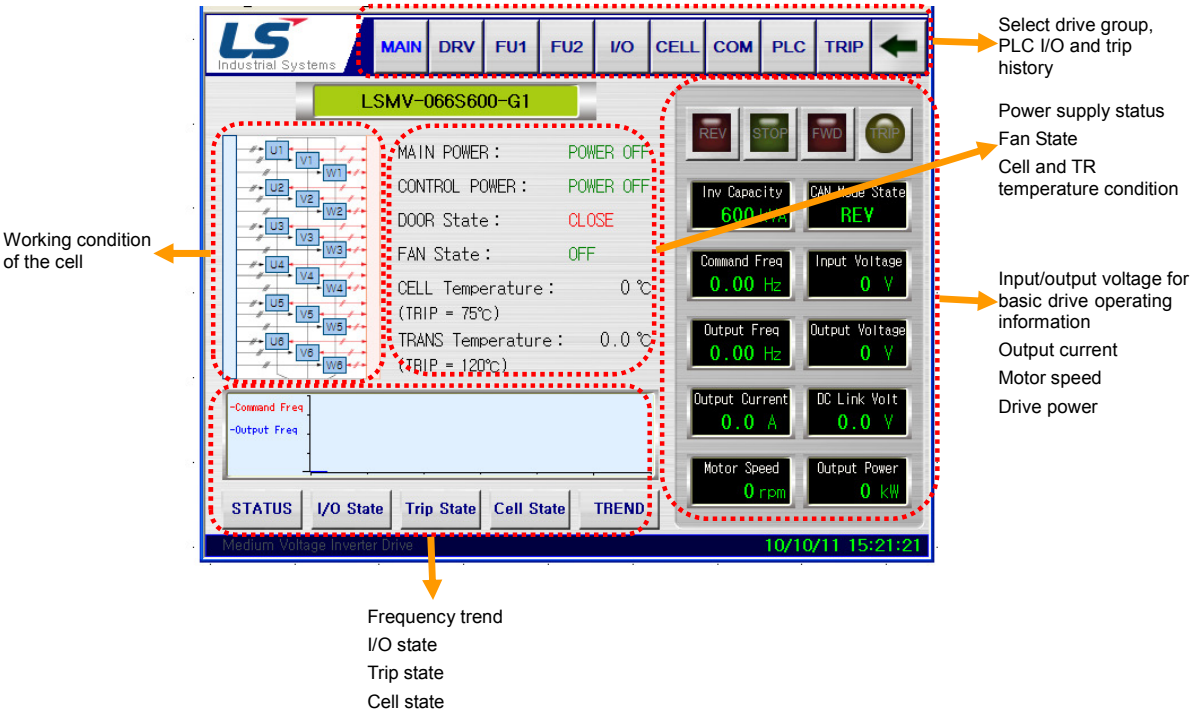
- Displays communications, fault and bypass information for each cell on U, V and W phases.
- Displays DC-Link voltage information.
- Displays drive connection information.
- Displays fault history, event history and cell diagnosis history.
- Short term history: Displays time, target frequency, output voltage and current, system status and operation status.
- Long term history: Displays R/S/T phase input voltage, drive temperature and trip information.

- Set DRV, FU1, FU2, I/O, CELL parameters.
- Upload and download parameters, modification, and open and save file are available.
- Set communications environment.
- Set serial port environment such as communications port and transmission speed.
- Sets environment for communications management such as drive ID and communications method.

10.2 MV HMI (Basic Installation)

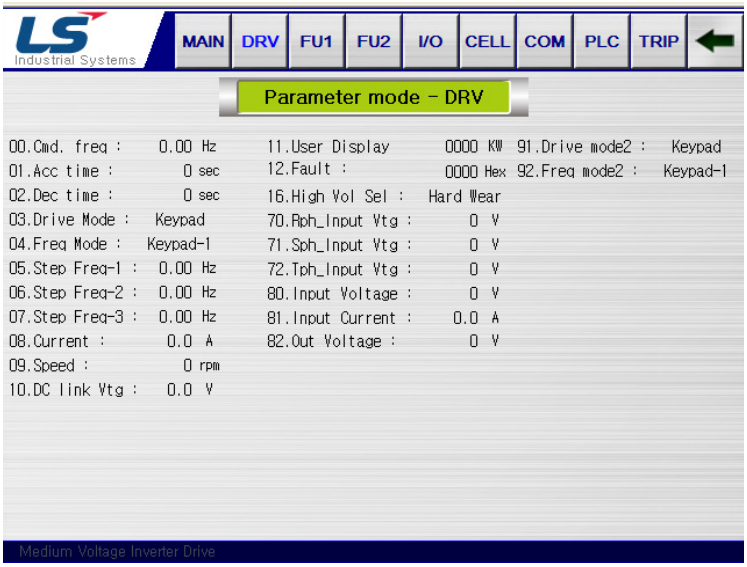
■ Main Screen Layout and Features

HMI is a touch-type device for human-machine interaction designed exclusively for monitoring, which is implemented to allow users to check MVD status at a glance with simple manipulation.



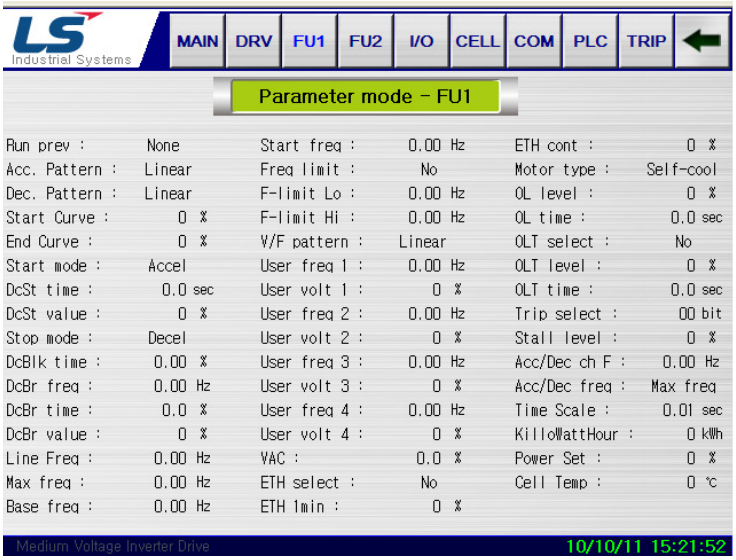
- Drive group

Shows configuration status of parameters for DRV group.



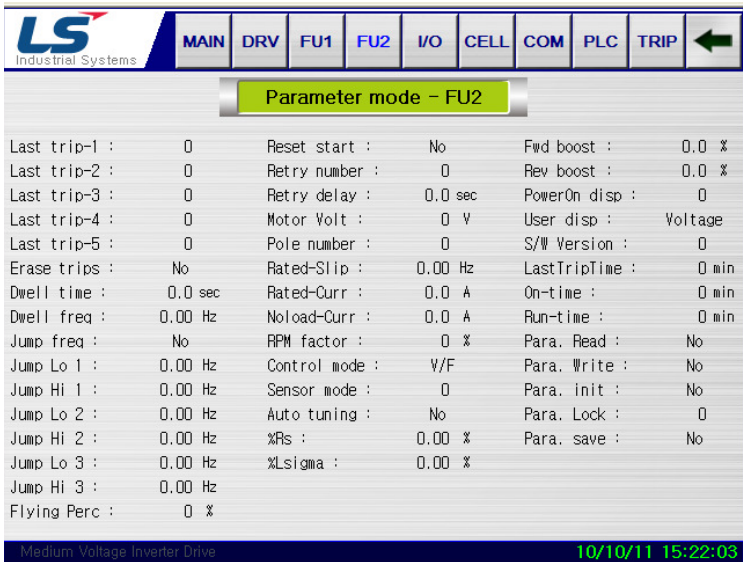
- FU1 Group

Shows configuration status of parameters for FU1 group.



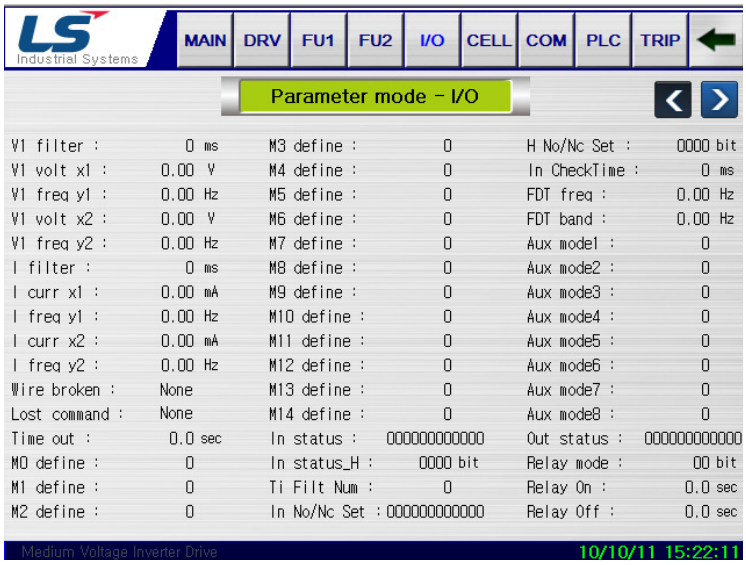
- FU2 Group

Shows configuration status of parameters for FU2 group.



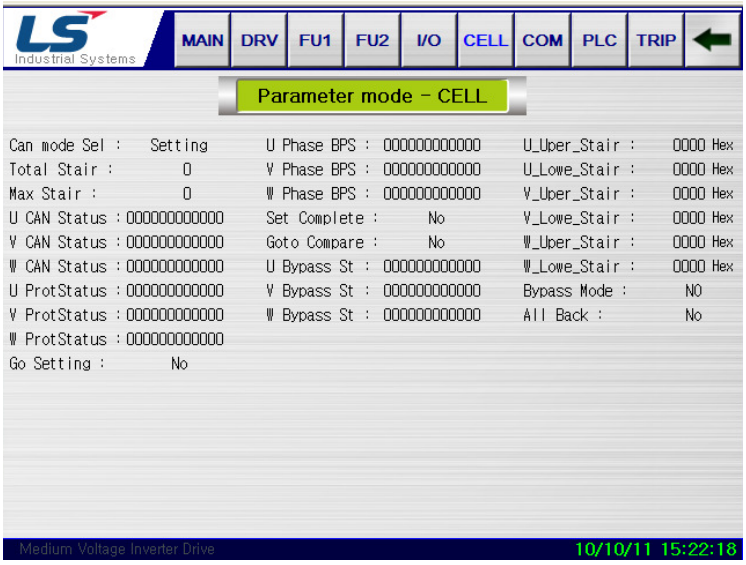
- I/O Group

Shows configuration status of parameters for I/O group.



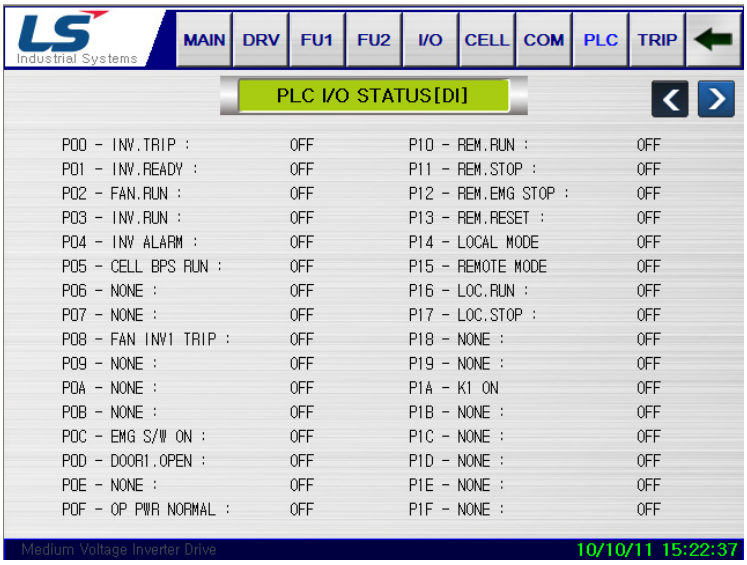
- Cell group

Shows configuration status of parameters for cell group.



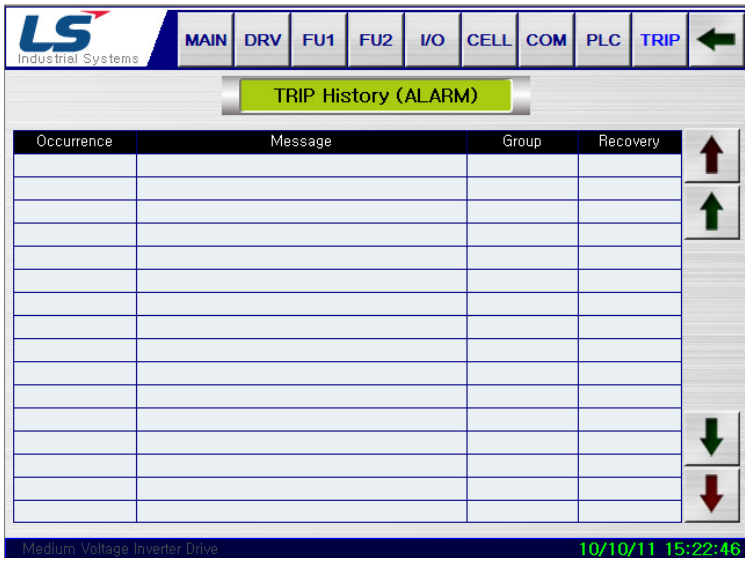
- PLC status

PLC I/O status: Shows functions and operation statuses of PLC input/output terminals.



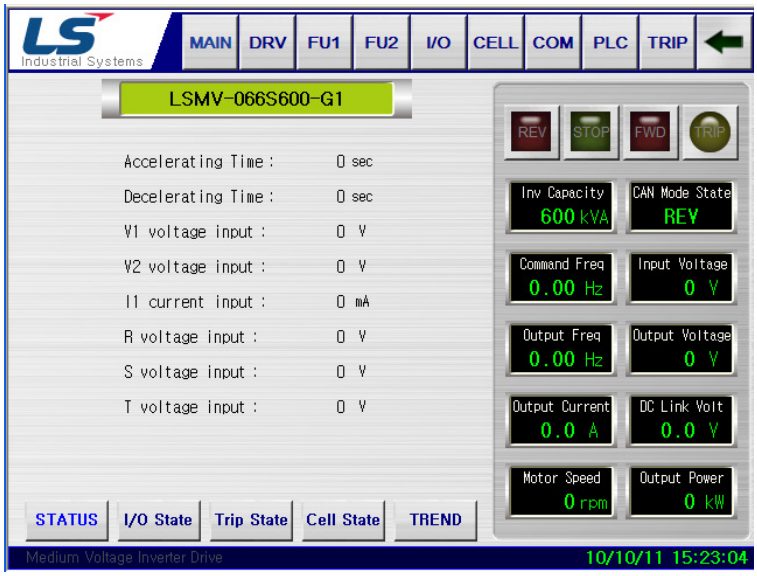
- Trip history

  Shows trip information in sequence of date/time of occurence.



- Operation status

  Shows basic information for operation status.



- I/O status

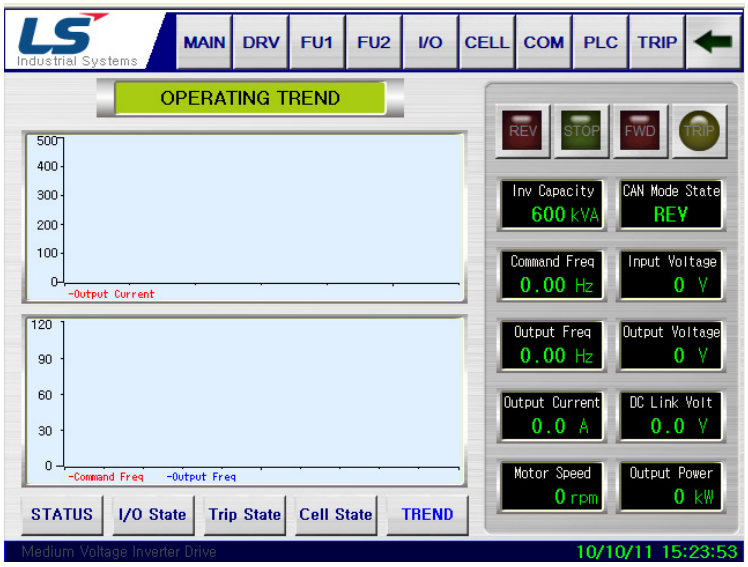
Shows operation status of inverter input/output terminals.

- Trip status

Shows current trip status.

- Target frequency trend

  Shows trend of command frequency, output frequency and output current.



Warranty

Product Name	LS Industrial Systems Medium Voltage Drive	Date of Installation	
Model Name	LSMV Drive	Warranty Terms	
Customer	Name		
	Address		
	Phone Number		
Sales Agency	Name		
	Address		
	Phone Number		

This product has been manufactured through strict quality control and inspection processes by LS Industrial Systems technical team.

The warranty period is generally 12 months from the date of installation. 18 months from the date of manufacture will be applied if the date of installation has not been entered.

However, the warranty period may vary according to the terms of contract.

Free after sales service

When there is a failure in the drive, under normal conditions and within the warranty period, contact our agency or designated service center. We will repair the drive free of charge.

Services Provided at a Cost

In the following cases, repair services are provided at a cost:

- **If failure is made deliberately or occurs due to careless use**
- **If the failure occurs due to power supply problems or poor connecting device**
- **If the failure is a result of by natural disaster (for example, fire, flood, gas, earthquake, etc.)**
- **If the product has been modified or repaired somewhere other than our agency or service center**
- **If the product does not have a LS Industrial Systems plate attached to it**
- **If the warranty period is over**

Please visit LS Industrial Systems homepage ***(http://www.lsis.biz)***for more useful information and services:

Manual Revision History

Number	Date of Publication	Contents Changed	Version Number	Remarks
1	July, 2010	First edition	1.00	-

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Always at your service, standing for our customers.

www.lsis.biz

LS Industrial Systems

LS MV Series

■ **HEAD OFFICE**
Address: LS tower, 1026-6, Hogye-dong, Dongan-gu, Anyang-si, Gyeonggi-do 431-848, Korea http://eng.lsis.biz

■ **LS Industrial Systems Europe B.V 》 Amsterdam, Netherland**
Address: 1st FL., Tupolevlaan 48, 1119NZ Schiphol-Rijk, The Netherlands
Tel: 31-20-654-1420 Fax: 31-20-654-1429 e-mail: junshickp@lsis.biz

■ **LS Industrial Systems (Middle East) FZE Office 》 Dubai, UAE**
Address: LOB 19 Jafza View Tower Room 205, Jebel Ali Free Zone, P.O.Box 114216, Dubai, UAE.
Tel: 971-4-886-5360 Fax: 971-4-886-5361 e-mail: jungyongl@lsis.biz

■ **Dalian LS Industrial Systems Co., Ltd. 》 Dalian, China**
Address: No. 15 Liaohexi 3-Road, Economic and Technical Development Zone, Dalian 116600, China
Tel: 86-411-8273-7777 Fax: 86-411-8730-7560 e-mail: lixk@lsis.com.cn

■ **LS Industrial Systems Wuxi Co., Ltd. 》 Wuxi, China**
Address: 102-A National High & New Tech Industrial Development Area, Wuxi, Jiangsu 214028, China
Tel: 86-510-8534-6666 Fax: 86-510-522-4078 e-mail: xuhg@lsis.com.cn

■ **LS-VINA Industrial Systems Co., Ltd. 》 Hanoi, Vietnam**
Address: Nguyen Khe, Dong Anh, Ha Noi, Vietnam
Tel: 84-4-882-0222 Fax: 84-4-882-0220 e-mail: srjo@lsisvina.com

■ **LS-VINA Industrial Systems Co., Ltd. 》 Hochiminh, Vietnam**
Address: 41 Nguyen Thi Minh Khai Str. Yoco Bldg 4th FL., Hochiminh City, Vietnam
Tel: 84-8-3822-7941 Fax: 84-4-3822-7942 e-mail: sbpark@lsisvina.com

■ **LS Industrial Systems Tokyo Office 》 Tokyo, Japan**
Address: 16th FL., Higashi-Kan, Akasaka Twin Tower 17- 22, 2-chome, Akasaka, Minato-ku, Tokyo 107-8470, Japan
Tel: 81-3-3582-9128 Fax: 81-3-3582-2667 e-mail: jschuna@lsis.biz

■ **LS Industrial Systems Shanghai Office 》 Shanghai, China**
Address: Room E-G, 12th FL., Huamin Empire Plaza, No. 726, West Yan'an Road, Shanghai 200050, China
Tel: 86-21-5237-9977 (609), FAX: 89-21-5237-7191 e-mail: jinhk@lsis.com.cn

■ **LS Industrial Systems Beijing Office 》 Beijing, China**
Address: B-tower 17th FL., Beijing Global Trade Center B/D, No.36, BeiSanHuanDong-Lu, DongCheng-District, Beijing 100013, China
Tel: 86-10-5825-6025, 7 Fax: 86-10-5825-6026 e-mail: cuixiaorong@lsis.com.cn

■ **LS Industrial Systems Guangzhou Office 》 Guangzhou, China**
Address: Room 1403, 14th FL., New Poly Tower, 2 Zhongshan Liu Road, Guangzhou, China
Tel: 86-20-8326-6764 Fax: 86-20-8326-6287 e-mail: linsz@lsis.biz

■ **LS Industrial Systems Chengdu Office 》 Chengdu, China**
Address: 12th FL., Guodong Building, No.52 Jindun Road, Chengdu, 610041, P.R. China
Tel: 86-28-8612-9151 Fax: 86-28-8612-9236 e-mail: yangcf@lsis.com.cn

■ **LS Industrial Systems Qingdao Office 》 Qingdao, China**
Address: 7B40, Haixin Guangchang Shenye B/D B, No.9, Shandong Road, Qingdao 26600, China
Tel: 86-532-8501-6568 Fax: 86-532-583-3793 e-mail: lirj@lsis.com.cn

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LSMV/2010.07